Recommendations of the Expert Panel to Define Removal Rates for Shoreline Management Projects

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Submitted to:
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Chesapeake Bay Partnership

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Cheston Point, MD (top), a retreating shoreline in VA (bottom left) and Bay Tree Beach, York County in VA (bottom right). Pictures courtesy of Jana Davis and Pam Mason.

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Executive Summary

Many shoreline landowners in the tidal Chesapeake Bay states protect shoreline property and water quality using a suite of shoreline management practices. These shoreline management practices consist of structural or hard practices, vegetated practices, or a mix of hardened and vegetative practices often called a hybrid approach. Currently, states and local jurisdictions claim minimal nutrient and sediment reduction pollutant load reduction for shoreline projects as no one has systematically reviewed the available science to determine the appropriate "credit" for these practices. It is the purpose of this Panel to review the science and develop protocols to estimate the sediment and nutrient pollutant load reduction associated with different shoreline management practices. This will enable the Bay states to use shoreline management practices as part of an overall watershed strategy to meet nutrient and sediment load reduction targets for existing urban development under the Chesapeake Bay Total Maximum Daily Load (TMDL).

The Panel conducted an extensive review of recent and relevant shoreline management practice research and their effect on the processing, storage, and delivery of sediments and nutrients to the Bay. The Panel agreed that the existing credit associated with shoreline practices is not scientifically defensible because it is based on a tangentially related practice, stream restoration. Furthermore, the existing credit does not account for the uniqueness of every project with respect to its design, shoreline location/position, and function.

Importantly, this best management practice (BMP) differs from other urban BMPs. The tidal shoreline load is in the Water Quality and Sediment Transport Model (also known as the Estuary Model) and the pollutant load reduction is in the Chesapeake Bay Watershed Model. This BMP is on the shoreline edge therefore the shoreline management practices stop sediment and nutrients from entering the Chesapeake Bay directly. This means that there is no sediment delivery factor. Therefore, the benefit and associated pollutant load reduction credit can be much higher than other urban BMPs. In addition, the BMP's pollutant load reduction is correlated to the tidal erosion rate. This means the higher the erosion at a site the higher the pollutant load reduction can be when a BMP is implemented. There are ecosystem tradeoffs and future research needs that were identified. For example, the shoreline sand content is valuable to nearshore habitat such as SAV beds. Therefore, the panel incorporated recommendations to value habitat and meet Bay water quality goals. To that point, the panel outlined basic qualifying conditions, capped the pollutant load reductions available per state basin, and reduced credits for the prevented sediment by a BMP (Protocol 1: Prevented Sediment) based on sand content and bank instability. The panel recommended pollutant load reductions that were conservative based on the available science and aimed to reduce unintended consequences. Finally, future research needs were outlined and the panel recommended this report should be updated in two years.

The basic qualifying conditions are extremely important and each shoreline management practice must pass all conditions prior to any Chesapeake Bay TMDL pollutant load reductions allowed. The Panel recommended qualifying conditions and environmental considerations for shoreline management projects to ensure they support both the Chesapeake Bay and local environmental goals. Also, examples are provided (*Section 5.3 Examples*) to show users how to apply each protocol in the appropriate manner.

The Panel recognized that the data available at this time do not allow a perfect understanding or prediction of shoreline management performance. As a result, the Panel stressed that verification of the initial and long term performance of shoreline management projects is critical to ensure that projects are functioning as designed. To this end, the Panel recommended that the shoreline management credits be limited to 5 years, although the credits can be renewed based on a field inspection that verifies the project still exists, is adequately maintained, and is operating as designed.

The Panel developed the following four general protocols to define the pollutant load reductions associated with individual shoreline management projects. In order to receive these pollutant load reductions, the practice must meet the basic qualifying conditions that are summarized in *Section 4 Basic Qualifying Conditions for Individual Projects*. The four shoreline management protocols are provided here and are summarized in Table 1.

> *Protocol 1: Prevented Sediment* - This protocol provides an annual mass nutrient and sediment reduction credit for qualifying shoreline management practices that prevent tidal shoreline erosion that would otherwise be delivered to nearshore/downstream waters. The pollutant loads are reduced for sand content and bank instability.
>
> *Protocol 2: Credit for Denitrification* - This protocol provides an annual mass nitrogen reduction credit for qualifying shoreline management practices that include vegetation.
>
> *Protocol 3: Credit for Sedimentation* - This protocol provides an annual mass sediment and phosphorus reduction credit for qualifying shoreline management practices that include vegetation.
>
> *Protocol 4: Credit for Marsh Redfield Ratio* - This protocol provides one time nutrient reduction credit for qualifying shoreline management practices that include vegetation.

An individual shoreline management project may qualify for pollutant load reductions under one or more of the protocols, depending on its design and overall restoration approach. The pollutant load reductions are available for five years and renewable upon field verification to ensure they are still working as designed. These protocols are based on the best available data as of March 2014. Additional research and management needs were identified in the panel's review and are outlined in the report (*Section 7 Future Research and Management Needs*). The panel report's recommendations should be updated every two years so that the latest science is incorporated in these management recommendations.

Table 1. Summary of shoreline management pollutant load reduction for individual projects.

Protocol	*Name*	*Units*	*Pollutants*	*Reduction Rate*
1	Prevented Sediment	Pounds per year	Sediment TN, TP	• Measured TSS, TN and TP content in sediment prevented. • Calculated based on shoreline erosion with reductions for sand content and bank instability
2	Denitrification	Pounds per year	TN	• Measured TN removal for denitrification rate associated with vegetated area. • 85 lbs TN/acre/yr
3	Sedimentation	Pounds per year	Sediment and TP	• Measured TSS and TP removal rates associated with vegetated area. • 6,959 lbs TSS/acre/yr • 5.289 lbs TP/acre/yr
4	Marsh Redfield Ratio	Pounds	TN, TP	• Measured TN and TP removal rates associated with vegetated area. • Note that this is a one-time credit. • 205 lbs TN/acre • 9 lbs TP/acre

Finally, the Panel's charge and focus was to meet the Chesapeake Bay water quality goals. Additional shoreline management practice considerations such as design, cumulative impacts, sampling protocols, and others, while important, were outside this panel's charge. The panel reached consensus to the extent possible and refinements to the recommendations were made through the panel process. The panelist dedication, work, and effort to update these shoreline management pollutant load reductions using the panel process should be commended. Therefore, the panel recommendations should be implemented.

Important Disclaimer: The Panel recognizes that shoreline management projects as defined in this report may be subject to authorization and associated requirements from federal, State, and local agencies. The recommendations in this report are not intended to supersede any other requirements or standards mandated by other government authorities. Consequently, some shoreline management projects may conflict with other regulatory requirements and may not be suitable or authorized in certain locations.

Section 1. Charge and Membership of the Expert Panel

1.1 Panel Members

The roster of the Expert Panel for shoreline management practices are listed in Table 2. In addition, the panel background and panel charge are summarized here.

Table 2. Shoreline management expert BMP review panelists.

Panelist	Affiliation
Jana Davis, Ph.D.	Chesapeake Bay Trust (CBT) / Habitat Goal Implementation Team (HGIT)
Kevin DuBois, PWS, PWD	City of Norfolk, VA
Jeff Halka	Maryland Geologic Survey
Scott Hardaway, P.G.	Virginia Institute of Marine Scientists (VIMS) Shoreline Studies Program
George Janek	United States Army Corps of Engineers (USACE), Norfolk District
Lee Karrh	Maryland Department of Natural Resources (MD DNR)
Eva Koch, Ph.D.	University of Maryland Center for Environmental Science (UMCES)
Lewis Linker	Environmental Protection Agency Chesapeake Bay Program Office (EPA CBPO)
Pam Mason	VIMS Center for Coastal Resource Management
Ed Morgereth, MS ISS	Biohabitats, Inc.
Daniel Proctor, P.E.	Stantec (formerly Williamsburg Environmental Group)
Kevin Smith	MD DNR
Bill Stack, P.E.	Center for Watershed Protection, Inc. and EPA CBPO
Steve Stewart/Nathan Forand	Baltimore County Department of Environmental Protection and Sustainability
Bill Wolinski, P.E.	Talbot County Department of Public Works
Sadie Drescher	Center for Watershed Protection, Inc. and EPA CBPO (coordinator)
Other Panel Support: Jeff Sweeney (CBPO), Matt Johnson (CBPO/UMD), Julie Winters (CBPO), and Hannah Martin Chesapeake Research Consortium (CRC), CBPO)	

The Shoreline Management Expert Panel (the Panel) defined shoreline management practices, their pollutant load reductions, and other work outlined by the panel charge. The initial charge of the panel was to review all of the available science on the nutrient and sediment removal performance for shoreline erosion control practices. The panel was specifically requested to:

- Evaluate how shoreline erosion control practices are simulated in the context of Chesapeake Bay Watershed Model (CBWM) version 5.3.2.
- Review available literature on the nutrient and sediment loading rates associated with shoreline erosion and the effect of shoreline erosion control practices in reducing them.

- Provide a specific definition of what constitutes a shoreline erosion control practice, describe the shoreline erosion control practices' geographic boundary, and determine the qualifying conditions under which a locality can receive a nutrient and/or sediment reduction credit.
- Evaluate whether the existing CBPO-approved removal rates for shoreline erosion control practices are suitable for qualifying projects or whether a new protocol(s) needs to be developed to define improved rates. In doing so, the Panel should consider project specific factors such as physiographic region, landscape position, stream order, and/or type of shoreline erosion control protection practices employed.
- Define the proper units that local governments will report shoreline erosion control practices to the state to incorporate into the CBWM.
- Recommend procedures to report, track and verify that shoreline erosion control practices are actually being implemented and maintained during construction and after construction.
- Critically analyze any unintended consequences associated with the nutrient and sediment removal rates and any potential for double or over-counting of the credit.

1.2 Panel Process

The Panel met twelve times for two to six hour meetings in addition to several conference calls between meetings to discuss specific topics such as protocol research and development, basic qualifying conditions, geographical extent, research considerations, etc. The meetings covered the following topics: CBPO modeling background, MD and VA shoreline management policy, case studies, panel literature review and research reports, draft panel findings, and panel discussion/work. Panel members worked in between Panel meetings using email and conference calls. The Panel followed the Water Quality Goal Implementation Team (WQGIT) (2010) protocols to reach consensus and develop the report's recommendations (WQGIT, 2012). The meeting minutes for the Expert Panel can be found in Appendix A and Appendix B documents the Panel's conformity with the BMP review protocol requirements.

A flow chart for the BMP review protocol is provided in

Figure 1. In general, the expert panel process starts with a new request or new research that is routed to the appropriate GIT lead then the appropriate workgroup. The BMP is prioritized and placed on a list to be updated. When there are available resources, the expert panel reviews the BMP and develops a panel report. Then the report is reviewed and edited until accepted by the appropriate workgroups and WQGIT. Finally, the panel's recommendations are integrated into the appropriate model. The BMP is periodically reviewed and reassessed through the expert panel process. This information is from the CBPO's Chesapeake*Stat* and available online at: http://stat.chesapeakebay.net/?q=node/130&quicktabs_10=3

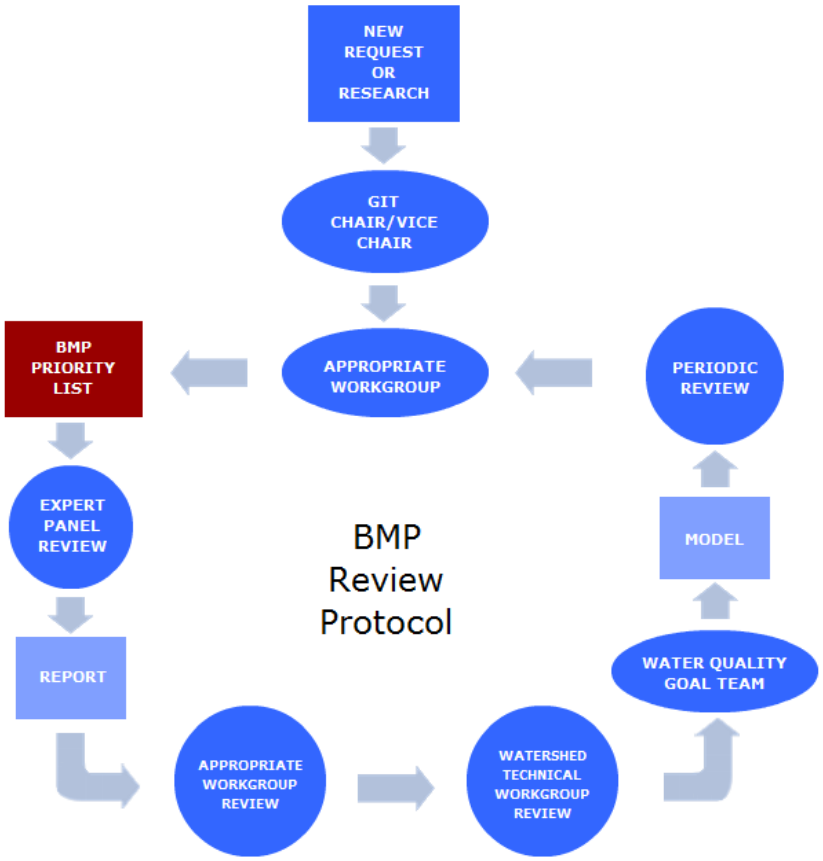

Figure 1. BMP review protocol. This information is from the *ChesapeakeStat* website and includes annotated descriptions for each process point in the decision tree.

Section 2. Definitions and Geographic Scope

This section provides shoreline management practice's past definitions, provides the current definition, and discusses the geographic scope.

2.1 Shoreline Management Definitions

There are a range of shoreline management practice types that limit tidal erosion and protect property (Figure 2). Practices that use natural habitats such as vegetation are encouraged in many states, including purely non-structural living shorelines, or hybrid living shorelines that use a combination of vegetation and hard structures. Hybrid living shorelines should aim to use as little structure as possible given site conditions to maximize the proportion of natural habitat features and decrease structure footprint. However, because design criteria have yet to be defined, debate exists about minimization of structure (Pilkey et al., 2012). Purely structural practices are often discouraged, given that a growing body of research suggests hardened shorelines negatively impact habitat value and do not increase shoreline protection functions. See also Shoreline Management and Habitat Impacts (Section 3) and Hard Shore Armor Impacts (Section 3.3.2) in this report. Both Maryland and Virginia promote vegetative shoreline erosion control through policy and guidelines. See the "Shoreline Management and Habitat Impacts" in this section for more information on practice type and habitat impact. Finally, the CBP (2006) report titled, "Best Management Practices for Sediment Control and Water Clarity Enhancement. Chesapeake Bay Program," outlined practice types and management strategies for shoreline management.

2.1.2 Current Definitions

The Scenario Builder documentation (CBP, 2012) defines shoreline erosion control practices as "protection of shoreline from excessive wave action by creating a marsh or an offshore structure such as a sill, breakwater, or sand containment structure." In Maryland and Virginia the following represent the shoreline erosion definitions:

- "Improvements to protect a person's property against erosion shall consist of non-structural shoreline stabilization measures (i.e., living shorelines) that preserve the natural environment, such as marsh creation" HB973 – Living Shoreline Protection Act of 2008 (MDE, 2008).
- Nonstructural Shoreline Stabilization Measures or "Living shoreline" means a suite of stabilization and erosion control measures that preserve the natural shoreline and are designed to minimize shoreline erosion, maintain coastal processes, and provide aquatic habitat. Measures must include marsh plantings and may include the use of sills, sand containment structures, breakwaters, or other natural components (MDE, 2008)
- In Virginia, as per Senate Bill 964, "Living shoreline" means a shoreline management practice that provides erosion control and water quality benefits; protects, restores or enhances natural shoreline habitat; and maintains coastal processes through the strategic placement of plants, stone, sand fill, and other structural and organic materials (VIMS, 2013).

Shoreline management practice type varies based on the site location, local regulatory requirements, and additional factors. Figure 2 outlines the shoreline management practice based on the amount of hardened armor used.

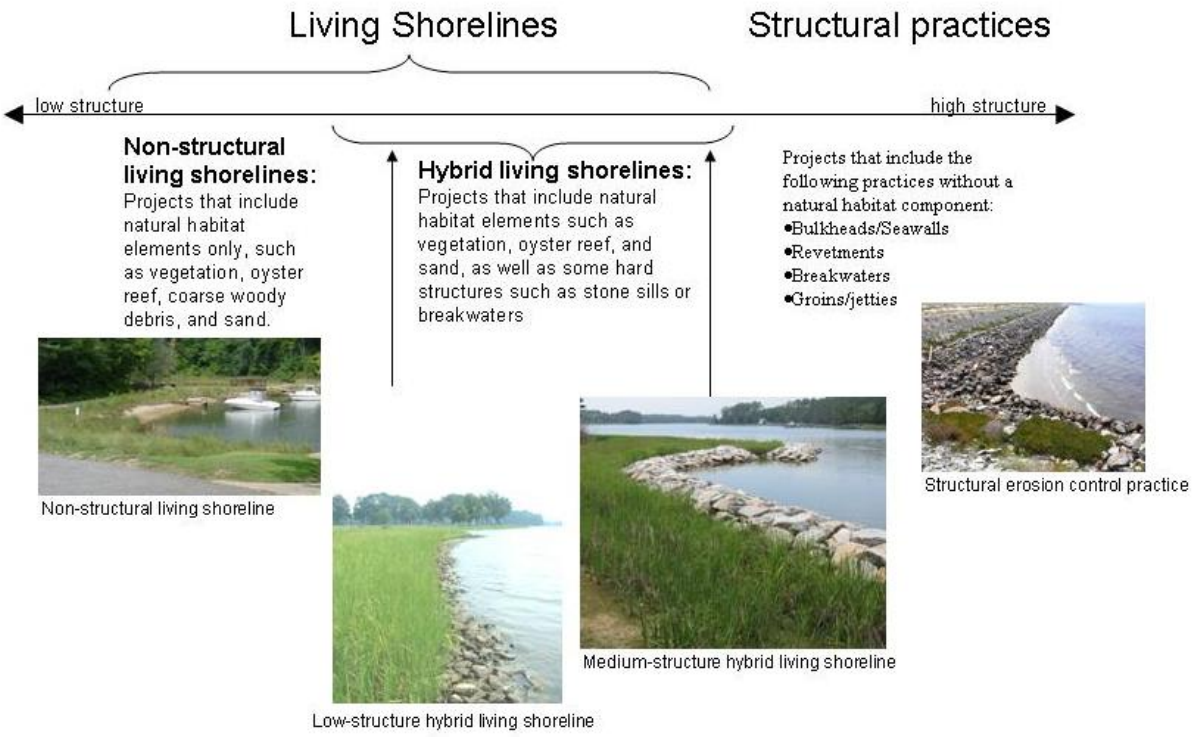

Figure 2. A continuum of shoreline management practices that is based on the amount of hard shore armor structure used.

The Panel recognized that the shoreline management practice strategy or type that is used can vary based on local policies (as well as definitions and terminology), site specific characteristics, owner preference, available funds, and other factors. In addition to the practices outlined here, the panel recognizes that innovative shoreline management strategies should be considered as part of an overall shoreline management strategy that aims to meet multiple goals (e.g., habitat, regulation, policy, and others).

2.1.3 Expert Panel Definition

The Panel deemed "Shoreline Erosion Control" a limiting term for the practice and decided that "Shoreline Management" should be used instead. Therefore, the remainder of this report uses shoreline management for these shoreline practices. The definition for shoreline management adopted by the expert panel was the following:

- "Shoreline management" is defined as any tidal shoreline practice that prevents and/or reduces tidal sediments to the Bay.

2.2 Geographic Boundary

There is no clear geographic boundary for where tidal shoreline management practices can be implemented.

The CBPO provided the panel with a map (Figure 3) that shows the tidal and non-tidal portions of the Chesapeake Bay such as lakes and reservoirs. The Panel noted that shoreline management practices could be implemented in non-tidal areas, but are most commonly implemented in tidal areas where shoreline erosion is more prevalent. The shapefile includes segments adjacent to tidal waters and non-tidal waters where we consider there was a significant shoreline and BMPs can be implemented. This shapefile was refined by CBPO staff and is online for local municipality and/or state use at https://archive.chesapeakebay.net/Modeling/phase5/Phase532/Segmentation/p532_shoreline_v1.zip

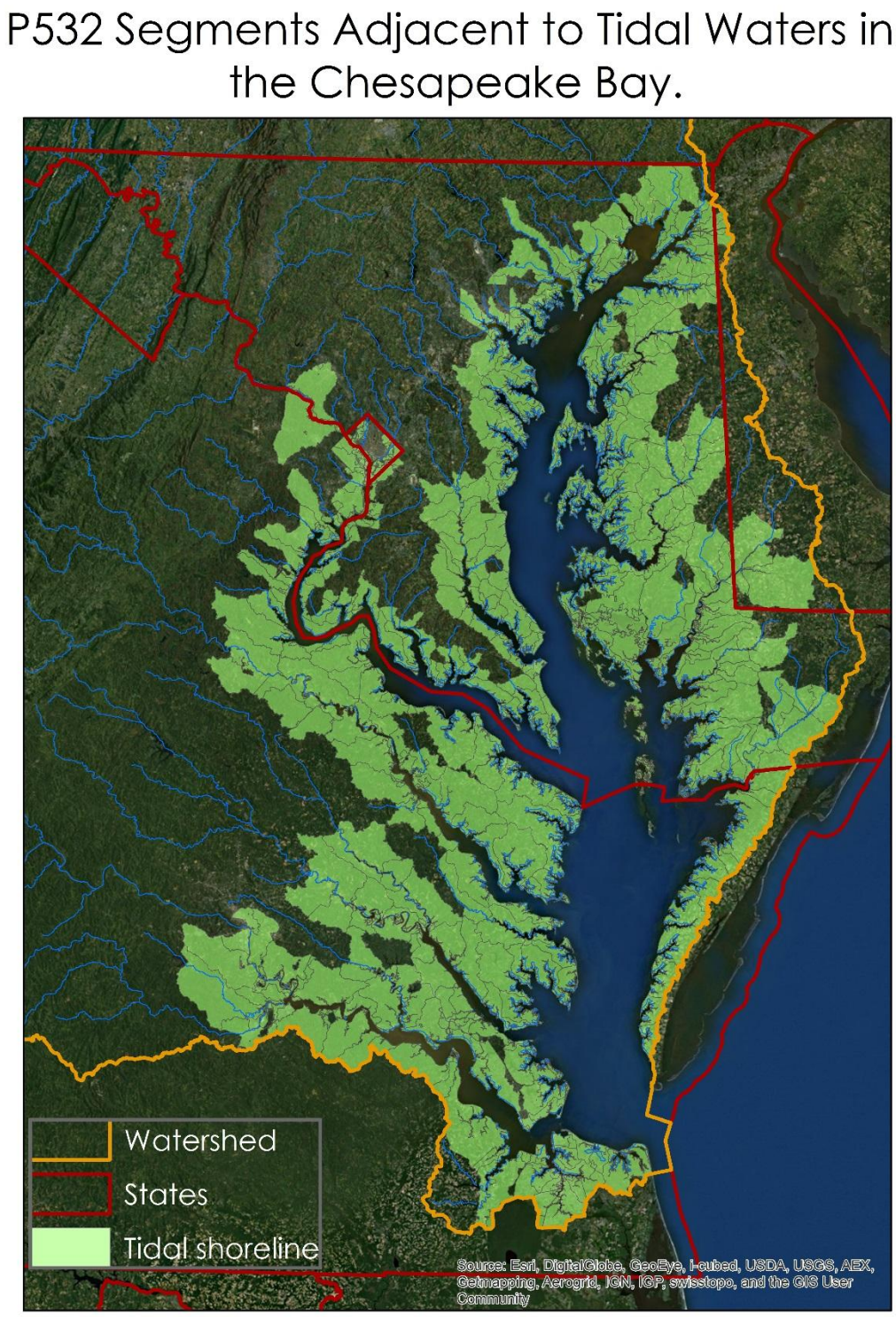

Figure 3. Segments adjacent to tidal waters in the Chesapeake Bay (shaded in the map). Map provided by CBPO Watershed Data Modeling Specialist, University of Maryland Center for Environmental Science (UMCES).

Section 3. Shore Erosion and Management in the Chesapeake Bay

The panel reviewed shoreline management policy, case studies, peer reviewed scientific and grey literature research. The panel's focus was in Maryland and Virginia since the majority of the Chesapeake Bay available for shoreline management practices are in MD and VA. However, the panel's recommendations apply to and can be adapted for the District of Columbia and Delaware. This section provides the panel's findings based on the review of the science for shoreline erosion, shoreline management definitions, pollutant load reduction that is currently in the Chesapeake Bay Watershed Model, shoreline management and habitat impact, and geographic boundary.

3.1 Shoreline Erosion

Shoreline erosion is part of the natural ecosystem processes in the Bay and tidal tributaries and feeds the natural sediment budget that contributes to the Bay's geomorphology; however, excess suspended fine sediment degrades water quality and has adverse effects on submerged aquatic vegetation (SAV) beds and other critical habitats (Langland and Cronin, 2003). Shoreline erosion is primarily caused by wind-driven waves and to a smaller extent boat wakes and is exacerbated by the rapid rate of sea-level rise (Langland and Cronin, 2003). The main factors influencing shoreline erosion are wind velocity, duration, and fetch (the open water distance wind travels) that drive wave energy climate. In addition, the soil composition (e.g., sand, silt, and clay content) of the nearshore and fastland areas and presence of vegetation are critical for determining erodibility.

Erosion of unconsolidated shorelines is a major source of sediment to the Chesapeake Bay. Langland and Cronin (2003) summarizing work of the Chesapeake Bay Program's Sediment Work Group emphasized that shoreline erosion (nearshore and fastland) accounts for approximately 57% of the sediment source loads to the Bay (65% fastland and 35% nearshore). Riverine (watershed and streams) sources at the fall line account for 29% of the total load. Eroding shoreline sediments, especially large-grained sediments, contribute to geomorphologic processes such as accretion of some shorelines and maintenance of certain features such as sand spits and islands. Eroding sediments also contribute to habitat creation, by, for example, allowing for growth and accretion of tidal marshes, which may be an especially important process considering sea level rise and providing optimal conditions for SAV (Koch, 2001). However, suspended sediment in the water column, especially fine grained sediments, can also have negative consequences. As a result, best management practices (BMPs) were developed that address both sediment sources upland in the watershed (such as stream restoration and bank stabilization and low impact development practices) as well as sources from the shoreline itself. Shoreline management practices prevent erosion that would enter the nearshore waters. Therefore, the nitrogen and phosphorus adhered to soil particles is also prevented from entering Bay waters. However, few studies measured the erosion rate and associated sediment TN and TP concentration. TN and TP concentrations reported by Ibison et al. (1990 and 1992) are commonly used throughout the Chesapeake Bay although the data were variable.

The Chesapeake Bay Program (CBP, 2005) provided early guidance on shoreline erosion management to the Tributary Teams (previous equivalent to the Watershed Implementation Plans) in a report titled "Sediment in the Chesapeake Bay and Management Issues: Tidal Erosion Processes." This report provided a broad outline of Chesapeake Bay shoreline erosion processes and introduced key aspects of management that included:

1. A preference for nonstructural management in low and moderate energy shorelines;
2. Estimated shoreline erosion to be comprised of fastland erosion (57%) and nearshore erosion (43%). Note that this ratio was subsequently changed to 65% fastland erosion and 35% nearshore erosion based on expert opinions in the group (e.g., MGS, VIMS);
3. Established that shoreline erosion at some sites was environmentally benign or beneficial and that sand erosion can support fringe marsh and/or living shorelines in many areas and is a beneficial erosional resource;
4. Established that shoreline erosion of silts and clays were damaging to the Bay due to their contribution to light attenuation and bottom habitat loss and that erosion of sand was at worst environmentally neutral but often beneficial; and
5. Provided estimated watershed and shoreline erosion total suspended solids (TSS) loads by basin.

The Panel found that nearshore habitat and marsh accretion can benefit from sediment inputs such as sand in the nearshore waters. The following is a summary of the major findings from the literature related to the shoreline management loading rate and loading concentrations:

- Factors that impact loading rates include bank heights, erosion rates, and nutrient loading concentrations (Ibison et al., 1992)
- Measurements made at the site are better than estimates from literature values (Ibison et al., 1992; Langland and Cronin, 2003; Cerco et al, 2010; Proctor, 2012)
- Nutrient loads with respect to grain size and location along bank profile reported by (Ibison et al., 1990) included:
    - Higher nutrients in the upper horizons
    - No statistically significant trend in TP with grain size distribution
    - Noted relationship between TN and grain size (higher in silt/clay)
- There were no significant differences between site nutrient concentrations, but nutrient loads varied due to site specific heights, erosion rates, and other factors. The TN ranged from 0.14 to 6.44 lbs/ft-yr and TP ranged from 0.04 to 4.42 lbs/ft-yr (Ibison et al., 1990)
- Compared shoreline component of nutrient loading to other sources was approximately 5% of the controllable NPS for TN and 23% of TP (Ibison et al., 1990)
- Explicitly stated that shoreline stabilization of critical sites was an appropriate tool to help meet Chesapeake Bay nutrient reduction goals (Ibison et al., 1990)
- Hardaway et al. (1992) assessed 383 miles of VA's eroding upland banks and estimated approximately 68,416 feet of shoreline was defended from 1985 to 1990. This 18% increase in defensive shoreline structures resulted in a sediment reduction of 403,273 cy (80,655 cy/yr). Consequently, the reduction in nutrient loading by defended shorelines was 372,924 lbs of TN and 244, 551 lbs of TP (using Ibison et al., 1992). Finally, the annual rate reduced was 74,584 lbs/yr for TN and 48,910 lbs/yr for TP.

The tidal shoreline erosion contributes sediment and nutrients to the Chesapeake Bay. Limited studies quantify the tidal shoreline erosion rate and the associated TSS, TN, and TP pollutant load to the waters. For example, Cerco et al. (2010) provided average annual shoreline erosion mass loadings for Maryland and Virginia. Approximately 32% of Maryland's shores are protected and approximately 19% of Virginia's shores are protected (Table 3). The mass loading assumes that fastland protected by structures does not deliver sediment to the Bay. Cerco et al. (2010) also provides each state's fines (silt and clay), coarse (sand), and organic (delivered only from marsh erosion) sediment. The silt and clay constitute 56% of the average sediment eroded from banks and 44% of sediment eroded from marshes (Cerco et al., 2010).

Table 3. Chesapeake Bay shoreline characteristics and shoreline erosion mass loading (averaged) (Cerco et al., 2010).

Annual	MD	VA
Length (total) – (meters)	2,912,000	4,060,000
Length (unprotected) – (meters)	1,993,000	3,276,000
% Protected	32	19
Loading MT/yr - total	2,733,000	1,500,000
Fines	1,503,000	506,000
Coarse	1,153,000	994,000
Organic	77,000	-
Loading (kg/m/day) - total	2.43	1.01
Fines	1.34	0.34
Coarse	1.02	0.67
Organic	0.07	-
m = meters MT = metric tons		

3.2 Shoreline Erosion Loading Rates

Data sources to estimate tidal shore erosion loading rates and their application in the model were reviewed by the Panel. Shoreline erosion information in MD was compiled by the Maryland Geologic Survey (MGS) and in VA by the Virginia Institute of Marine Science (VIMS). The MGS monitors shoreline changes both in the Bay and along the Atlantic Coast. The MGS erosion data was compiled on the, "Shoreline Change Maps for Tidewater Maryland" maps that span from the 1800's to the 1900's. The maps are online at http://www.mgs.md.gov/coastal/maps/schangepdf.html. The MD Department of Natural Resource's Coastal Atlas' Shorelines mapping tool provides the MGS data online in a simple to use forum for the public. However, in VA there are two static reports known as the Shoreline Situation Reports (Hobbs et al., 1979; Byrne and Anderson, 1977) and the Shoreline Evolution Reports available by county. Resources for MD and VA are included in Table 4.

These are the best available shoreline erosion loading rates. However, updated information should be used when available. For example, panelist Scott Hardaway presented preliminary information from AMBUR (Hardaway, July 2013 panel meeting) which is an ongoing project to provide better bank sediment input data. This pilot study's coverage provided to the Panel included data from 1937 to 2009.

Table 4. Resources for MD and VA shoreline erosion.

MD's Coastal Atlas' Shorelines mapping tool • http://www.dnr.state.md.us/ccp/coastalatlas/shorelines.asp
VA's Shoreline Situation Reports • http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/virginia/scan_reports/SSRSummary.pdf • http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/virginia/scan_reports/TidewaterShorelineErosion.pdf
VA's Shoreline Evolution Reports • http://web.vims.edu/physical/research/shoreline/Publications-Evolution.htm

3.3 Shoreline Management and Habitat Impacts

Tidal shoreline erosion is a natural process, albeit exacerbated by anthropogenic actions, that impact a large percentage of the shoreline of the Chesapeake Bay (Berman et al., 2000). Examples of the anthropogenic actions that can exacerbate tidal shore erosion include, forest clearing of tidal shoreline, bank modification, boat wakes, and sea level rise from climate change impacts. Studies of shoreline condition by the Virginia Institute of Marine Science (VIMS) estimate that 33% of the tidal shorelines of the Chesapeake Bay are eroding, in many areas with rates up to several feet per year.

Several practices were developed to prevent or reduce erosion and protect property value and function over centuries of human shoreline development. These include seawalls, bulkheads, stone revetments, and revetments comprised of various other types of materials. In the 1970s,

researchers experimented with the idea to incorporate elements of natural habitat into erosion control devices in order to improve their value and reduce the theoretical damage that hard shoreline armor causes to natural shoreline habitat function. The technique of using naturally occurring habitats to address erosion is commonly termed "living shorelines." Living shoreline approaches initially used tidal marsh vegetation to attenuate waves instead of armor features. Within the next two decades, the concept was refined to include a variety of materials, including stone if necessary, from an engineering perspective. Incorporating natural designs was done using "hybrid" designs that incorporated both marsh, rock, and natural habitat elements such as oyster shell or reef, mussels, and coarse woody debris.

In recent years, focus has turned to quantifying living shoreline sustainability elements (e.g., how they fare at their erosion control function relative to armor in both storm conditions and general wave climates) as well as the ecological benefits (e.g., are they better habitat than armor as hypothesized.) Research suggested that both natural fringe marshes and constructed living shorelines provide habitat to greater densities and species diversity of motile macrofauna than armor (e.g., Davis et al., 2006; Seitz et al., 2006; Bilkovic and Roggero, 2008). Studies showed a preferential use of marsh edge and use of fringing marsh, such as hose typical of living shoreline design, by species including blue crab and nekton had comparable rates to extensive marshes (Currin et al., 2010). Reasons for this preferential marsh edge use include: 1) provision of shallower depths for use as a refuge; 2) provision of structural habitat (plant stems) for use as a refuge; 3) provision of forage habitat, differences in other site characteristics such as sediment grain size which could impact prey distributions and accessibility; and 4) hybrid projects that incorporate hard structure such as rock or oyster shell as a sill or breakwater experience, enhanced use of the "blueway" between the structure, and the intertidal marsh by finfish (e.g., sea trout, red drum, flounder) and blue crabs (Swann, 2008; Scyphers et al., 2011).

As a result, management and policy strategies in many states across the United States initiated either voluntary programs (e.g., Texas, New Jersey, Rhode Island, Florida) or regulatory guidelines that are intended to promote living shorelines (e.g., Virginia, Maryland, North Carolina, and Connecticut). In addition, states implemented strategies to prevent or make extremely difficult to permit, certain types of armor, such as bulkheads (e.g., Delaware and Maryland). At the time of this report, a collaborative effort was underway in Alabama, Mississippi, Florida, Texas, and Virginia to streamline permitting processes for living shorelines.

3.3.1 Coastal Wetland and Tidal Marsh Impacts

Filling, clearing, and armoring shorelines for many different reasons have resulted in cumulative impacts to riparian areas and tidal wetlands for some time. According to the report, Status and Trends of Wetlands in the Coastal Watersheds of the Eastern United States, 1998 to 2004 (Stedman and Dahl, 2008), about 18% of all coastal wetlands losses are tidal salt marsh. In Virginia, permitted impacts to tidal wetlands from 1993 to 2004 amounted to about 42 acres (Duhring, 2004). Similarly, the current trend for riparian vegetation is toward loss of natural cover to development. In Maryland, estuarine vegetated wetlands declined about 8% from the 1950s to late 1970s/early 1980s (Tiner and Finn, 1986). Tidal marsh loss was due to natural (submergence and sea level rise) and human (dredging and urbanization) factors. These coastal wetland losses are similar to the trends reported for the Chesapeake Bay (e.g., about 9%

estuarine vegetated loss from 1950 to late 1970s/early 1980s) as reported in Tiner and Finn (1986). Past and future shoreline hardening has negatively impacted the riparian areas.

The cumulative losses of tidal wetlands and riparian vegetation are having adverse impacts on the health of Virginia's tidal waters and the animals that inhabit them. Shoreline alteration linked with watershed land development has been shown to have negative impacts on water quality and a wide variety of aquatic animal populations including blue crabs, finfish, marsh birds, and the communities of organisms living in the nearshore sediments underwater (Lerberg et al., 2000; DeLuca et al., 2004; King et al., 2005; Bilkovic et al., 2006; Bilkovic and Roggero, 2008). The nearshore habitat in the Bay is negatively impacted by wetland loss and efforts to establish or restore tidal habitat and riparian vegetation that can support habitat are encouraged.

3.3.2 Hard Shore Armor Impacts

Hard shoreline armor, such as riprap revetments, bulkheads, and seawalls, has been used to protect soft estuarine shorelines for centuries. In some areas, more than half of the shoreline has been armored. For example, in San Diego Bay, armor makes up almost three-quarters of the shoreline, providing habitat for open-coast rocky intertidal species in the bay (Davis et al., 2002). Some of the subwatersheds of the Chesapeake Bay are similarly armored (Berman et al., 2000). *See also 4.1.1 Urban Considerations and Table 6 Pollutant load reductions for shoreline management practices.*

The process of armoring can lead to several key physical differences between armored sites and natural sites, especially in environments in which the natural habitat at the land-water interface is "soft," such as beach or marsh, as opposed to "hard," such as rocky intertidal habitat. Armor in estuaries, especially bulkheads and seawalls, generally removes the shallowest areas of habitat available such that the land-water interface can be a meter deep or more (Jennings et al., 1999; Peterson et al., 2000; Bilkovic et al., 2006; Davis et al., 2008), often removing the entire range that is considered a refuge from subtidal predators (Ruiz et al., 1993). Sediment grain size of the area offshore armor and fringe marshes can also differ (Davis et al., 2008). In contrast, in cases in which armor replaces hard natural habitat, such as rocky intertidal, similar differences can exist (e.g., Bulleri and Chapman 2004) or the differences can be smaller (Pister, 2009).

Chemical differences may also exist between armor and natural shorelines. Armor can be constructed from materials that leach toxic chemicals (Weis et al,. 1998). Contribution of chemical signal from natural sources can differ as well: The contribution of allochthous carbon may be lower across the land-water interface at armored sites (Jennings et al., 1999).

As a result of one or more of these physical and chemical differences, several studies have illustrated the impacts of armor on ecological communities and assemblages in both lake and estuarine systems. Generally, armored sites (bulkheads and/or riprap) have been found to have lower species diversity of motile macrofauna and infauna (Bänziger, 1995; Bilkovic and Roggero, 2008; Davis et al., 2008; Long et al., 2011), lower density of such species (Davis et al., 2008; Weis et al., 1998; Hendon et al., 2000; Peterson et al., 2000), and differences in individual body size of species that occurred in both habitat types (Hendon et al., 2000; Peterson et al., 2000; Long et al., 2011). Some studies found greater differences between vertical features

(bulkheads, seawalls) and natural shorelines than between riprap revetments and natural shorelines, with the conclusion that habitat complexity is the important element (e.g., Bulleri and Chapman, 2004; Brauns et al., 2007).

Hard shore armor impacts negatively impact nearshore habitats. Hard shore armor projects are not the recommended shoreline management practice in the Bay.

3.4 Pollutant Load Reduction Currently in the Chesapeake Bay Watershed Model

Sediment inputs from tidal shoreline erosion are accounted for in the Water Quality Sediment Transport Model (WQSTM) also known as the Estuary Model while management practices for reducing these inputs are "credited" in the Chesapeake Bay Watershed Model (CBWM). The WQSTM estimates the pollutant load to the Chesapeake Bay based on estimates of unprotected or protected shorelines. The associated tidal erosion rates are applied to the unprotected shorelines. The total shoreline load is the bank load (e.g., fastland erosion) and nearshore erosion. Fastland is the tidal shoreline above water and nearshore is the tidal shoreline below water (see Figure 4). Tidal shoreline erosion from unprotected lands for the fastland and nearshore represent 65% and 35% of the total tidal shore load, respectively. Figure 4 details the tidal shore erosion from fastland and nearshore.

Importantly, this BMP differs from other urban BMPs. Currently, the tidal shoreline load is in the WQSTM and the pollutant load reduction is in the CBWM. This BMP is on the shoreline edge therefore the shoreline management practices stop sediment and nutrients from entering the Chesapeake Bay directly. This means that there is no sediment delivery factor. Therefore, the benefit and associated pollutant load reduction credit can be much higher than other urban BMPs. In addition, the BMP's pollutant load reduction is correlated to the tidal erosion rate. This means the higher the erosion at a site the higher the pollutant load reduction can be when a BMP is implemented.

The erosion of fastland from unprotected shorelines represents 65% of the total load while nearshore erosion represents 35% (i.e., 65:35) (Cerco et al., 2010). There are 92 model segments or reaches in the model which are actual shoreline lengths with variable loading rates incorporated into the appropriate model cell. Cerco et al. (2010) updated the WQSTM with spatially explicit shoreline erosion inputs developed by the CBP Nutrient Subcommittee's Sediment Workgroup.

Cerco et al. (2013) recently reported that the suspended solids budget based on the model indicated that internal production of organic solids was the greatest source of suspended solids in the Bay's mainstem. Overall sediment loads to the Bay are ranked as follows: 1) biogenic loads, 2) shoreline loads, 3) Susquehanna River, and 4) ocean sources. Shoreline management practices provide TSS reductions in the vicinity of the loading source and therefore an effective management practice to reduce sediment to the Bay which is the same conclusion found in Langland and Cronin (2003).

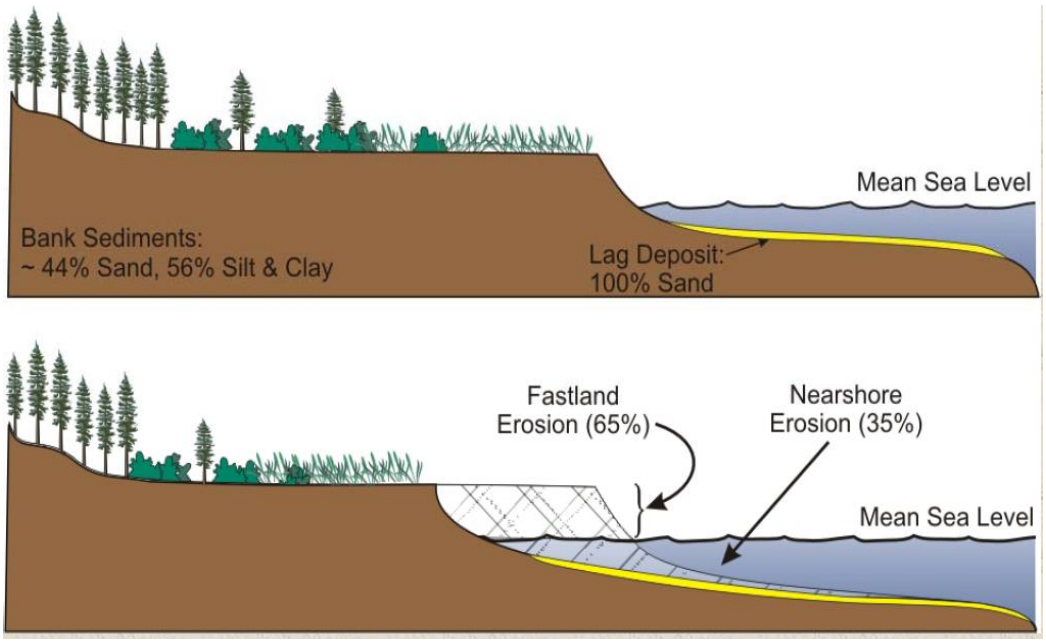

Figure 4. Tidal shoreline erosion from unprotected lands for the fastland and nearshore represent 65% and 35% of the total tidal shore load, respectively (Cerco et al, 2010; Langland and Cronin, 2003).

For more information about the CBPO model documentation and supporting tools such as CBWM, WQSTM, Scenario Builder, etc. visit the CBPO webpage at http://www.chesapeakebay.net/

In 2003, the CBPO approved nitrogen, phosphorus, and sediment removal rates for shoreline management practices (see Table 5). In the current Chesapeake Bay Model, nutrient and sediment removal rates for shoreline erosion control practices are equal to the rates for stream restoration practices. These removal rates were initially based on a single stream restoration study and are expressed in pounds of sediment or nutrient reduction per linear foot of the project per year (Table 5).

In 2012 an Expert Panel was formed to define removal rates for individual stream restoration projects and concluded that it was inappropriate to use removal rates based on a single study given the range of stream conditions and available restoration options (Stream Restoration Expert Panel, 2013). In 2013 the CBPO approved four general protocols developed by the expert panel for estimating sediment and nutrient reduction credits associated with different types of stream restoration practices.

The stream restoration removal rates are important because shoreline management practices are commonly if not exclusively reported as stream restoration to the CBPO.

Table 5. Removal rates for shoreline erosion control (management) practices.

Source	TN (lbs per foot per year)	TP (lbs per foot per year)	TSS (lbs per foot per year)
CBPO-Approved Rate in 2003	0.02	0.0025	2
Interim Rate, 2013	0.2	0.068	54.25
• Interim Rate, 2013 is found in the model tool's update history, e.g., MAST update history is online at http://www.mastonline.org/UpdateHistory.aspx (July 15, 2013)See also, Scenario Builder documentation (CBP, 2012) available online at http://www.chesapeakebay.net/documents/SB_Documentation_V24_11_01_2012.pdf • The stream restoration pollutant load reductions were modified in the "Recommendations of the expert panel to define removal rates for individual stream restoration projects" final report to the Urban Stormwater Workgroup that is dated February 19, 2013.			

Currently, the shoreline management practices receive pollutant load reductions through Scenario Builder, which is the input deck to the CBWM and is the process where all management actions are aggregated for representation in the CBPO models. The CBPO modeling team will adjust the CBWM and WQSTM so that the shoreline management pollutant load reductions are credited in the CBWM. See Appendix C for more details. The shoreline erosion loads to the Chesapeake Bay are associated with tidal erosion rates are simulated in the WQSTM. However, the modeling team and the panel determined that Scenario Builder should be used to manage shoreline management actions and that this is operationally efficient. Using Scenario Builder the shoreline management actions can be correctly credited in the accounting of sediment and nutrient load reductions.

3.5 Rationale for New Shoreline Management Protocol

The panel decided that the shoreline erosion control (management) pollutant load reduction rate needed to be updated based on the following:

- The current shoreline management pollutant load reduction is based on the previous CBPO approved stream restoration rate. There is no scientific basis for assuming the restoration based on a single stream study should be equivalent to "all" shoreline management practices. Table 6 outlines the available studies for TN, TP, and TSS pollutant loads compared to the CBPO policy thresholds.
- Shoreline management practices were "lumped together" and reported with stream restoration practices. Therefore there is no accurate accounting for the implementation of these practices in the Chesapeake Bay watershed. The reporting for shoreline management practices is inaccurate. For example, states report no shoreline management projects to CBPO through National Environmental Information Exchange Network (NEIEN).
- Shoreline erosion is one of the greatest sources of sediment and turbidity to the Chesapeake Bay and tributaries. Because there is no lag time associated with transport

and delivery of sediment, the benefits of shoreline management practices in reducing turbidity are immediate.

- The literature review by the Expert Panel supports development of protocols for estimating pollutant shoreline management rates that can be tailored using locally available data.

Table 6. Pollutant load reductions for shoreline management practices.

Source	TN (lb per foot per year)	TP (lb per foot per year)	TSS (lb per foot per year)	Study Location
Ibison, 1990	1.65[2]	1.27[2]	7,000[3]	Virginia
Ibison, 1992	0.81[4]	0.66[5]	2,800[6]	Virginia
Proctor, 2012	NA	0.38 or 0.29[7]	1,180[8]	Virginia
MDE, 2011*	0.16	0.11	451	Maryland
Baltimore County mean (Forand, 2013)	0.27	0.18	749	Maryland
CBPO Scenario Builder (CBP, 2012)	0.02	0.0025	2	CBPO policy threshold that comes from one stream restoration site in Maryland
Interim CBPO Rate (Stream Restoration Expert Panel, 2013)	0.20	0.068	310	CBPO policy thresholds that comes from six stream restoration sites in Maryland
Interim Rate, 2013	0.2	0.068	54.25	CBPO update history July 15, 2013

[1]MDE data was based on Baltimore County Department of Environmental Protection and Sustainability (DEPS) analysis of twenty three individual shoreline restoration projects completed by Baltimore County DEPS Capital Projects and Operations. Median values were used and reported (Forand, 2013).
[2] Table 5 on p.43 (Ibison, 1992)
[3] calculated from Table 5 on p. 43 (Ibison, 1992) (sediment loading rate 3.5 tons/ft-yr)
[4] Table 2 on p. 38 (Ibison, 1992)
[5] Table 3 on p. 40 (Ibison, 1992)
[6]Calculated from (Ibison, 1992) (sediment loading rate 1.4 tons/ft-yr)
[7] Calculated using numbers on p. 25 and 2,300 ft project length on p. 18 (Proctor, 2012)
8 Calculated using numbers from p. 25 (Proctor, 2012) and 2,300 ft project length on p. 18 (Proctor, 2012)

Therefore, shoreline management protocols and associated pollutant load reductions should be developed for this practice. A tailored protocol for shoreline management through the expert panel process will better reflect the TN, TP, and TSS pollutant load reductions for the Chesapeake Bay TMDL and local government planning. In addition, better reporting, tracking, and verification are needed to reflect the number and extent of shoreline management practices in the Chesapeake Bay.

Section 4. Basic Qualifying Conditions for Individual Projects

The shoreline management panel recommendations are intended to support the CBPO, the state, and the local governments to provide the best available techniques to the land that promote habitat and prevent shoreline erosion. These practices will prevent excessive pollutants from entering the Bay and impairing habitat. In addition, these shoreline management practices are intended for implementation where needed and where feasible. Appendix D provides more detail about this shoreline management approach to include, why it is important, and how to implement a shoreline management approach in the Chesapeake Bay watershed. All aspects of shoreline management should support the policies in place or promote better practices within these policies and permits. Finally, although MD and VA are highlighted here, the Panel acknowledges the tidal range extends to Delaware and the District of Columbia and these recommendations apply there as well.

Not all shoreline management projects may qualify for sediment or nutrient reduction credits. The Panel outlined the qualifying conditions for acceptable shoreline management restoration credit. Additionally, environmental and habitat considerations, urban considerations, and unintended consequences are outlined here to promote the most effective shoreline management.

Maryland and Virginia's preferred shoreline management approach is to use living shorelines where appropriate to prevent shoreline erosion and to protect the associated habitat. Maryland is a "high water state" meaning the jurisdictional line is at MHW (mean high water) and Virginia is a "low water state" meaning the jurisdictional line is at the MLW (mean low water). The policy and permit structure differs in the states, but the goals to protect property, prevent erosion, promote nearshore water habitat, and prevent unintended consequences are similar for the states. More information about the policy and permits is provided in Appendix E.

4.1 Basic Qualifying Condition Rationale

Shoreline management should be implemented in areas where there is a demonstrated need to control erosion to the Bay and where there will be a water quality benefit from the practice. The panel also considered habitat benefits as much as possible within the panel framework. The following benchmarks are commonly used to determine if the shoreline management practice should be considered: 1) site energy; 2) water depth offshore; 3) fetch; and 4) erosion rate (CBF, 2007). The jurisdictions (state) policy and procedures for shoreline management outline thresholds and qualifying conditions for the projects. For example, in Maryland the MDE (2008) guidance outlines the "preliminary considerations for erosion control of your waterfront property" guidelines and suggests contacting professionals, the state offices of MDE, MD DNR, US Army Corps of Engineers, and/or the Soil Conservation District Office. In Maryland and Virginia these policies are currently being updated. Finally, there is no Chesapeake Bay TMDL pollutant load reduction credit allowed for projects that are required for mitigation.

Shoreline environment and habitat should be considered in the planning, implementation, and maintenance phases. Erosion and property loss are important to protect. Additionally, the nearshore waters should be protected from non-point sources (NPS) pollution and also protected

from disturbances that are associated with shoreline management. Practices should be implemented that are appropriate for the site and are the minimum necessary to address the identified erosion problem. For example, the practice footprint should be minimized to reduce the amount of clearing and grading and impacts to other natural resources. Shoreline management should be part of the larger watershed restoration and preservation effort that include best practices such as using vegetative buffers upland of the shoreline practices, protecting natural resources where possible, and implementing sound design and construction standards. A shoreline management approach considers the site's shoreline reach, the factors that influence the reach, property owners, spatial parameters to address shoreline erosion, and helps frame the problem. A shoreline management approach in the Chesapeake Bay (see Appendix D) should be considered for sustainable shoreline management.

4.1.1 Urban Considerations

Urban areas can contain land use, available space, and other considerations that are not encountered elsewhere. For example, the Panel realized that preferred living shorelines may not be possible in urban areas that contain port facilities, marine industrial facilities, and/or other marine commercial areas. There may not be available space in the urban area and alternative shoreline management strategies may be needed. In addition, benchmarks such as fetch, boat traffic, and others can be limiting factors in urban development. Urban considerations may determine the shoreline management practice. However, the basic qualifying conditions outline the criteria for Chesapeake Bay TMDL pollutant load reduction eligibility for these urban practices.

4.1.2 Sea Level Rise Considerations for Shoreline Management Practices

The Shoreline Management expert panel realizes that future sea level rise (SLR) considerations for shoreline management practices are needed. The design, maintenance, and ultimate effectiveness can be impacted by rising waters and/or more intense storm events. Based on the available information there is a need to consider the future impacts to the shoreline management options provided in this panel report.

The Chesapeake Bay coastal states are vulnerable to rising seas and subsequent coastal wetland loss. The panel underlines the need for better designs that incorporate SLR, practices that allow landward migration for wetland systems are ideal, and additional research needs were identified (Section 7). See Appendix F for more SLR considerations for shoreline management practices.

4.1.3 SAV Habitat

The panelists researched and discussed the application of the Chesapeake Bay SAV goals to set thresholds for the basic qualifying conditions criteria. The aim for SAV basic qualifying conditions criteria was to aid SAV future growth by providing incentive to consider this natural resource habitat through the Chesapeake Bay TMDL pollutant load reduction credit (or lack of pollutant load reduction credit). SAV research findings and current research preliminary findings were presented and vetted through the panel process.

Based on past records, SAV occurs where horizontal shoreline erosion is less than 2 ft yr^{-1} (Karrh et al., 2011). Shoreline erosion is also a natural process that can contribute sand and other sediment sources that promote nearshore habitats, such as SAV. See also, *Section 3.2 Shoreline Management and Habitat Impacts*. In addition, stone structures in the water have negative impacts on SAV. Patrick et al. (*in press*) reported that SAV distribution was negatively impacted when more than 5.4% of the shoreline contained stone structures in the watershed. SAV habitat should be protected to meet the Bay-wide SAV goal.

The panel vetted the idea to not provide a Chesapeake Bay TMDL pollutant load reduction for projects in areas with horizontal shoreline erosion that was less than 2 ft yr^{-1} and to include this threshold as a basic qualifying condition. This threshold was not adopted as a basic qualifying condition. An analyses to further refine shoreline erosion rates that included eroded volume was conducted in an attempt to provide a compromise for a qualifying condition yielded inconclusive results. Based on these SAV discussions, the panel cited that more research was needed (Section 7) to support a SAV specific basic qualifying condition.

4.2 Basic Qualifying Conditions for Individual Projects

The basic qualifying conditions that are outlined in
Table 7 are the criteria a shoreline management project must meet in order to receive Chesapeake Bay TMDL pollutant load reduction. Projects that do not meet these basic qualifying conditions (e.g., a bulkhead or seawall where a living shoreline is feasible) do not receive Chesapeake Bay TMDL pollutant load reduction. Finally, no Chesapeake Bay TMDL pollutant load reductions should be provided for projects that impact Chesapeake Bay Preservation Act protected vegetation without mitigation.

Table 7. Criteria for Chesapeake Bay TMDL pollutant load reduction for shoreline management practices. These are the basic qualifying conditions.

Shoreline Management Practice	The Practice Must Meet these Criteria for TMDL Pollutant Load Reduction[1]
Living Shoreline – a) nonstructural; b) hybrid system including a sill; and c) hybrid system including a breakwater	1. The site is currently experiencing shoreline erosion or is replacing existing armor. The site was graded, vegetated, and excess sediment was removed or used.[2] AND 2. When a marsh fringe habitat (a or b) or beach/dune habitat (c) is created, enhanced, or maintained.
Revetment AND/OR Breakwater system without a living shoreline	1. The site is currently experiencing shoreline erosion. The site was graded, vegetated, and excess sediment was removed or used.[2] AND 2. A living shoreline is not technically feasible or practicable as determined by substrate, depth, or other site constraints. AND 3. When the breakwater footprint would not cover SAV, shellfish beds, and/or wetlands.
Bulkhead/Seawalls	1. The site is currently experiencing shoreline erosion. AND 2. The site consists of port facilities, marine industrial facilities, or other marine commercial areas where immediate offshore depth (e.g., depths deeper than 10 feet 35 feet from shore) precludes living shoreline stabilization or the use of a breakwater or revetment.
[1]Projects that impact the Chesapeake Bay Preservation Act protected vegetation without mitigation receive no Chesapeake Bay TMDL pollutant load reduction. [2]Bank analysis that demonstrates the site has bank stability and does not have erosion can serve to meet this qualifying condition. This should be coordinated with the local reporting authority to ensure proper methods, reporting, and requirements are done and are accepted by that authority so that the project meets this basic qualifying condition.	

The basic qualifying conditions are based on the panel's previous literature review, panel discussions and best professional judgment. See also, Appendix G that includes additional shoreline management site conditions and benchmarks.

Section 5. Rationale, Methods, and Examples for New Shoreline Management Protocols

5.1 Literature Review to Support New Shoreline Management Protocols

The Panel's review of available science per the panel process outlined in WQGIT (2010) included rigorous reviews, report outs to the group, and discussions. The major focus for this literature review section is to present the supporting science for the shoreline management protocols for sediment and nutrient pollutant load reductions in the Chesapeake Bay. The science and past CBPO EPA panel precedent support this panel's recommendations for providing pollutant load reductions for shoreline management practices that:

1. prevent erosion and associated sediment and nutrients from entering the Bay (Protocol 1: Prevented Sediment); and
2. shoreline management practices that incorporate vegetation
    a. promote denitrification and remove nitrogen (Protocol 2: Denitrification);
    b. promote accretion and sedimentation that remove sediment and phosphorus (Protocol 3: Sedimentation); and
    c. promote vegetative uptake and associated nutrient removal (Protocol 4: Marsh Redfield Ratio).

The Panel's research included their own expertise and research. In addition, the Panel conducted a literature review of over 200 publications that covered multiple topics in the coastal management field, including nutrient and sediment efficiency, policy, reporting, tracking and verification, shoreline management practice types, case studies, and erosion. The Panel's research and findings intersect with wetlands, especially coastal wetlands. A future Wetlands Expert Panel will convene and it is anticipated that the Shoreline Management Panel's recommendations will the foundation of future work done by the Wetland Expert Panel.

5.1.1 Prevented Sediment

Erosion of unconsolidated shorelines is a major source of sediment to the Chesapeake Bay. Tidal erosion is the major driver for property owners and for local jurisdictions to implement shoreline management practices. Langland and Cronin (2003) summarizing work of the Chesapeake Bay Program's Sediment Work Group emphasized that shoreline erosion (nearshore and fastland) accounts for approximately 57% of the sediment source loads to the Bay (65% fastland and 35% nearshore). Riverine (watershed and streams) sources at the fall line account for 29% of the total load. Shoreline management practices are implemented to stop this tidal erosion. These practices prevent sediment and associated nutrients from entering the Bay. In addition, the recently approved urban stream restoration expert panel included a prevented sediment protocol for the urban stream corridor. In summary, shoreline management practices prevent tidal shore erosion and thereby protect the property as well as prevent pollutants from entering the Bay.

See also sections *3.1 Shoreline Erosion*, *3.2 Shoreline Erosion Loading Rates*, and *5.2 Recommendations for Shoreline Management Sediment and Nutrient Load Reductions* for more information.

Section 5.2 Recommendations for Shoreline Management Sediment and Nutrient Load Reductions includes refinements that were made to reduce unintended consequences for the shoreline management's prevented sediment protocol. These refinements discounted the prevented sediment protocol's pollutant load reduction based on: 1) sand content; and 2) bank instability. In addition, a pollutant load reduction cap will ensure that the state basin model segment does not exceed the available pollutant load reductions. Therefore, the unintended consequences were reduced.

5.1.2 Tidal Marsh Denitrification

Tidal marsh, especially fringe tidal marsh, sediment and nutrient pollution removal rates can be used to estimate the added benefit for shoreline management practices that add marsh habitat. Upland or terrestrial source nutrient and sediment loading to the coastal nearshore waters has increased with increased urbanization. Tidal marshes can ameliorate some of these loadings due to: 1) their location between the upland and the coast; and 2) their ability to transform nutrients (Nixon, 1980; Valiella, 2000) and trap sediment (Jordan et al., 1986).

Denitrification is the anaerobic microbial conversion of nitrate (NO^{-3}) to nitrogen gas (N_2). Denitrification removes nitrogen from the system (Seitzinger, 1988; Tobias et al., 2001; Groffman and Crawford, 2002). Denitrification rates vary based on the tidal inundation period, salinity, sample location in the marsh, sample time, catchment size and characterization, denitrification method, sediment carbon content, and other factors. Additional research for shoreline denitrification and quantifying the impact these variables have on denitrification is an identified research need. All geographically relevant marsh studies were used without screening for the variables previously discussed. Therefore, the panel gathered a robust dataset for the management recommendation.

The Panel focused on tidal marsh literature since the findings were most applicable to shoreline management practices. Although there is extensive wetland research available, the Panel's professional judgment was that the wetland studies were not as applicable to the panel work since wetland systems most often have large surface areas compared to shoreline projects.

Research found that denitrification is a major nitrogen removal process in marsh vegetation. Greene (2005) and Merrill (1999) found that tidal marshes in the upper Patuxent estuary sequester nitrogen and phosphorus. For example, the upper Patuxent estuary's mean denitrification rate over 25.8 km^2 was 1,040 kg N d^{-1}. This tidal marsh denitrification could remove 24% of N inputs to the upper Patuxent. Annual net denitrification rates for the Chesapeake Bay marsh sediments were estimated at 60 µmol N m^{-2} h^{-1} (Merrill and Cornwell, 2002). Additional work by (Seitzinger, 1988) found five fringe salt marshes in Narragansett Bay, Rhode Island, showed denitrification rates up to 420 µmol N_2 m^2 hr^{-1} to intercept and transform land-derived nitrogen loads (Davis et al., 2004). The Dyke Marsh is a tidal freshwater marsh on the Potomac River. The mean denitrification rate was 147 µmol N m^{-2} h^{-1}. Using this rate for the Dyke Marsh area, the potential N removal is 14,600 kg yr^{-1} (Hopfensperger et al., 2009).

Marsh vegetation are sites for denitrification and other physical and chemical pathways, too. Tidal marshes are effective at trapping sediment both as individual grains and as flocculants. Tidal marsh vegetation plays a role by reducing velocity and breaking up turbulent eddies that might result in resuspension of deposited sediment (Christianson et al., 2000). Merrill (1999) reported that burial in the Patuxent River tidal marshes can remove up to 24% of nitrogen and 68% of phosphorus that enters the upper Chesapeake Bay subestuary. Marshes trap 35% of the nitrogen and 81% of the phosphorus load before entering the estuary where the nutrients would be recycled, exported, or buried. Therefore, vegetation in shoreline management practices will remove total pollutants through other pathways that are captured in Protocol 3 and 4.

In summary, the literature review found that denitrification was an important nitrogen removal pathway in vegetative systems. The nitrogen removed in tidal marshes and fringing marshes can represent estimates for shoreline management denitrification.

A summary for the tidal marsh literature and associated denitrification rates are included in Appendix H. This data was used in Section 5 for the denitrification protocol. Denitrification rates reported per area were used and denitrification rates reported per mass (e.g., Windham and Meyerson, 2003; Findlay et al., 2003; Otto et al., 1999, etc.) were not used for the protocol's pollutant load reduction. Denitrification rates reported per mass cannot be converted to a per area value.

The available denitrification information (Appendix H) was compiled and grouped so that one value was reported per study. If more than one value was available per study the average was used. The grand median was 78 µmol m^{-2} h^{-1} or 85 lbs ac^{-1} yr^{-1}.

5.1.3 Sedimentation: Sediment Trapping through Accretion

The study of marsh accretion rates has been conducted for a variety of reasons, including understanding of marsh dynamics, and most recently, related to the ability of marshes to maintain their surface elevations in light of sea level rise. The methods of study have ranged from differential total suspended sediment (TSS) concentrations between flood and ebb tides, inference from sediment cores using radioisotope methodologies, direct measurement of changes in marsh surface elevation over time, to direct measurement using marker horizons or filters.

Accretion in marshes is due to the trapping of sediment and organic matter and associated TN and TP removal from the system. Deposition is the settling of material on the marsh surface. The net balance between deposition and removal processes is accretion (Neubauer, 2002). The elevation of the tidal marsh over time is related to the interaction of increases in sea level, local subsidence, decomposition, and surface sediment compaction decreasing the marsh surface, while accumulation of sediment and input of local organic matter from local plant production result in marsh surface elevation increases. In most marshes these processes are in relative balance (Callaway, et.al. 2012). Sediment is delivered to the marsh surface through tidal inundation; waves and storm surges (Nyman, 2006). Marsh accretion may also occur through vegetative growth, primarily subsurface root growth. The total accretion due to both the sediment delivered to the marsh surface and vegetative growth. Neubauer's research summary for the mid-

Atlantic tidal marshes reported most accretion rates in marshes as 6.85 mm yr^{-1}(n=20). In another study conducted in Georgia, marsh type impacted accretion values, with salt marsh, brackish, and freshwater marsh accretion rates of 1.91 mm yr^{-1}, 4.41 mm yr^{-1}, and 7.78 mm yr^{-1}, respectively (Loomis and Craft, 2010).

Accretion was determined to be higher at the marsh edge which most closely mimics living shoreline projects (Leonard and Croft, 2006). Fringing marshes typically constructed as part of living shoreline projects may have comparable sediment retention capacity as extensive marshes if they have similar edge habitat where the highest rates of deposition occur (Christiansen et al., 2000; Neubauer et al., 2002). Morgan et al. (2009) reported sediment trapped at the edge of the marsh from 2 to 30 g m^{-2} d^{-1}. Larger marsh systems also accreted near the edge even when losing sediment overall (e.g., Blackwater marshes as reported by Stevenson et al. (1985)). The science review supported accretion as an important removal mechanism that living shorelines provide (see Appendix I).

Many studies report vertical accretion in millimeters or centimeters per year. In order to convert this measurement to a weight for crediting purposes, the bulk density of the material is needed. Callaway et al. (2012) provided the bulk density of restored marsh sediments by depth and location within the marsh (Table 8). Table 8 presents the results of four transects, two in a natural marsh and two in a restored marsh. The transects were core sampled to represent low marsh, mid marsh, and high marsh locations and were further sectioned by 10 centimeter increments. The researchers found no significant difference between the natural marsh and the restored marsh in the bulk density for the 1 to 10 cm or the 10 to 20 cm core interval categories, but the deeper cores were found to be significantly greater with the restored marsh. However, to ensure a conservative estimate for the sediment accretion credit a bulk density of 0.3895 g/cm^3 was selected, representing the restored low marsh mean. This will result in a conservative sediment reduction credit. Additional information about sedimentation is provided in Appendix I.

Table 8. Bulk density results by marsh type, marsh location, and core depth (g/cm^3).

Marsh Location	Core Depth				
	0-10 cm	10-20 cm	20-30 cm	30-40 cm	40-50 cm
Natural Marsh					
Low	0.4700	0.5175	0.4955	0.5385	0.5330
Mid	0.4320	0.3775	0.3760	0.4460	0.4450
High	0.3710	0.3600	0.4115	0.4630	0.4350
Average	0.4243	0.4170	0.4277	0.4825	0.4710
Restored Marsh					
Low	0.3895	0.4890	0.5430	0.7265	0.8000
Mid	0.3915	0.4930	0.4980	0.6160	0.7985
High	0.5975	0.7610	0.8255	0.8035	0.9595
	0.4595	**0.5810**	**0.6222**	**0.7153**	**0.8527**
Average All Groups	***0.4419***	***0.4990***	***0.5249***	***0.5989***	***0.6618***
	N	**Mean**	**Std. Dev.**	**Minimum**	**Maximum**
Survey	4	456,446	258,145	259,933	832,619

The results from the sediment core, horizontal marker, and sediment flux studies were used to determine the annual sediment accretion credit for marsh creation associated with shoreline management projects (Table 9). An ANOVA found that only the survey methodology resulted in annual sediment accretion rates that were significantly different than the other methodologies. Therefore the results from the sediment core, horizontal marker, and sediment flux studies were used to determine the annual sediment accretion credit for marsh creation associated with shoreline management projects.

Table 9. Pounds of sediment per acre per year derived by various methodologies.

	N	Mean	Std. Dev.	Minimum	Maximum
Survey	4	456,446	258,145	259,933	832,619
Core	30	8,329	4,373	1,428	19,194
Horizontal Marker	7	14,486	9,413	5,908	27,800
Sediment Flux	2	2,855	1,514	1,784	3,926

Since the data is highly variable and to account for uncertainty, the median value of 6,959 pounds TSS/acre/year (not shown) was used for the credit based on sediment accretion in tidal marsh restoration associated with shoreline management projects. For comparison the mean for data was 8,489 pounds TSS/acre/year.

Tidal marsh sediments are comprised of organic and inorganic autochthonous and allochthonous material in variable proportions. The nutrient content of this material can be permanently removed through burial (Libes 1992, Nixon 1980) as long as there is not physical disturbance to the system. Few studies have looked at the concentrations of nutrients in tidal marsh sediments. Zelenke and Cornwell (1996) and Cornwell et al. (1994) studied four tidal marsh sediments in the Chesapeake Bay to determine the relative importance of sedimentation in phosphorus retention which includes phosphorus data that can be used to estimate removal rates associated accretion. The four systems include, the Monie Bay National Estuarine Research Reserve, Otter Creek National Estuarine Research Reserve, Jug Bay National Estuarine Research Reserve-Patuxent River and Choptank River. The studies involved the measurement of nutrient concentrations in vertical core profiles. Cores were divided into 3, 5, and 10 cm sections which were dried and weighed to determine bulk density and phosphorus concentration. While this study also determined areal accretion rates, for the purpose of this protocol only phosphorus data will be discussed. Monie Bay, Jug Bay and Otter Creek had comparable total phosphorus (TP) concentrations within the top 10 cm ranging between 0.4 to 0.6 mg/g with higher variability at greater depths. The Patuxent site had substantially greater TP concentrations (>1.0 mg/g). Using these same data, Cornwell et al. 1994 reported a mean sediment concentration of 0.76 mg/g (0.17) in surface sediments and 0.66 (0.04) mg/g in buried sediments. The authors indicate that phosphorus burial in Monie Bay does not play a significant role in phosphorus retention and are approximately one fourth the concentration of subtidal sediments in the Chesapeake Bay. Therefore, given the limited studies on phosphorus retention through accretion this protocol will use 0.76 mg/g as an average TP concentration (5.289 lbs TP/acre/yr) as a conservative default value for this protocol.

5.1.4 Marsh Redfield Ratio

Vegetation in marshes and wetlands are active areas for nutrient cycling. The panel researched and discussed the vegetative uptake and associated pollutant removal due to the vegetation in marsh and wetland systems. Based on this research there was not enough available information to support a protocol for the vegetative uptake and ultimate removal for total nitrogen and total phosphorus. In addition, the vegetative uptake findings often overlapped with the denitrification and sedimentation nutrient removal pathways that are outlined in protocols 2 and 3. Therefore, the marsh Redfield ratio was used as a conservative estimate of the nitrogen and phosphorus removed from the Bay by vegetation.

The marsh Redfield ratio represents the nitrogen and phosphorus that is biologically and chemically unavailable to nearshore waters and Chesapeake Bay due to vegetative processes. These processes include the above ground and below ground nutrient cycles. The marsh C:N and N:P are reported in Table 10. Nyman et al. (2009) analyzed C, N, and P in the marsh vegetation tissue in laboratory conditions where neither salinity nor nutrients significantly impacted the N:P ratios in the plant tissues. Based on these results the marsh Redfield ratio for C:N:P was 1,454:23:1.

Table 10. Marsh Redfield ratio findings (Nyman et al., 2009).

C:N	N:P	C:N:P
56:1	8:1	
ND	44.01:1	
ND	25:1	
ND	16.2:1	
49.04:1	ND	
84.5:1	ND	
60:1	ND	
62:1 (mean)	**23:1 (mean)**	**1,454:23:1**
Notes: The mean C:N was 62:1 and N:P was 23:1. The resulting C:N:P was 1,454:23:1.		

The marsh vegetation area and associated production for that vegetated area represents the mass per year. The marsh vegetation reported for the aboveground and below ground aerial production is in Appendix J. The grand median value was 1,458 g dry matter m^{-2} yr^{-1}. This median vegetative production value was used to adjust the C:N:P to 1,455:23:1. The resulting N:P was 23:1. This represents the nitrogen and phosphorus removed from the Chesapeake Bay per square meter shoreline management vegetation per (i.e., 23 g TN m^{-2} and 1 g TP m^{-2}). Converting this TN and TP to pounds per acre resulted in the following pollutant load reductions: 1) 205 TN lb ac^{-1} and 2) 9 TP lb ac^{-1}. The marsh Redfield ratio protocol is a one-time TMDL pollutant load reduction.

5.2 Recommendations for Shoreline Management Sediment and Nutrient Load Reductions

The Panel's recommended protocols for shoreline management pollution reduction are provided here. The four protocols include:

1. Prevented Sediment
2. Denitrification
3. Sedimentation
4. Marsh Redfield Ratio (one-time credit)

The protocol supporting rationale and research were provided in *Section 5.1 Literature Review to Support Shoreline Management Protocols*. The basic qualifying conditions for individual projects were outlined in *Section 4 Basic Qualifying Conditions for Individual Projects*. A shoreline management project must meet the basic qualifying condition to qualify for and receive TMDL pollutant load reduction credit. Examples to use the basic qualifying conditions and protocols are included in *Section 5.3 Examples*. Default values are provided, as appropriate, however the panel recommended site sampling and provided guidelines in Appendix K.

The literature review to support development of the four protocol methods were provided in *Sections 5.1.1 Prevented Sediment* through *5.1.4 Marsh Redfield Rat*io.

5.2.1 Protocol 1. Prevented Sediment

The prevented sediment protocol follows a three-step process to compute a mass reduction credit for prevented sediment:

1. Estimate shoreline erosion rates and annual sediment loadings,
2. Convert erosion rates to nitrogen and phosphorus loadings, and
3. Estimate reduction attributed to restoration.

Step 1. *Estimate shoreline sediment erosion rate*

Estimates of sediment loss are required as a basis to this protocol. To estimate shoreline erosion rates in Maryland for Step 1 of this protocol, the Maryland Department of Natural Resources Coastal Atlas website can be used to determine erosion rates. Use the S*horelines Rates of Change* layer and the Identify tool to obtain the rate for a given site. If a transect is unavailable at the specific location, use the nearest transect. To estimate shoreline erosion rates in Virginia use closest existing data from VIMS and additional updated refinements or data sets (e.g., Scott Hardaway's AMBUR). The calculations discussed herein should be performed on a reach basis along the shoreline, with overall reported values consisting of a weighted-average of each reach (weighted by the shoreline reach lengths). The shoreline should be broken into homogenous reaches represented by the shoreline's natural breaks or on or around 1,000 feet long. Finally, projects in DE and the District of Columbia should obtain and vet shoreline erosion rates with the local permitting authority.

Step 2. *Convert shoreline erosion to nutrient loading*

To estimate nutrient loading rates, the volume of prevented erosion must be determined. Using the equation V=LEB, where V=volume of sediment (cubic feet), L=length of shoreline (feet) project, E = Shoreline recession rate (feet/year) and B=bank height (feet), this can be calculated. For new or current projects, length of the project and average bank height can be obtained from the project design specifications. For old projects, this data can be taken from engineering plans. Shoreline erosion (recession) rate was determined in step 1.

This equation yields a volume expressed in cubic feet per year. Cubic feet are converted to pounds using a soil bulk density of 93.6 lb/ft^3 (Ibison, 1992). This 93.6 lb/ft^3 is the panel's recommended default bulk density value. Pounds are then converted to tons using a factor of 0.0005. To determine nutrient loading prevented or nutrient reduction, TN and TP concentrations from Ibison (1992) in Table 7 were used:

- 0.57 pounds TN/ton sediment
- 0.41 pounds TP/ton sediment

Site TSS, TN, and TP may vary greatly from site to site in MD and VA. Therefore, sampling is encouraged so that the most applicable pollutant loads are estimated. Panelists, led by Scott Hardaway, developed a sediment sampling protocol provided in Appendix K.

If there is better information for the bulk density and/or nutrient concentrations available, such as through site specific site monitoring, then this data could be used. A local sampling plan that documents the sampling process, handling procedure, laboratory protocols and methods, calculations, and QA/QC protocols should be followed and available for review. Applying the bulk density and/or nutrient concentrations should be documented and coordinated with the state agency that is responsible for tracking, verifying, and reporting this data.

Step 3. *Estimate shoreline restoration efficiency*

Shoreline erosion is estimated in Steps 1 and 2, but not the efficiency of shoreline restoration practice in preventing bank erosion.

The panel considered the effectiveness of the practices or how well they will work and what, if any, reduction should be made to the resulting pollutant load calculated in this protocol. The panel determined that full efficiency or 100% should be used since the practice prevents the fastland and nearshore erosion, however the protocol only accounts for the fastland sediment prevented from eroding. Since the nearshore sediment prevented is not accounted for in this protocol, 100% efficiency for the shoreline management practice is a conservative estimate.

If there is better information for the practice efficiency available, such as through site specific site monitoring, then this efficiency could be used. Applying the efficiency should be documented and coordinated with the state agency that is responsible for tracking, verifying, and reporting this data.

5.2.1.1. Sand and Bank Instability Reductions for Prevented Sediment

Sand Reduction for Prevented Sediment

The final TSS pollutant load reduction should be reduced by the sand component in the sediment prevented by the practice. This is done so that prevented sand is not included in the load reduction. The natural erosion of sand is beneficial to nearshore water habitats (see *Section 3.3 Shoreline Management and Habitat Impacts and 4.1.3 SAV Habitat* for more information) and the unintended prevention of this process through shoreline stabilization should be minimized. The fines consist of silts and clays that are most associated with TN and TP. The Cerco et al. (2010) provided fines in Maryland and Virginia (see Table 3 Chesapeake Bay shoreline characteristics and shoreline erosion mass loading). The following table
Table 11) outlines the values for fines, coarse sediment (sand), and organics. The sand reduction factor in
Table 11 should be applied to the final TSS load.

Note that the sand reduction factor is not applied to the TN and TP since the default sediment sample or site specific sediment sample concentrations reflect the amount of fines and sand of that sample.

Table 11. Chesapeake Bay shoreline soil characteristics (Cerco, 2010) and the sand reduction factor.

State	Loading (kg/m/d)			Sand Reduction Factor
	Total	Fines	Coarse	
Maryland	2.43	1.34	1.02	0.551
Virginia	1.01	0.34	0.67	0.337
Source: Chesapeake Bay shoreline characteristics and shoreline erosion mass loading (averaged) (Cerco, 2010).				

If better information for the % fines and % sand available, such as through site specific site monitoring, then this information could be used. Applying the resulting factor should be documented and coordinated with the state agency that is responsible for tracking, verifying, and reporting this data.

Bank Instability Reduction for Prevented Sediment

The panel recognized that tidal shoreline management projects that do not adequately address the critical angle of repose are at a continued risk of erosion due to waves and usual storm events, which impact the base of the bank. This is supported by Clark et al. (2004) who studied the bluffs at Calvert Cliffs and found the angle of repose was critical for maintaining the bank stability. This means that the Protocol 1 – Prevented Sediment should be calculated and then

reduced by 50% unless it is demonstrated that the project addresses the angle of repose through bank grading and stabilization.

The shoreline management project should provide detailed bank stability analysis to the local reporting agency to document that no additional sediment and associated pollutants will enter the nearshore waters to include the following conditions: 1) the project was graded and vegetated so that the bank is stable and 2) excess sediment was removed offsite so that the sediment does not enter the nearshore waters. Bank analysis can demonstrate the site is stable with a minimum risk of erosion. This should be coordinated with the local reporting authority to ensure proper methods, reporting, and requirements are done and are accepted by that authority so that the project meets this basic qualifying condition.

5.2.1.2 Pollutant Load Reduction Cap

In addition, a pollutant load reduction cap will be implemented for each state basin's level. The shoreline management practices per state basin segments should not exceed one-third of the pollutant load to the state basin. States are encouraged to sub allocate this cap further (e.g., county) to be consistent with their WIP strategies. The pollutant load cap ensures that each state basin's segments do not exceed the available pollutant load reductions. This will be implemented in the suite of EPA CBPO modeling tools (see Appendix C).

5.2.2 Protocol 2. Denitrification

This credit is for marsh denitrification and based on the denitrifying capabilities of marsh soils. The pollutant load reduction is based on the square footage of wetland planting in conjunction with a shoreline management project. This credit applies to nitrogen.

The denitrification literature was reviewed, synthesized, and selected to include for the denitrification protocol. See *Section 5.1 Literature Review to Support Shoreline Management Protocols* and associated appendices for more information. The denitrification rates were converted to pounds of nitrogen per acre per year. As mentioned earlier, methods that yielded denitrification rates per mass (e.g., ng N g^{-1} h^{-1}) could not be converted to pounds of nitrogen per acre per year and were not used for this analysis. In order to provide a conservative estimate of the pounds of nitrogen removed through the denitrification process, the grand median value of 85 pounds nitrogen/acre/year were used for this protocol.

Step 1. *Determine the total post construction area of the net increase in marsh plantings and convert to acres.*

This may be taken from the restoration drawings after confirmation in the field through as-builts. Future credit should be based on field verification of survival of the initial planting and any expansion of the restored marsh area due to either re-enforcement planting or natural expansion.

Step 2. *Multiply the acres of marsh planting by the unit denitrification rate (85 pounds total nitrogen/acre/year).*

In-lieu of the default denitrification pollutant load reduction, site determined values may be substituted, if based on scientifically defensible study design. Applying the site denitrification should be documented and coordinated with the state agency that is responsible for tracking, verifying, and reporting this data.

5.2.3 Protocol 3. Sedimentation

This credit is based on the sediment trapping capabilities of both vegetative planting and/or on sediment deposition behind shoreline management structures. The pollutant load reduction is based on the square footage of wetland planting in conjunction with a shoreline management project. This credit uses median accretion rates and a conservative bulk density as described in *Section 5.1.3 Sedimentation: Sediment Trapping through Accretion*. This credit applies to sediment and phosphorus.

Step 1. *Determine the total post construction area of the net increase in marsh plantings and convert to acres.*

This may be taken from the restoration drawings after confirmation in the field through as-builts. Future credit should be based on field verification of survival of the initial planting and any expansion of the restored marsh area due to either re-enforcement planting or natural expansion.

Step 2. *Multiply the acres of marsh planting by the unit sedimentation value (6,959 lbs total suspended solids/acre/yr).*

Step 3. *For total phosphorus load removed multiply the acres of marsh planting by 0.76 mg/g (conversion = 0.00076) (5.289 lbs total phosphorus/acre/yr).*

In-lieu of the default sedimentation pollutant load reduction, site determined values may be substituted, if based on scientifically defensible study design. Applying the site values should be documented and coordinated with the state agency that is responsible for tracking, verifying, and reporting this data.

5.2.4 Protocol 4. Marsh Redfield Ratio

This is a one-time credit that is applied in the first year after construction and is based on vegetative uptake of nutrients for vegetative growth in marshes. The pollutant load reduction is based on the square footage of wetland planting in conjunction with a shoreline management project. Future credit should be based on field verification of survival of the initial planting and any expansion of the restored marsh area due to either re-enforcement planting or natural expansion. This credit applies to nitrogen and phosphorus.

The marsh Redfield ratio literature that was outlined in *Section 5.1.4 Marsh Redfield Ratio and Appendix J Marsh Redfield Ratio Data* was reviewed, synthesized, and summarized for the marsh Redfield ratio protocol. In addition, the median TN and TP removal values were converted to pounds of nitrogen per acre. In order to provide a conservative estimate of the pounds of nitrogen and phosphorus removed from the system when vegetation is present, the grand median values of 205 pounds nitrogen/acre and 9 pounds/phosphorus/acre will be used for this protocol.

This Marsh Redfield Ratio pollutant load reduction credit **IS A ONE-TIME** credit **AND** is based on vegetative uptake of nutrients for vegetative growth in marshes. This credit applies to nitrogen and phosphorus.

Step 1. *Determine the total post construction area of the net increase in marsh plantings and convert to acres.*

This may be taken from the restoration drawings after confirmation in the field through as-builts. There is no future credit as this is a one-time credit.

Step 2. *Multiply the acres of tidal marsh planting by the unit marsh Redfield ratio value (205 pounds total nitrogen/acre and 9 pounds total phosphorus/acre).*

In-lieu of the default pollutant load reduction, site determined values may be substituted, if based on scientifically defensible study design. Applying the site values should be documented and coordinated with the state agency that is responsible for tracking, verifying, and reporting this data.

5.3 Examples

Example projects were used to demonstrate the pollutant load reductions for protocols 1, 2, 3, and 4. Practices must meet the criteria for the basic qualifying conditions to receive TMDL pollutant load reduction. Basic qualifying condition decision tree examples are provided.

The remaining examples in *Section 5.3.2 Maryland Example* and *Section 5.3.3 Virginia Example*, assume that the basic qualifying conditions were met. This means that after meeting the basic qualifying conditions, the Chesapeake Bay TMDL pollutant load reductions were allowed and were calculated using the protocols. In addition, the examples in *Section 5.3.2 Maryland Example* and *Section 5.3.3.1 Virginia Example -1* assume that the default values were used for bulk density, TN, and TP. In addition, these examples assume that the reporting agency did not receive acceptable bank stability report (*see Section 5.2.1.1 Sand and Bank Instability Reductions for Prevented Sediment for more information*). However, example in *Section 5.3.3.2 Virginia Example -2* used site specific site specific values for bulk density, TN, TP, and provide acceptable bank stability reports. Finally, these examples were provided from sites and panelists in Maryland and Virginia.

5.3.1 Basic Qualifying Conditions Examples

Projects must meet the basic qualifying conditions (Table 12) to receive Chesapeake Bay TMDL pollutant load reductions.

Table 12. Basic Qualifying Condition examples.

Site Conditions	Meets Criteria for TMDL Pollutant Load Reduction?	Notes
Example 1. The property owner will build a bulkhead. The site currently has no shoreline management practice and is 50 feet long. The site has active erosion and is in an area where living shoreline could be possible. The project is not anticipated to enhance the marsh fringe habitat and does not cover nearshore habitats.	No	• Living shoreline is possible but not implemented • Policy/permit applicability is not considered in this example, only the basic qualifying conditions criteria
Example 2. The property owner requests a living shoreline practice to replace 50 feet of bulkhead. The project area has active erosion. The project regraded and revegetated the bank.	Yes	• Bulkhead is replaced by living shoreline practice
Example 3. A port facility will build a 50 foot bulkhead in an area with tidal shoreline erosion. No living shoreline is possible due to site constraints; the nearshore water is too deep. The tidal erosion is contributing toxics to the water.	Yes	• Site is experiencing shoreline erosion • Site is a port facility where no living shoreline, breakwater, or revetment can be constructed
Example 4. A 50 foot bulkhead is failing and a 50 foot bulkhead will be constructed. The project area is experiencing shoreline erosion. The practice will negatively impact marsh fringe habitat. Other practices such as a breakwater or revetment without living shoreline could be implemented.	No	• Alternative practices with less, or no adverse habitat impacts could be implemented • Policy/permit applicability is not considered in this example, only the basic qualifying conditions criteria
Example 5. A 50 foot living shoreline will be constructed. The project area is experiencing shoreline erosion. The site will not be regraded. The site will not be revegetated.	No	• The site will not be regraded and will not be revegetated

5.3.2 Maryland Example

This is the Essex Skypark Living Shoreline Enhancement Project that was conducted by Baltimore, County, Maryland's Department of Environmental Protection and Sustainability through the Capital Program Operations Section. Essex Skypark is located on the Back River community of Essex, MD located in the Back River watershed.

Figure 5. Reach 2 – Location 1 pre-construction.

Figure 6. Reach 5-B Location 1 post-construction.

5.3.2.1 Maryland Example– Pollutant Load Reductions for the Shoreline Management Practice: Living Shorelines with Sills and Breakwaters

Protocol 1 – Prevented Sediment

Three reaches along the Back River shoreline were identified as severely eroded and in need of stabilization (Figure 5). The first reach (reach 2) had a variable 6 to 8 foot high vertical bank along 1,079 feet on the north end of Essex Skypark (Figure 6). The fetch is approximately 2.9 miles and the shoreline is subject to significant wind-generated wave action. Many trees along the shoreline fell. This exposed the clay soils and resulted in bank recession. The second reach

(reach 5A) includes a total of 881 linear (LF) and the third reach (reach 5B) includes 650 LF on the south end of the property with a bank height ranging from 3 to 5 feet along the shoreline (Figure 6). The rate of erosion on the north shoreline averaged of 1.5 feet per year and on the south shoreline averaged 1.0 foot per year. No in-situ sampling obtained at this site, so default values used for the nutrient concentrations.

The shoreline management project included structural and non-structural erosion control and shoreline enhancement techniques along 2,610 LF including the creation of a living shoreline planted with 79,513 square feet of wetland grasses that were protected by 12 off shore stone sills and 5 off shore stone breakwaters. Table 13 outlines the protocol 1 Prevented Sediment values.

Table 13. Protocol 1: Prevented sediment calculations for MD Example.

Shoreline Parameter	Length (ft)	Erosion Rate (ft/yr)	Average Bank Height (ft)	Sediment (ft^3/yr)	Sediment[1] (lbs/yr)	Sediment (tons/yr)	TN[2] (lbs/yr)	TP[3] (lbs/yr)
Reach 2	1,079	1.5	7	11,329.5	1,060,441	530.2	302.2	217.4
Reach 5A & 5B	1,531	1.0	4	6,124.0	573,206	286.6	163.4	117.5
Totals	2,610				1,633,647		465.6	334.9
MD Reduction (55.1%)[4]					**900,139**			
50% Bank Instability Reduction[5]					**450,070**		**233**	**168**

[1]Soil bulk density – 93.6 lb/ft^3 (p.9)*
[2]Soil TN concentration – 0.57 lbs/ton of sediment (p.56)*
[3]Soil TP concentration – 0.41 lbs/ton of sediment (p.56)*
[4]Reduction for sediment based on % fines vs sands in MD soils**
[5]Reduction for bank instability for the Chesapeake Bay.
*Ibison, N.A., J.C. Baumer, C.L. Hill, N.H. Berger, J.E. Frye. 1992. Eroding Bank Nutrient Verification Study for the Lower Chesapeake Bay. Department of Conservation and Recreation, Division of Soil and Water Conservation. Gloucester Point, VA.
**Chesapeake Bay shoreline characteristics and shoreline erosion mass loading (averaged) (Cerco, 2010).

Protocol 1 total project pollutant load reductions from Table 13:

- TN –233 lb/yr
- TP – 168 lb/yr
- TSS – 450,070 lb/yr

Protocol 2 – Denitrification

Vegetated Area: 79,513 square feet of vegetative plantings (1.8 acres)
Denitrification rate: 85 lb TN/acre/yr

Area of marsh planting = 1.8 acres
Denitrification pollutant load reduction: 85 lb TN/acre/yr

Protocol 2 total project pollutant load reduction:

- TN = 85 lb TN/acre/yr * 1.8 acres
- **TN = 153 lb/yr**

Protocol 3 - Sedimentation
Vegetated Area: 79,513 square feet of vegetative plantings (1.8 acres)
Sedimentation pollutant load reduction: 5.289 lbs TP/acre/yr and 6,959 lbs TSS/acre/yr

Protocol 3 total project pollutant load reduction:

- TP = 5.29 lbs TP/acre/yr * 1.8 acres
- **TP = 9.52 lbs-TP/yr**

- TSS = 6,959 lbs TSS/acre/yr * 1.8 acres
- **TSS = 12,526 lbs-TSS/yr**

Protocol 4 - Marsh Redfield Ratio
Vegetated Area: 79,513 square feet of vegetative plantings (1.8 acres)
Marsh Redfield Ratio pollutant load reduction: 205 lbs TN/acre and 9 lbs TP/acre

Note: This Marsh Redfield Ratio TN and TP pollutant load reduction is applied in the first year after construction only.

Protocol 4 total project pollutant load reduction:

- TN = 205 lbs TN/acre/yr * 1.8 acres
- **TN = 369lbs-TN/yr**

- TP = 9 lbs TP/acre/yr * 1.8 acres
- **TP = 16.2 lbs-TP/yr**

This example's total pollutant load reductions are the sum of Protocol 1, Protocol 2, Protocol 3, and Protocol 4 that are provided in
Table 14.

Table 14. Maryland's example total pollutant load reductions. Note the TN and TP pollutant load for Protocol 4's marsh Redfield ratio is a ONE TIME credit realized in year 1 but not in subsequent years.

Pollutant	Protocol 1 Pollutant Load Reduction (lb/yr)	Protocol 2 Pollutant Load Reduction (lb/yr)	Protocol 3 Pollutant Load Reduction (lb/yr)	Protocol 4 Pollutant Load Reduction (lb)[1]	Year 1 Total Pollutant Load Reduction (lb/yr)[2,3]
TN	233	153	NA	369	755
TP	168	NA	9.52	16.2	193
TSS	450,070	NA	12,526	NA	462,596

[1]Marsh Redfield Ratio pollutant load reduction if a one-time credit.
[2]The TN and TP totaled here are for the first year and include the one-time credit for the Marsh Redfield Ratio. In subsequent years there will be no TN or TP pollutant load reduction for this protocol.
[3] This practice was 2,610 linear feet, had an erosion rate of 1 and 1.5 ft/yr, had a bank height of 4 and 7 feet, and had 1.8 acres of vegetation. See other site specifics in the project description.

5.3.3 Virginia Examples

Two Virginia example sites were provided. The Virginia examples include an unnamed Department of Defense (DOD) facility and the City Farm in Newport News, Virginia. These sites both experience erosion and need a shoreline management practice. A breakwater system was proposed at DOD (Figure 7) and a marsh sill was proposed at City Farm (Figure 8 and Figure 9). The breakwater system and living shoreline represent Virginia's examples 1 and 2.

For each site, review the basic qualifying conditions in Section 4 to ensure the project is eligible for Chesapeake Bay TMDL TN, TP, and TSS pollutant load reductions. If the project is eligible, calculate the TN, TP, and TSS pollutant load reductions using Protocols 1, 2, 3, and 4, if applicable.

5.3.3.1 Virginia Example 1– Pollutant Load Reductions for the Existing Site Conditions: DOD Breakwater System (Hybrid Design)

Site Characteristics for the DOD Breakwater System (Hybrid Design)
The following site characteristics existed at the DOD VA site:

- High bank fastland erosion with small beach at toe
- Between two stable marsh areas that did not have bank erosion landward of the marsh
- Length = 750 ft
- Example 1 – Proposed breakwater system (Hybrid Design)

Protocol 1 – Prevented Sediment

- Step 1: Erosion (E) = 0.383 ft/yr
  - *Note: The erosion rate was obtained from average of VIMS shoreline evolution report data, derived from actual shapefile results and not the published ranges.*
- Step 2: Average bank height (B) = 29 ft
  - Volume (V) = 8,330 cf/yr
  - *Note: No in-situ sampling obtained at this site, so default values were used for the nutrient concentrations.*
    - TN = 222.2 lbs-TN/yr * [0.50 (50% Bank Instability Reduction)]
    - **TN = 111.1 lbs-TN/yr**
    - TP =159.8 lbs-TP/yr * [0.50 (50% Bank Instability Reduction)]
    - **TP = 80 lbs-TP/yr**
- Step 3: Sediment Removal = [389.8 tons/yr] * [0.337 (VA default sand reduction factor)] * [0.50 (50% Bank Instability Reduction)]
  Sediment Removal = 65.7 tons/yr
    - **TSS = 131,400 lb-TSS/yr**

Protocol 2 – Denitrification

Area of marsh planting = 0.41 acres
Denitrification pollutant load reduction: 85 lb TN/acre/yr

Protocol 2 total project pollutant load reduction:

- TN = 85 lbs-TN/acre/yr * 0.41 acres
- **TN = 34.9 lbs-TN/yr**

Protocol 3 – Sedimentation

Area of marsh planting = 0.41 acres
Sedimentation pollutant load reduction: 5.289 lbs TP/acre/yr and lbs 6,959TSS/acre/yr

Protocol 3 total project pollutant load reduction:

- TP = 5.289 lbs-TP/acre/yr * 0.41 acres
- TSS = 6,959 lbs-TSS/yr * 0.41 acres

- **TP = 2.2 lbs-TP/acre/yr**
- **TSS = 2,853 lbs-TSS/yr**

Protocol 4 - Marsh Redfield Ratio

Area of marsh planting = 0.41 acres
Marsh Redfield Ratio pollutant load reduction: 205 lbs TN/acre and 9 lbs TP/acre
Protocol 4 total project pollutant load reduction:

- TN = 205 lbs-TN/acre * 0.41 acres
- TP = 9 lbs-TN/acre * 0.41 acres

- **TN = 84.1 lbs-TN**
- **TP = 3.69 lbs-TP**

Virginia example 1 total pollutant load reductions are the sum of Protocol 1, Protocol 2, Protocol 3, and Protocol 4 provided in Table 15.

Table 15. Virginia Example 1 total pollutant load reductions. Note the TN and TP pollutant load for Protocol 4's marsh Redfield ratio is a ONE TIME credit realized in year 1 but not in subsequent years.

Pollutant	Protocol 1 Pollutant Load Reduction (lb/yr)	Protocol 2 Pollutant Load Reduction (lb/yr)	Protocol 3 Pollutant Load Reduction (lb/yr)	Protocol 4 Pollutant Load Reduction (lb)[1]	Year 1 Total Pollutant Load Reduction (lb/yr)[2,3]
TN	111.1	34.9	NA	84.1	230
TP	79.9	NA	2.2	3.7	86
TSS	131,400	NA	2,853	NA	134,253

[1]Marsh Redfield Ratio pollutant load reduction if a one-time credit.
[2]The TN and TP totaled here are for the first year and include the one-time credit for the Marsh Redfield Ratio. In subsequent years there will be no TN or TP pollutant load reduction for this protocol.
[3] This practice was 750 linear feet, had an erosion rate of 0.383ft/yr, had a bank height of 29 feet, and had 0.41 acres of vegetation. See other site specifics in the project description.

5.3.3.2 Virginia Example 2– Pollutant Load Reductions for the Existing Site Conditions: City Farm Living Shoreline (Marsh Sill)

Site Characteristics for the City Farm Living Shoreline (Marsh Sill)

The following site characteristics existed at the City Farm site in Newport News, VA site:

- Low to moderate bank heights
- Located at the mouth of Deep Creek, at its confluence with the James River
- Length = 500 ft
- Example 2 – Proposed Living Shoreline (marsh sill) with bank grading and stabilization

Protocol 1 – Prevented Sediment

- Step 1: E = 1.34 ft/yr
  - *Note: There were no erosion values included in the VIMS shoreline evolution report since it stopped just short of the project site. Therefore, comparable information was derived from aerial imagery comparisons for the same two years as the VIMS study that included 1937 and 2007.*
- Step 2: Average bank height (B) = 3 ft
  - *Note 1: There was one isolated area with a higher bank height and the average observed height was used for this 500 ft reach.*
  - *Note 2: The applicant coordinated with the reporting agency prior to site sampling to clarify sampling requirements, followed the procedures summarized in Appendix K (Sediment Sampling Protocol), and provided acceptable site specific TN and TP nutrient bank values. The weighted average (weighted by soil horizon thickness) of these values were 0.74 lbs-TN/ton of sediment and 0.65 lbs-TP/ton of sediment.*
  - V = 2,680 cf/yr
  - Soil bulk density = 93.6 lb/cf (default value)

  - **TN = 93 lbs-TN/yr**
  - **TP = 82 lbs-TP/yr**

- Step 3: Sediment Removal = [125.4 tons/yr] * [0.530 (site specific weighted average for percentage of silts/clays obtained during sediment sampling; this value was used instead of the VA default sand reduction factor)] * [100%]
  - *Note: No 50% bank instability reduction was used since proper bank grading and vegetation practices were included in the project design. The shoreline management project applicant provided detailed bank stability analysis to the local reporting agency to document that no additional sediment and associated pollutants were expected to enter the nearshore waters and included the following conditions: 1) the project was graded and vegetated so that the bank was stable and 2) excess sediment was removed offsite so that the sediment did not enter the nearshore waters. Bank analysis demonstrated the site had bank stability with minimum risk of erosion. This was coordinated with the local reporting authority to ensure proper methods, reporting, and requirements were fulfilled and were accepted by that authority so that the project met this basic qualifying condition.*
  - **Sediment Removal = 66.5 tons/yr**
  - **TSS = 4133,000 lb-TSS/yr**

Protocol 2 – Denitrification

Area of marsh planting = 0.21 acres
Denitrification pollutant load reduction: 85 lb TN/acre/yr

Protocol 2 total project pollutant load reduction:

- TN = 85 lbs-TN/acre/yr * 0.21 acres
- **TN = 17.9 lbs-TN/yr**

Protocol 3 – Sedimentation

Area of marsh planting = 0.21 acres
Sedimentation pollutant load reduction: 5.289 lb TP/acre/yr and 6,959 lbs TSS/acre/yr

Protocol 3 total project pollutant load reduction:

- TP = 5.289 lbs-TP/acre/yr * 0.21 acres
- TSS = 6,959 lbs-TSS/acre/yr * 0.21 acres

- **TP = 1.1 lbs-TP/yr**
- **TSS = 1,461 lbs-TSS/yr**

Protocol 4 – Marsh Redfield Ratio
Area of marsh planting = 0.21 acres
Marsh Redfield Ratio pollutant load reduction: 205 lbs TN/acre and 9 lbs TP/acre

Protocol 4 total project pollutant load reduction:

- TN = 205 lbs-TN/acre * 0.21 acres
- TP = 9 lbs-TP/acre * 0.21 acres

- **TN = 43.1 lbs-TN**
- **TP = 2 lbs-TP**

Virginia Example 2 total pollutant load reductions are the sum of Protocol 1, Protocol 2, Protocol 3, and Protocol 4 provided in Table 16.

Table 16. Virginia Example 2 total pollutant load reductions. Note the TN and TP pollutant load for Protocol 4's marsh Redfield ratio is a ONE TIME credit realized in year 1 but not in subsequent years.

Pollutant	Protocol 1 Pollutant Load Reduction (lb/yr)	Protocol 2 Pollutant Load Reduction (lb/yr)	Protocol 3 Pollutant Load Reduction (lb/yr)	Protocol 4 Pollutant Load Reduction (lb)[1]	Year 1 Total Pollutant Load Reduction (lb/yr)[2,3]
TN	93	17.9	NA	43.1	154
TP	82	NA	1.1	2	85
TSS	133,000	NA	1,461	NA	134,461

[1]Marsh Redfield Ratio pollutant load reduction if a one-time credit.
[2]The TN and TP totaled here are for the first year and include the one-time credit for the Marsh Redfield Ratio. In subsequent years there will be no TN or TP pollutant load reduction for this protocol.
[3] This practice was 500 linear feet, had an erosion rate of 3 ft/yr, had a bank height of 3 feet, and had 0.21 acres of vegetation. See other site specifics in the project description.

Figure 7. Virginia DOD site used for Example 1.

Figure 8. Virginia City Farm site (B-1) used for Example 2.

Figure 9. Virginia City Farm site (B-2) used for Example 2.

Section 6. Accountability and Unintended Consequences

Shoreline management practices must be accounted for and verified to maintain the function and therefore the Chesapeake Bay water quality protection that we track as the pollutant load reductions outlined here. The reporting, tracking, and verification parameters are provided.

The Panel recognizes that shoreline management projects as defined in this report may be subject to authorization and associated requirements from federal, State, and local agencies. The recommendations in this report are not intended to supersede any other requirements or standards mandated by other government authorities. Consequently, some shoreline management projects may conflict with other regulatory requirements and may not be suitable or authorized in certain locations. Therefore, close and continued coordination with the federal, State, and local agencies will be necessary.

The panel recognizes that shoreline management practices are an ecosystem trade off and these recommendations were made with science that may be updated (Section 7). The identified unintended consequences are provided.

6.1 Reporting, Tracking, and Verification

Reporting, tracking, and verification are needed to ensure that the shoreline management practices are performing as designed. The CBPO's BMP Verification Review Panel is charged with developing verification recommendations that the States in the Chesapeake Bay Partnership can use to develop specific verification protocols to confirm continual nutrient and sediment reductions from Chesapeake Bay watershed BMPs. The CBPO requires robust protocols for reporting, tracking, and verification to support the TMDL goals.

The panelist's experience and research determined that the local governments may not always report the shoreline management practices to the state and that the state may report the shoreline management practices as urban stream restoration to the EPA CBPO. Currently, there are a variety of systems to report, track, and verify shoreline management practices at the local government level and at the state level. In addition to multiple systems for reporting, tracking, and verifying, the data extent, duration, and quality of data varies. The Panel recommends the following actions to report, track, and verify shoreline management for credit towards the Chesapeake Bay TMDL.

Currently, shoreline projects are reported from local governments to the state agency responsible for tracking progress of the Watershed Implementation Plans and MS4 permits using existing conduits/tools to acquire information. The states then report to the CBPO through National Environmental Information Exchange Network (NEIEN). Although jurisdictions may enter shoreline management practices into NEIEN and the supporting CAST, VAST, or MAST, the CBPO has no record of these projects reported. The NEIEN BMP reporting guidance should be updated to ensure that this practice is correctly reported in NEIEN.

6.1.1 Units for Local Government to Report to State

The local governments should report shoreline management projects to the state based on the state's standard reporting practices. The reporting parameters are provided in Table 17.

The default values will be used in the EPA CBPO modeling tools. The technical requirements for entering the shoreline management practice into Scenario Builder are provided in Appendix C.

Additional data gathered to meet basic qualifying conditions and/or to take the place of default values in the protocols must be thoroughly vetted prior to data collection and fully accepted by the permitting and reporting agency. This ensures that the best practices and best information from these practices are used and reported. For example, the site specific data, such as bank stability information, should be vetted with the permitting and reporting agency. Another example includes, the site specific monitoring data used to calculate and report TN, TP, and/or TSS pollutant load reductions for protocols 1 through 4 should be vetted with the permitting and reporting agency. The default values provided represent the best available information at the time and site specific sampling can provide more accurate pollutant load reduction values for that site. All site specific data must be fully vetted with the permitting and reporting agency to ensure that the information is allowed for Chesapeake Bay TMDL pollutant load reduction credits.

Table 17. Units for local governments to report to state.

Protocol	Parameters to Report	Notes
All Protocols	• Practice type • Year installed • Location coordinates • USGS HUC and/or latitude and longitude at the project center to identify where project is located • Land use(s) • If applicable, acres treated by practice	• All reporting should be coordinated with the local and state permitting and reporting authority to ensure compliance • General reporting requirements for all projects should be followed • If values other than default values are used, these calculations should be reported to the reporting entities specification (e.g., TN, TP, and TSS for sites with site specific sampling data) Records should be kept and available for inspection to relay the data source, calculations made, and other data reported to the state
Protocol 1. Prevented Sediment	• Length (ft) • Height of project (ft) • Erosion rate (ft/yr)	
Protocol 2. Denitrification	• Vegetation surface area (acre) ○ Net increase of vegetation	
Protocol 3. Sedimentation	• Vegetation surface area (acre) ○ Net increase of vegetation	
Protocol 4. Marsh Redfield Ratio	• Vegetation surface area (acre) ○ Net increase of vegetation	

6.1.2 Expected Values

The expected values for TN, TP, and TSS pollutant load reduction will vary based on the following factors:

- Site erosion rate
- Practice length and bank height
- Site specific nutrient values sampled or default values used
- Practice vegetative area

However, the examples provided in Section 5.3 for Maryland and Virginia provide a general framework for the potential TN, TP, and TSS pollutant load reduction values using the protocols provided in this report and the example site conditions.

6.1.3 Tracking

State agencies currently track shoreline management projects using their own databases. In Maryland, MDE collects and tracks the project information to include the tracking number, permit number, effective start date (date of authorization), project type, county, practice type, activity code, and national wetlands inventory (NWI) code. For marsh projects the name, tracking number, permit number, county, latitude, longitude, watershed, hydrologic unit code (HUC) 8-Digit, marsh type, effective start date, length, width, square feet, and acreage are collected and tracked. If the project is a living shoreline the surface area in square feet is also recorded. In Virginia, a tracking number is generated when VMRC receives the permit application for each project. Recently, the VMRC developed a habitat management permit tracking system that includes shoreline management projects. The database includes several parameters such as the tracking number, applicant, locality, waterway, practice type, and linear feet of the project.

6.1.4 Verification

Verification is required for practices to ensure the practice is installed as designed, is maintained, and functions as designed over time. The verification guidance serves to create a record for the responsible party to document and record the practice meets or exceeds benchmarks in the field, recordkeeping, and reporting needed for the pollutant load reduction received. Finally, verification principles outline the evaluation and re-evaluation criteria, timeframe, and process. The verification principles outlined here should support local, state, and federal requirements. Finally, the verification process includes guidance for nonconforming project evaluation.

6.1.4.1 Initial Performance Verification

Initial performance verification involves the responsible crediting party providing post-construction documentation to the reporting agency (local government or state agency). This certification should demonstrate that the project was installed properly and meets or exceeds the restoration objectives. If vegetation was present, the certification should demonstrate the

vegetation is stable and has acceptable vegetation coverage. Stable vegetation thresholds should be defined and consistently used by the responsible party. For example, the threshold for the City of Norfolk, Virginia is 85% vegetation coverage at the site. Initial verification is provided either by the designer, local inspector, or state permit authority as a condition of project acceptance or final permit approval. Initial verification should be done prior to submitting the load reduction to the state tracking database.

6.1.4.2 Duration of Shoreline Management Credit

The shoreline management pollutant load reduction credit is for five years which can then be re-evaluated using local inspection, verification, and reporting protocols.

6.1.4.3 Reporting to the State

The agency that seeks credit for the practice must submit basic documentation to the appropriate state agency to document the nutrient and sediment reduction reported for each individual shoreline management project installed. Localities should check with their state agency for the specific data to report for individual projects.

6.1.4.4 Record Keeping

The crediting agency should maintain an extensive project file for each shoreline management project installed (e.g., construction drawings, credit calculations, digital photos, post construction monitoring, inspection records, and maintenance agreement). The file should be maintained for the lifetime for which the load reduction will be claimed.

6.1.4.5 Future Field Verification to Ensure Project Performance

The crediting agency should conduct inspections once every five years to ensure that individual projects are still capable of removing nutrients and sediments. The crediting agency is the entity doing or overseeing the implementation, such as local governments. States should develop performance standards to determine that projects are functioning as designed.

6.1.4.7 Previously Installed Project and/or Non-Conforming Projects

Past projects and projects that do not conform to these reporting requirements, can receive credit using the *"old rate"* that is equal to the rates in Section 3's Table 5. The new protocols can be applied to projects that were installed less than 5 years from this expert panel report's acceptance at the CBPO to receive credit. However, the credit determined from the new protocols must then be used, regardless of whether it is higher or lower than the credit provided by the old rate.

6.1.4.8 Down-Grading

If a field inspection indicates that a project is not performing to its original specifications, the locality has up to one year to take corrective maintenance or rehabilitation actions to bring it back into compliance. If the facility is not fixed after one year, the pollutant reduction for the project would be eliminated, and the locality would report this to the state in its annual MS4 report or WIP progress updates. If the locality is not an MS4 community or is a non-permitted municipality, they are expected to submit annual progress reports. Finally, the load reduction can be renewed if evidence is provided that corrective actions were performed that restored the practice performance.

6.2 Unintended Consequences

The basic qualifying conditions (
Table 7) are critical for reducing unintended consequences. These conditions provide criteria for the site and project conditions under which nitrogen, phosphorous, and sediment Chesapeake Bay TMDL pollutant load reductions should or should not be provided to a project. Generally, projects can earn credit only if they are implemented at sites at which active erosion can be demonstrated, and credit for armor can only be obtained at sites in which "softer" approaches (living shorelines) are demonstrated to be infeasible or at sites such as port facilities, marine industrial facilities, or other marine commercial area. Ideally, the implementation of shoreline management practices is to improve water quality and ecological conditions. However, it is recognized by the panel that this may not always be the case. The shoreline zone of the Chesapeake is host to many different habitat types such as emergent wetland, SAV, oyster reef, coarse woody debris, mudflat, etc., many of which themselves are known to host higher macrofaunal species densities and diversities than armored shoreline erosion control devices. Two of these habitats, oyster and SAV both, are currently managed by the Chesapeake Bay Program Office with the goal to achieve higher levels of distribution. Additionally, specific minimum SAV acreage requirements have been established to remove a water body from the 303d list of impairments for water clarity. Installation of erosion control devices can be at the expense of these other habitat types. As an example, studies show that reduction in erosion in some cases can negatively impact SAV, and that SAV densities are highest in areas of mid-range erosion rates (Palinkas and Koch, 2012). Therefore, to avoid encouragement of adverse impacts on SAV, credit is not provided for erosion control practices in areas in which SAV is already present. Jurisdiction and, or EPA may choose to not provide credit when another natural resources are adversely affected by the use shoreline management practices.

There are overlaps with the practice in areas such as marsh vegetation plantings that serve another benefit for areas without active erosion. The panel anticipates areas of overlap such as this will be addressed in future panels, such as the wetland panel slated to commence in 2014. In addition, credits should not be provided when another natural resource is adversely impacted. This last point can be complicated. The shoreline zone of the Chesapeake is host to many different habitat types such as emergent wetland, SAV, oyster reef, coarse woody debris, mudflat, etc., many of which themselves are known to host higher macrofaunal species densities and diversities than armored shoreline erosion control devices. Two of these habitats, oyster and SAV both, are currently managed by the Chesapeake Bay Program Office with the goal to

achieve higher levels of distribution. Additionally, specific minimum SAV acreage requirements have been established to remove a water body from the 303d list of impairments for water clarity. Installation of erosion control devices can be at the expense of these other habitat types. As an example, studies show that reduction in erosion in some cases can negatively impact SAV, and that SAV densities are highest in areas of mid-range erosion rates (Palinkas and Koch, 2012). Therefore, to avoid encouragement of adverse impacts on SAV, credit is not provided for erosion control practices in areas in which SAV is already present.

The use of SAV thresholds as a qualifying condition was considered but not recommend by the panel at this time. SAV is a Chesapeake Bay goal and is a habitat to protect. However, the current state of the science did not warrant a basic qualifying condition at this time. SAV research needs were identified (Section 7) to inform future updates and recommendations to this report.

An unintended consequence for shoreline management is the promotion of the practice given the pollutant load reduction credits in the CBWM where practices are located in poorly selected sites or where they are not needed. However, jurisdictional approvals and the permitting process would likely minimize the unintended consequences. Shoreline protection structures are justified only if there is active, detrimental shoreline erosion which cannot be otherwise controlled; if there is rapid sedimentation adversely impacting marine life or impairing navigation which cannot be corrected by upland modifications; or if there is a clear and definite need to accrete beaches. A watershed management approach should be used to identify and use appropriate BMPs in the watershed prior to the shoreline whenever possible. In addition, the comprehensive approach to shoreline management (see Appendix D) can support better shoreline management practice implementation to meet Chesapeake Bay goals.

Shoreline management practices should be properly located on the site, should include the proper BMP type for that site. The local policy and permitting authority can guide these decisions. For example, Maryland is updating the structural shoreline stabilization maps that will be used for guidance. These maps provide guidance for areas designated as appropriate for structural shoreline stabilization measures. MDE is the agency responsible for the development and maintenance of the maps.

Each shoreline management project should be assessed based on the guidance provided by the local permitting authority, the best professional judgment of experts in the field, and can be supported by the principles and benchmarks presented in this document (Appendix G).

Section 7. Future Research and Management Needs

The Panel included experts in the field and as part of its work intensively reviewed relevant research to provide the recommendations in this report. However, the available information used to make management decisions is compiled and summarized to make broad management decisions, is often incomplete, and often superseded when new information is gathered. The Panel recognizes these limitations and provides the following recommendations for future management and research needs. These recommendations provide guiding principles to advance shoreline management in the future.

7.1 Panel's Confidence in Recommendations

One of the key requirements of the BMP Review Protocol is for the Expert Panel to assign its degree of confidence in the removal rates that it ultimately recommends (WQGIT, 2010). While the Panel considers this report's current recommendations are an improvement to the previously approved CBPO removal rates, the Panel clearly acknowledges that scientific gaps exist to our understanding for shoreline management. Examples of information gaps that point to research needs included:

- Site specific shoreline management erosion rates and associated estimates of TSS, TN and TP loads;
- Information on shoreline management type and its associated effectiveness to protect the nearshore water quality (i.e., prevent sediment and associated TN and TP loads); and
- Shoreline management type and the associated habitat protection and restoration.

The Panel worked to reach consensus for the management recommendations included in this report. However, the Panel included a minority dissenting view for the following recommendations: 1) allow pollutant load reduction for hard shore armor; and 2) allow pollutant load reduction for sandy sediments. See Appendix L for the panel's dissenting views. Based on the available information, Expert Panel expertise, and outlined panel process these decision points were vetted with the panel members, voted on, and this report contains the recommendations reached through the panel process (see *Section 1.2 Panel Process*; WQGIT, 2010; WQGIT, 2012).

7.1.1 Proposed Timeframe for Panel Recommendations Review and Update

The panel proposes that **the report findings should be updated at least every two years** to include new information. The new information can come from additional research, implementation lessons learned, and/or CBPO workgroups and goal implementation teams.

7.2 Proposed Refinements in Next Phase of the CBWM and/or the WQSTM

Implementation of the sediment and nutrient load reductions from shoreline management actions will be operationally accomplished through aggregation of the shoreline management practices through Scenario Builder. The decrease in nutrient and sediment loads will be accomplished

through an appropriate decrement of the sediment and nutrient loads from watershed land-river segments adjacent to the tidal waters simulated by the WQSTM (Figure 10). Location of the shoreline management action by latitude and longitude, if available, will correctly place the shoreline management action in the correct land-river segments. Refinements will be proposed in the next phase of the CBWM and/or the WQSTM to accomplish better simulation for the land-river segments adjacent to tidal waters.

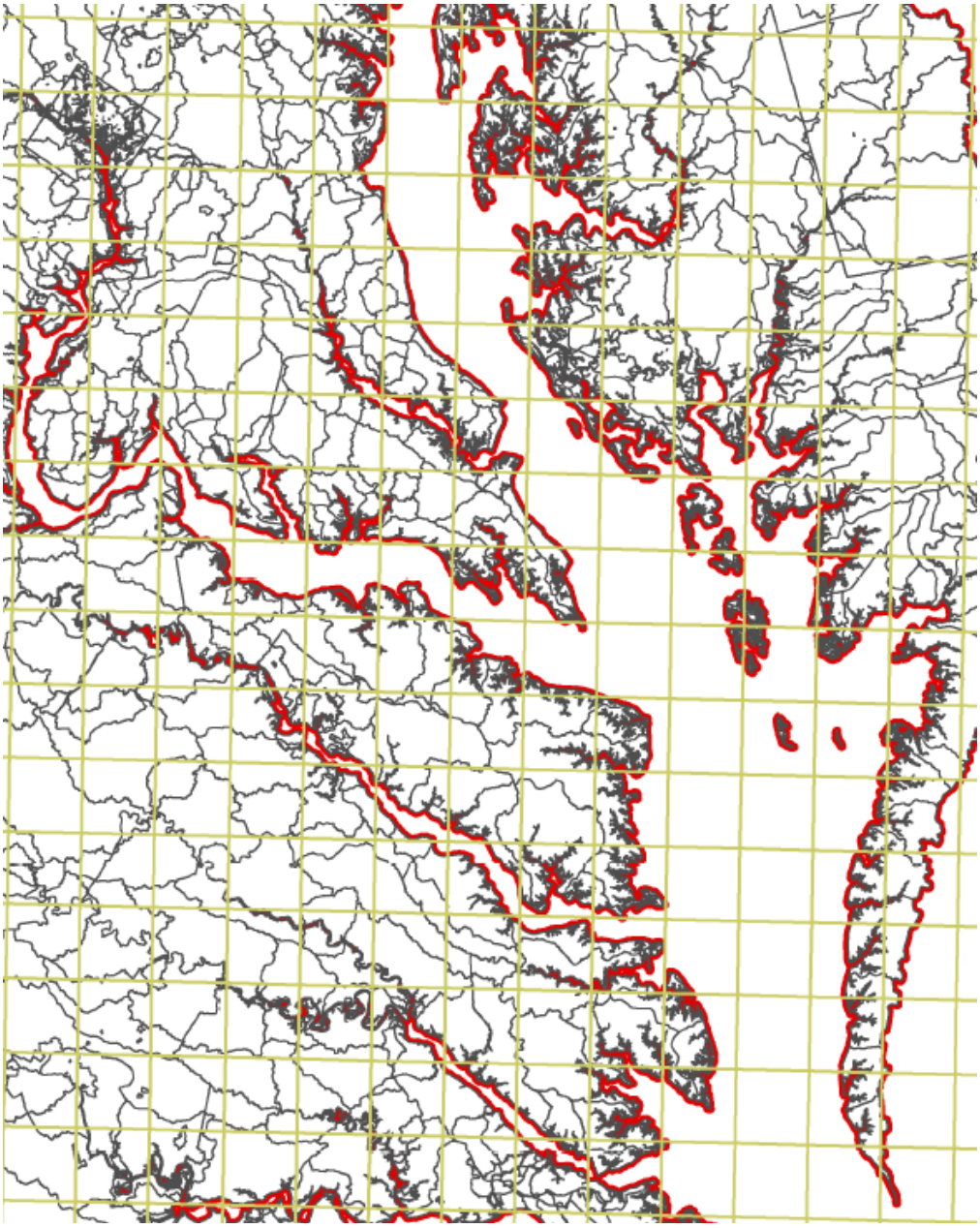

Figure 10. Watershed Model land-river segments shown in black and adjacent tidal waters are outlined in bold red.

7.3 High Priority Management and Research Recommendations

The Panel recognized that the Panel report's recommendations were based on the best available information. This synthesis of the available information and discussion in the Expert Panel process led to a list of high priority management and research recommendations. These research recommendations are not exhaustive and should be added to as more data needs, information needs, and/or policy needs are recognized.

Table 18 outlines the management and research recommendations and their rationale. There is a need to conduct, review, and synthesis new findings so that the shoreline management practices are represented to the best extent possible in the models and on the ground. This research should be used to update this panel recommendations included in this report.

Table 18. High priority management and research recommendations.

Research Recommendation	Rationale
• Update the shoreline erosion rates so that the states have a complete dataset	A complete shoreline erosion rate that is up-to-date is needed to calculate the prevented sediment. The reported shoreline erosion data and modeling is based on the best available information. However, there are data limitations that include but are not limited to the following: 1) the reported total sediment loading from shoreline erosion from Cerco et al. (2010) was approximately half the value reported from Langland and Cronin (2003); 2) shoreline areas of limited or no data exist.
• Research the nearshore sediment erosion and associated nutrient pollutant load	There is a need to account for the nearshore erosion to better estimate the practice's prevented sediment. Study recommendations include using updated erosion rates and adding 0.5 meters to upland bank height for future 2050 estimates of shoreline erosion loads as the percentage of sediment load and re-calculate the contribution of bank and nearshore sediment loading (Hardaway et al., 2009). The addition of 0.5 meters to the upland bank height when estimating future loads from shoreline erosion is based on the best estimate of relative sea level rise by 2050 in the Chesapeake (Boesch et al., 2013).
• Identify SAV habitat basic qualifying condition criteria • Identify additional habitat basic qualifying condition	There is a need to research and identify SAV habitat where future growth can be supported, report shoreline erosion control structure impacts to SAV, and develop policy recommendations based on these findings. Also, habitat research, the associated basic qualifying conditions, and the resulting policy recommendations are needed. This

Research Recommendation	Rationale
	research can inform the Chesapeake Bay TMDL pollutant load reduction basic qualifying condition criteria that promote SAV and other nearshore habitat. Note: A large body of research examining the impact of shoreline types, including shoreline erosion control structures, on SAV and other habitats and species will be available for the next expert panel's consideration (i.e., in two years).
• Gather more site specific TN, TP, and TSS bulk density data, bank stability, and sand content • Develop bank sand content thresholds for habitat protection and for CB TMDL pollutant load reductions	There is a need to use site specific sediment, nutrients, and bulk density data instead of the default values from published literature. Also, there is a need to use site specific bank stability and sand content values. This updated site specific data can support better local and default pollutant load reductions. Finally, banks with high sand content contribute to nearshore habitat. A bank sand content threshold is needed to guide CB TMDL pollutant load reduction as an incentive or disincentive to protect habitat that would benefit from that bank sand.
• Research and refine the fines (silt/clay), organic, and sand component of the shoreline • Refine the pollutant load reduction and/or appropriate model to incorporate refined fines, organic, and sand findings	There is a need to recognize and quantify the shoreline sediments. The sediment components (e.g., fines (silt/clay), organic, and sand) correlate with the TN and TP pollutant load. In addition, sand can benefit the nearshore habitat; therefore, sand may not be a pollutant and can benefit the nearshore habitat/water quality.
• Update guidance for the following site evaluation parameters: o Map appropriate areas for shoreline management practices o Design considerations o Selecting shoreline management practices o Marsh planting, sills, marsh toe revetments, and breakwaters o Level of protection, encroachment, costs, and permits o Case studies provided for each strategy that discuss the site setting, design elements, and performance o Develop and include design examples to facilitate the design process	There is a need to provide updated guidance for site evaluations that include map parameters and site parameters to better guide practice selection and placement (see also Hardaway et al., 2009).

Research Recommendation	Rationale
• Research new shoreline management practices (e.g., oyster reefs) and recommend TN, TP, and TSS pollutant load reductions	There is a need to keep up with the evolving science for new shoreline management practices to include researching the pollutant removal, maintenance, lifespan, and other parameters
• Monitor shoreline management practice efficiency, maintenance consideration, and lifespan	There is a need to monitor the shoreline management practices to better refine the pollutant load reductions based on updated efficiency, maintenance considerations, and lifespan.
• Improve sea level rise estimates	Sea level rise impacts are not considered in the WQSTM and represent an additional research need.
• Revisit the shoreline management information and update the panel report • Recommend a two year panel reassessment period	There is a need to use adaptive management that reviews existing information and new information to update the panel report recommendations. These high priority research recommendations provide better information for models, for local planning, for water quality, and for habitat in the Chesapeake Bay.

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Appendix A. Shoreline Panel Meeting Minutes

The panel notes are provided here without the appendices to conserve space. For more information email Sadie Drescher at sdrescher@chesapeakebay.net

Meeting Minutes
Shoreline Erosion Control Expert Panel
Meeting 1
Monday, January 28, 2013

EXPERT BMP REVIEW PANEL **Shoreline Erosion Control Practices**		
Panelist	***Affiliation***	**Present?**
Jana Davis, Ph.D.	CBT/HGIT	Yes
Kevin DuBois, PWS, PWD	City of Norfolk, VA	Yes
Jeff Halka	MD Geologic Survey	Yes
Scott Hardaway, P.G.	VIMS Shoreline Studies Program	Yes
George Janek	USACOE, Norfolk District	Yes
Lee Karrh	MD DNR	Yes
Evamaria Koch, Ph.D.	UMCES	Yes
Lewis Linker	CBPO	Yes
Pam Mason	VIMS Center for Coastal Resource Mgt	Yes
Ed Morgereth, MS ISS	Biohabitats	Yes
Daniel Proctor, P.E.	Williamsburg Environmental Group	Yes
Kevin Smith	MD DNR	Yes
Bill Stack, P.E.	CWP, CBPO	Yes
Steve Stewart/Nathan Forand	Baltimore County Dept of Environmental Protection and Sustainability	Yes/Yes
Bill Wolinski, P.E.	Talbot County Dept of Public Works	No
Sadie Drescher	CWP (facilitator)	Yes
Hannah Martin	HGIT/CRC/CBPO (support)	Yes
Non - Panelists: Jeff Sweeney (CBPO), Matt Johnson (CBPO/UMD) Yes/Yes		

ACTION ITEMS by DISCUSSION AREA

Review of the Panel Charge, the BMP Panel Review Process, and Panelist Responsibilities

- Panel members understood role, agreed with panel charge, and agreed to delete "urban" from panel title. Sadie will update the expert panel charge and present at the next panel meeting.

Panel Member Feedback and Next Steps

- Sadie will update SharePoint site with existing documents and start a database by 2/3/13, then provide panel with link.
  - **SharePoint Site Information**
    https://sites.tetratech.com/projects/100-CB_BMP_Review/default.aspx
    General username: ttsvcs\cbuser
    General password: Review2012
- Panel to send resource documents by 2/11/13 to Hannah Martin at martin.hannah@epa.gov and CC sdrescher@chesapeakebay.net
- Hannah to upload documents to SharePoint; Sadie to create resource database.
- Sadie to update the expert panel charge.
- **Mark your calendars**: panel meetings are scheduled for the last Monday of every month from 1:00 PM to 3:00 PM (EST).

- The next panel meeting is February 25th in Suite 305(A) (305 is located in the red building above Carroll's Creek restaurant). Conference Line: 866-299-3188
  Code: 267-985-6222. Sadie will provide the agenda by 2/18/13.

Chesapeake Bay Watershed Model (CBWM) 101 & Chesapeake Bay Water Quality and Sediment Transport Model (WQSTM) presentation by Lewis Linker (CBPO)

- Lewis to send supporting documents cited during the presentation to the group (i.e., Cerco et al., 2013; CBP, 2006).
- Eva Koch to share shoreline and SAV related data.

Question and Answer/Wrap Up

- Sadie to contact MDE to solicit panel support and/or plug POC into process.
- Sadie to follow up with panel member(s) absent.
- Sadie to coordinate with presenters for the next meeting.
- Sadie to provide panel with meeting minutes, next meeting logistics, and action items by 2/3/13.

MINUTES

(action items underlined)

1. Call to Order and Panelist Introductions

- Sadie Drescher called the meeting to order at 10 am.

2. Review of the BMP Panel Review Process, Panel Charge, and Panelist Responsibilities

- Each of the panelists introduced themselves and provided their expertise and how this background can support the panel. Sadie outlined the "Water Quality Goal Implementation Team (WQGIT) BMP review protocol" (2010 with 2011 addendum) that the panel will follow. Sadie asked the panel whether they understood their role and had any questions about the protocol.
- Sadie noted that representatives of industry or environmental advocacy groups were not considered appropriate panel members, but will be provided a comment period and the panel will consider the comments, as necessary. Also, members of these groups could be asked to present to this panel, if needed.
    - The panel concurred with the protocol process and their role.
    - The panel noted no conflict of interest with any panel members.
- Sadie then outlined that the facilitator's role was to facilitate the panel, organize the research and methods, and document its progress, but not be involved in the decision-making process.
- Sadie reviewed the expert panel "Proposed Charge for the Urban Shoreline Erosion Control Expert Panel" and solicited feedback.
- Sadie indicated that the under the expert panel work, the panel's final product is a technical memorandum that describes the definition, rates, qualifying conditions, and reporting mechanisms for this practice with an appendix that summarizes the scientific data evaluated.

3. Panel Member Feedback and Next Steps

- A SharePoint website hosted by TetraTech is available for the panel's literature review. Sadie and Hannah have upload capabilities. All panelists have download capabilities using this information:
    - **SharePoint Site Information**
      https://sites.tetratech.com/projects/100-CB_BMP_Review/default.aspx
      General username: ttsvcs\cbuser
      General password: Review2012
- Panelists, CBPO staff, and USWG agreed that "urban" should be removed from the title.
- Jana Davis asked why shoreline erosion control practices were given the same sediment and nutrient reduction efficiencies as stream restoration. Jeff Sweeney said that was the best data available at the time and that part of the panel's charge is to determine if there is evidence to suggest updated efficiencies.
- Sadie will update the expert panel charge and present at the next panel meeting.
- Panelists agreed that future meetings will be held on the last Monday of every month from 1:00 PM to 3:00 PM (EST), with the option of attending via webinar/conference line. This panel is anticipated to be active for about 6 to 8 months, as needed.
- Bill Stack explained that when the final report is completed it will be shared at a meeting attended by multiple workgroup chairs (e.g., Watershed Technical Work Group, Agriculture Workgroup, etc).
- Matt Johnson suggested that the panel technical memorandum go through a single 30 to 60 day comment period so that the panel can address one set of revisions. Sadie suggested coordinating panel work with the Ag work group.
- Bill Stack described how the Urban Stream Restoration Panel technical memorandum process went and was currently moving through the CBP and its work groups.

4. Chesapeake Bay Watershed Model (CBWM) 101 & Chesapeake Bay Water Quality and Sediment Transport Model (WQSTM) presentation by Lewis Linker (CBPO)

- Lewis Linker (CBPO) gave two presentations to provide the necessary background information on the CBWM and the WQSTM (aka Estuary Model).
- Lewis to send supporting documents cited during the presentation to the group (i.e., Cerco et al., 2013; CBP, 2006)
- Currently, the shoreline erosion control BMP "credit" or nutrient and sediment efficiency is in the CBWM while shoreline erosion rate and habitat impact are in the WQSTM.
- Eva Koch noted that the TSS includes sand; her research indicates sand can help support nearshore habitat. It may be useful to focus on clay and/or silts. **Eva** to share data.

5. Question and Answer/Wrap Up

- Part of the expert panel process will be to research and recommend updated shoreline erosion control practice nutrient and sediment efficiencies.
- Kevin Smith noted that shoreline erosion control practices (e.g., bulkheads) may stop all erosion but can cause erosion issues in other areas. Also, if the panel recommendations favored widespread implementation because of high sediment and nutrient reduction credits, ; there could be unintended consequences to the nearshore habitat (e.g., SAV). The panel should be careful in recommendations with unintended consequences.
- Steve Steward asked whether the tidal shoreline erosion is part of the wasteload allocation given to MS4 permits and Lewis said, "No." Despite this, Steve said that MDE said the MS4 permits can use Shoreline Stabilization BMP to help them meet their permit requirements and that they have developed their own protocol for determining sediment and nutrient reduction efficiencies.
  - Steve Stewart offered that Nathan Forand to present this protocol at the next meeting.
- Bill Stack asked whether the CBP have looked at the existing sediment reduction credits and compared them to estimated shoreline erosion rates. Lewis said they had not but showed a slide of erosion rates estimated by the Maryland Geological Survey (MGS) (via Jeff Halka). A quick look at the data indicated that the existing sediment reduction credits per unit length of shoreline are extremely small compared to the measured erosion rates suggesting that the credits are perhaps too low. The panel agreed that using the MGS shoreline erosion rates would be very useful in establishing "new" reduction credits.
- There may be an opportunity to provide CBP with updated tidal erosion information.
- It may be helpful to hear the process and lessons learned from the Stream Restoration expert panel that dealt with similar issues Bill Stack can present about this topic at the next meeting.
- Sadie asked if any group was missing from the panel. Jana Davis asked if the panel members had wetland expertise. Panel agreed to reach out to CBP and/or experts in the field, as needed.
- Sadie will contact MDE to solicit panel support and/or plug point of contact (POC) into process.
- Kevin Du Bois asked if the panel should consider operation and maintenance. Answer: Yes.
- Next meeting topics will include:
  - Example shoreline erosion control practice types (Kevin Smith, Division Chief Riparian & Wetland, MD Department of Natural Resources)
  - MD and VA policy background for shoreline erosion control practices
    - Tony Watkinson, VA (Chief, Habitat Management Division, Virginia Marine Resources Commission)
    - Rick Ayella Chief, MD (Tidal Wetlands Division Maryland Department of the Environment)
  - Example nutrient and sediment efficiencies for shoreline erosion control BMPs (Nathan Forand, Baltimore County)
  - Urban Stream Restoration Panel process and experience (Bill Stack)
  - Literature review update and literature review assignments (Sadie)

6. Set Next Meeting Date and Adjourn

- The panel agreed to meet on the last Monday of the month from 1:00 PM to 3:00 PM (EST) at the Chesapeake Bay Program Office in Annapolis, MD.
- Next meeting is February 25 from 1pm to 3pm in Room 305(A); 410 Severn Avenue, Annapolis, MD.
  - Sadie will provide a draft agenda at least one week prior to the meeting.

Meeting Minutes
Shoreline Erosion Control Expert Panel

Meeting 2
Monday, February 25, 2013

EXPERT BMP REVIEW PANEL **Shoreline Erosion Control Practices**		
Panelist	***Affiliation***	**Present?**
Jana Davis, Ph.D.	CBT/HGIT	Yes
Kevin DuBois, PWS, PWD	City of Norfolk, VA	Yes
Jeff Halka	MD Geologic Survey	No
Scott Hardaway, P.G.	VIMS Shoreline Studies Program	Yes
George Janek	USACOE, Norfolk District	Yes
Lee Karrh	MD DNR	Yes
Evamaria Koch, Ph.D.	UMCES	No
Lewis Linker	CBPO	No
Pam Mason	VIMS Center for Coastal Resource Mgt	Yes
Ed Morgereth, MS ISS	Biohabitats	Yes
Daniel Proctor, P.E.	Williamsburg Environmental Group	Yes
Kevin Smith	MD DNR	Yes
Bill Stack, P.E.	CWP, CBPO	Yes
Steve Stewart/Nathan Forand	Baltimore County Dept of Environmental Protection and Sustainability	Yes/Yes
Bill Wolinski, P.E.	Talbot County Dept of Public Works	Yes
Sadie Drescher	CWP (facilitator)	Yes
Hannah Martin	HGIT/CRC/CBPO (support)	Yes
Non - Panelists: Jeff Sweeney (CBPO), Tony Watkinson (VMRC), Denise Clearwater (MDE)		

ACTION ITEMS by DISCUSSION AREA

Review of Action Items, Approve Minutes, and Approve Panel Charge

- The panel approved the last meeting minutes (1/25/13) and the panel charge
- Eva Koch to share shoreline and SAV related data (carry over action item from 1/24/13)

Shoreline Erosion Control Practice Examples

- Kevin can share the preliminary results with the panel for the BMPs assessed.

Literature Review Update and Assignments

- Expert panel members to coordinate reviews with Sadie
- Sadie to provide literature review guidance and solidify papers reviewed with members
- Steve Stewart suggested there were a few sentinel papers that the entire panel should review (e.g., Langland and Cronin, 2003). Sadie to provide guidance to panel.
- Pam Mason will coordinate with Sadie and/or other panel members to search the peer reviewed journal databases for wetlands papers and other resources.

Question and Answer/Wrap Up

- **Mark your calendars**: Panel meetings scheduled for the last Monday of every month from 1:00 PM to 4:00 PM (EST).
  - The next panel meeting is March 25th in Suite 305(A) (305 is located in the red building above Carroll's Creek restaurant). Sadie will provide the agenda by 3/18/13.
  - The panel agreed to use 3 hours for at least the next two literature review work sessions.
  - April through November meetings will be held at the Fish Shack.
- Sadie to follow up with panel member(s) that could not attend.
- Sadie to coordinate with presenters for the next meeting.
- Sadie to provide panel with meeting minutes, next meeting logistics, and action items by 3/18/13.

MINUTES

(action items underlined)

Review of Action Items, Approve Minutes, and Approve Panel Charge

- Meeting 1 minutes and updated panel charge approved
- Update: Dropped "urban" from panel name and let the Urban Stormwater Workgroup know

Shoreline Erosion Control Practice Examples, Kevin Smith, Division Chief Riparian & Wetland, Maryland Department of Natural Resources (MD DNR)

- Presentations main points were:
  - There are three major categories of approaches typically used:
    - Structure (bulkhead, armoring system)
    - Non Structural (sand, marsh plantings), nonstructural projects often use structural components
    - Hybrid (combo of structure and planting approach)
  - Historic BMPs do not always fit well into these categories or comply with updated scientific based practices. Some evidence of public land/private land issues.
  - Site energy intensity impacts the shoreline erosion control approach
    - Low Energy Sites – can use sand fill with coir log, sand placement with rock sand, and/or containment structures and plantings
    - Medium Energy Site – can use low profile gapped sills and/or high profile sills
    - High Energy Site – can use gapped breakwaters and/or large and small scale headland breakwaters
  - BMP type depends on factors such as: fetch, nearshore bathymetry, shoreline bank condition, orientation, bottom substrate, and/or geographic area. No "one size fits all" and several adaptive management decisions needed.
- Q&A:
  - Are there studies on how well the presented approaches work? Yes, but it depends on where you are and what you are trying to accomplish. Karen Duhring at VIMS has done a review of living shorelines in VA. MD DNR's Bhaskaran Subramanian reviewed ~200 sites to determine their status. Kevin can share the preliminary results with the panel.
  - Talbot County, MD faces challenges that can include eroding shorelines and regulatory obstacles. MDE has guidance maps on where each approach might be appropriate. Might be valuable to determine the most economically effective approach.
  - Virginia is developing a general permit for living shoreline projects to ease permitting requirements.

VA Shoreline Erosion Control Policy Overview, Tony Watkinson, Chief, Habitat Management Division, Virginia Marine Resources Commission (VMRC)

- Presentations main points were:
  - Virginia is a low water state—Jurisdictional boundaries the state regulates for shoreline projects in VA; the commonwealth owns to low waterline. Most coastal counties adopted the wetlands ordinance or the dunes/beaches and wetlands ordinance.
  - Virginia uses a joint permit application process. Application is submitted to VMRC, and then passed to wetland review boards, USACE, VDEQ, VIMS. VIMS provides scientific review for permits, when needed.
  - The wetland review boards are county or city wide local government boards that have the opportunity to adopt ordinances for wetlands and/or dunes/beaches. The boards are appointed and are responsible for scheduling and overseeing public hearings for each application within 60 day of the application submission and then issuing/declining the permit within 30 days. If a permit is issued by a review board, VMRC reviews the decision. Only a handful of appeals are submitted each year.
  - VMRC has several existing guidance documents that Tony referenced
  - Senate Bill 964 was passed in 2011 and the following actions resulted:
    - Develop general permit for living shoreline projects
    - Define and encourage living shoreline projects
    - Work with VIMS to develop integrated guidance
    - Even though general permit is not in place yet, there are current regulatory mechanisms to approve living shorelines projects without undue paperwork/time/money restraints. Under the new permit, the applicants will not go through public hearing process
- Q&A:
  - What is the incentive for the counties to adopt the ordinances? It gives local authority and control and is designed for local citizens to make local decisions that impact their water quality, habitat, etc. Some boards do not adopt

both ordinances due to finances, staff support, or they do not receive many applications. Cities and counties that want to restore lost wetlands benefit from having professional wetland permit review staff especially now that TMDL credits are available.
    - Are there any potential problems or conflicts with implementing structural components in areas with potential emerging SAV? SAV, whether it is present or potentially present, is a major factor that is weighed during the application process. Usually, resources such as SAV and oyster reefs take priority in resource tradeoff debates. Those permits that are granted might require SAV mitigation.

MD Shoreline Erosion Control Policy Overview, Denise Clearwater, Special Projects Coordinator Wetlands and Waterways Program, Maryland Department of the Environment (MDE)

- Presentations main points were:
    - MDE makes decisions and recommendations on state wetland projects.
    - Bulkheads and stone revetments were past practices found in MD, since 80's MD has encouraged non structural practices such as living shorelines for the habitat benefits.
    - 2008-Living shorelines Act passed which made living shorelines the preferred option
    - Various exceptions are noted and include such things as excessive erosion, severe tides, limited space, etc.
    - While MDE provides guidance online and has staff available for field site visits to support site selection
    - MDE provides application process training
    - MDE has guidance available online that includes fact sheets, tech documents, etc.
        - Working with UMD looking for habitat benefits
    - New documents under development include:
        - Checklists
        - Updated sample plans for bulkheads, revetments, and living shorelines

Nutrient and Sediment Efficiency Calculation, Nathan Forand, Baltimore County Department of Environmental Protection & Sustainability, Natural Resource Specialist

- Presentations main points were:
    - An example was provided to calculate the pollutant load reduction for a shoreline erosion control project's TN, TP, TSS load reduction per year based on Ibison, 1992
        - V = LEB (V is volume eroded; L is shoreline length; E is erosion rate; B is bank height) determines the volume of erosion the BMP prevents
        - Data gathered from plans, MD DNR coastal atlas, etc.
        - Nearshore erosion and soil type (fines vs coarse) not accounted for in example
    - Why calculate? Required to meet local TMDL and CBP TMDL
- Q&A:
    - What efficiency did you use? Assumed the BMP was 100% efficient
    - How do we practically quantify each year that the practices are still functioning as designed? The data is found by revisiting old sites to see how they have evolved and if they are still functioning. Panels have to account for this by creating verification protocols.

Urban Stream Restoration Expert Panel Process and Experience, Bill Stack, P.E. CWP, Deputy Director & CBP Sediment and Stream Coordinator

- Presentations main points were:
    - The stream restoration panel met for about one year to develop a final report that was reported to the USWG, Agriculture Workgroup, Watershed Technical Workgroup (TBD), and went out for public review
    - The report included definitions, an extensive literature review, guidance for verification and preventing double counting, guidance for BMP submittal to the state agency, recommended 3 stream restoration protocols, and recommended a 6 month "test drive period" since these protocols were new
    - The panel developed recommended TN, TP, and TSS removal rates for the different types of stream restoration projects even though there were few scientific studies reporting these values, i.e., the panel had to use the best available information. The panel used "level of safety" for recommendations.
    - The panel did not want to surpass the existing local, state, or federal permitting authorities (e.g., specific verification recommendations) and felt permitting issues were not part of the Panel's charge
- Q&A:
    - What does the five year duration entail? The pollutant reduction credit is good for five years and then must "renew" through inspection and verification.

- What was the magnitude of erosion rates? BANCS method is controversial if not properly applied, it can be off as much as 100%, however a study is Philadelphia suggested that this is better than what was previously used. The Panel also recommends states develop an equivalent alternative or modify this methodology to improve the accuracy

Literature Review Update and Assignments, Sadie Drescher

- SharePoint site with existing documents and meeting information is online
  - **SharePoint Site Information**
    https://sites.tetratech.com/projects/100-CB_BMP_Review/default.aspx

General username: ttsvcs\cbuser

General password: Review2012

  - Panel members can download papers. Let Sadie know if you have any problems.
- Main points/notes:
  - Expert panel members to coordinate reviews with Sadie
  - Sadie to provide literature review guidance and solidify papers reviewed with members
    - Use the panel literature review matrix as per the WQGIT Expert Panel protocol
    - "Water Quality Goal Implementation Team (WQGIT) BMP review protocol" (2010 with 2011 addendum)
    - Each resource summary should contain the two to three key findings
  - Steve Stewart suggested there were a few sentinel papers that the entire panel should review (e.g., Langland and Cronin, 2003). Sadie to provide guidance to panel.
  - Need to add wetlands research papers
  - Kevin Du Bois will look at one of the report tracking papers and some of the shoreline erosion control practices papers. Kevin to coordinate this with Sadie.
  - George Janek will review some shoreline erosion control practices papers. George to coordinate reviews with Sadie.
  - Scott will review his papers
  - Lee Karrh to coordinate reviews with Sadie
  - Pam Mason will coordinate with Sadie and/or other panel members to search the peer reviewed journal data base for wetlands papers and other resources.

Question and Answer/Wrap Up

- **Mark your calendars**: Panel meetings scheduled for the last Monday of every month from 1:00 PM to 4:00 PM (EST).
  - The next panel meeting is March 25th in Suite 305(A) (305 is located in the red building above Carroll's Creek restaurant). Sadie will provide the agenda by 3/18/13.
  - The panel agreed to use 3 hours for at least the next two literature review work sessions.
  - April through November meetings will be held at the Fish Shack.
- All the presentations are on the SharePoint site
- Sadie to follow up with panel member(s) that could not attend.
- Sadie to coordinate with presenters for the next meeting.
- Sadie to provide panel with meeting minutes, next meeting logistics, and action items by 3/18/13.

Meeting Minutes
Shoreline Erosion Control Expert Panel
Meeting 3
Monday, March 25, 2013

EXPERT BMP REVIEW PANEL **Shoreline Erosion Control Practices**		
Panelist	***Affiliation***	**Present?**
Jana Davis, Ph.D.	CBT/HGIT	Yes
Kevin Du Bois, PWS, PWD	City of Norfolk, VA	Yes
Jeff Halka	MD Geologic Survey	Yes
Scott Hardaway, P.G.	VIMS Shoreline Studies Program	Yes
George Janek	USACOE, Norfolk District	Yes
Lee Karrh	MD DNR	Yes
Evamaria Koch, Ph.D.	UMCES	Yes
Lewis Linker	CBPO	No
Pam Mason	VIMS Center for Coastal Resource Mgt	Yes
Ed Morgereth, MS ISS	Biohabitats	No
Daniel Proctor, P.E.	Williamsburg Environmental Group	Yes
Kevin Smith	MD DNR	Yes
Bill Stack, P.E.	CWP, CBPO	No
Steve Stewart/Nathan Forand	Baltimore County Dept of Environmental Protection and Sustainability	Yes/Yes
Bill Wolinski, P.E.	Talbot County Dept of Public Works	Yes
Sadie Drescher	CWP (facilitator)	Yes
Non - Panelists: Jeff Sweeney (CBPO) and Laura Gardner (CWP, support)		

ACTION ITEMS by DISCUSSION AREA

Review of Action Items, Approve Minutes, and Announcements

- The panel approved the last meeting minutes (2/25/13)
- Mark your calendars for upcoming panel meetings that are held on the last Monday of the month from 1pm to 4pm; Next meeting is April 29th 1pm to 4pm in the Fish Shack and remote using AdobeConnect/conference call. Last Monday in May is Memorial Day; panel scheduled May's meeting on May 20th.
  - **April through November meeting dates are: 1) 4/29; 2) 5/20; 3) 6/24; 4) 7/29; 5) 8/26; 6) 9/30; 7) 10/28; and 8) 11/25**

Panel Members Literature Review Report Out

- All panel members to review Langland and Cronin, 2003; Cerco et al., 2013; CBP, 2005; and CBP, 2006
  - Jeff Halka to review Langland and Cronin, 2003 on 4/29 and Lewis Linker to review the other three resources
- Eva Koch to share shoreline and SAV related data on 4/29/13
- Kevin Smith can share the preliminary results with the panel for the BMPs assessed (TBD)
- All panel members to review Langland and Cronin, 2003; Cerco et al., 2013; CBP, 2005; and CBP, 2006
  - Lewis Linker to report out for Cerco et al., 2013; CBP, 2005; and CBP, 2006 on 4/29
  - Jeff Halka to report out for Langland and Cronin, 2003 on 4/29
- Nathan Forand Review
  - Scott Hardaway to check with author for discrepancy in data reported
  - Jeff Halka will bring data and report that has this comparative data, Re: Kevin Dubois Review
  - Panel should consider sampling/laboratory methods for sediment TN, TP, and/or TSS analysis
  - Panel should consider bulk density values used for conversion factor
- Jana Davis Review

- Add three wetland papers to literature review
- J. Halka can present some data on Blackwater Refuge and sediment export estimates

Literature Review Update and Volunteer Assignments

- Sadie will follow up with Jana to get the extra papers cited and Jana's literature review summaries
- Need to find/add wetlands research papers that include efficiency results
- Volunteers and papers to review included:
  - All panel members that didn't review a few papers to coordinate with Sadie before next meeting
  - George Janek can review 1-2 papers, if needed

Wrap Up

- Expert panel members to coordinate reviews with Sadie
- Sadie to provide literature review guidance and solidify papers reviewed with members
- Sadie to coordinate with presenters for the next meeting
- Sadie to follow up with panel member(s) that could not attend
- Sadie to provide panel with meeting minutes, next meeting logistics, and action items by 4/22/13

MINUTES

(action items underlined and panel considerations bolded)

Welcome, Review of Action Items, and Approve Minutes

- Reviewed action items
- Meeting 2 minutes approved
- Next meeting dates announced: Last Monday of each month, except May (see top of notes for dates)

Panel Members Literature Review Report Out

This meeting focused on the panel member's presentation of the key points for each of the literature they reviewed and then the panel members will discuss. Literature review guidance was provided for each panelist. For each review, the panelists considered the content in the context of the expert panel charge; panel recommendations; and final report to CBPO. The format for each review was: 1) panel member provided the key points for each paper (3 to 5 min per review); and 2) panel discussed each review. Panel members that provided a literature review did this with one or two PowerPoint slides per review, the literature review guidance document for each review, or verbal review only.

1. All Panel Members – Volunteer to Report Out (TBD)
   - Lewis Linker to review Cerco et al., 2013; CBP, 2005; and CBP, 2006 on 4/29
   - Jeff Halka to review Langland and Cronin, 2003 on 4/29
2. Nathan Forand Review
   - *Eroding bank nutrient verification study for the Lower Chesapeake Bay (Ibison et al., 1992)*
     Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
     - Used to calculate Balt Co. shoreline reductions
     - Discrepancies in the data – data presented in two different locations: table 2 and 3, 6 – table 6 numbers did not match when compared to table 2 and 3

     Panel Discussion
     - Can the authors be contacted to check on data discrepancy? Contact Scott Hardaway?
       - Scott Hardaway to check with author
     - MD GS did a study on this; there is a difference in point samples versus channel samples – Jeff Halka will bring data and report that has this comparative data
     - Mean loading concentrations will depend on bank height
     - Land use may not be a good measure of bank erosion (TN, TP, TSS loading) or sediment characteristics; these are likely more linked to bank height than land use
     - Loadings will also depend grain size of soil
   - *Accounting for stormwter wasteload allocations and impervious acres treated: Guidance for National Pollutant Discharge Elimination System Stormwater Permits (MDE, 2011)*
     Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
     - Only small section on shoreline
     - 23 shoreline restoration projects – used median point to get a rate for TN and TP

     Panel Discussion
     - Panel should consider laboratory methods for sediment TN, TP, and/or TSS analysis
     - Panel should consider bulk density values used for conversion factor
   - *PR Farm – Shoreline nutrient credit case study: Initial credit estimate summary (Proctor, 2012)*
     Panel Discussion
     - Tried to establish a landward erosion rate – proved to be difficult in that county
     - This loading concentration is based on this project
     - Did not account for subtidal
     - This report used 75% treatment efficiency, but Dan Proctor (author) recommended this should be re-assessed. **Panel to consider how effective shoreline erosion control practices are (e.g., 100%, 75%, etc.)**
     - Should research the bulk density of the soil
     - Overall have very variable number of loading rates when comparing all the papers
3. Kevin Du Bois Review
   - *Recommendations for appropriate shoreline stabilization methods for the different North Carolina estuarine shoreline types (Bendell et al., 2006)*
     Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
     - Highest rank was "do nothing" but not included in this report out

Panel Discussion
- NC House Bill 819 bans the state from basing coastal policies on the latest scientific predictions of how much the sea level will rise

- *Final recommended principles and protocols for urban stormwater BMP verification (Goulet and Schueler, 2012)*
  Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
  - Nothing on adequate staff resources or staff training – need a lot of work to be done
  - Will that happen based on federal furloughs and downsizing? How will local governments staff this?
  - If not in a MS4, not required to have staff, maintenance, or inspection requirements/documents
  - State oversee the locality and EPA oversee the state – multiple levels of oversight

  Panel Discussion
  - Visual inspection for the BMPs? Is it functioning as designed? For Maryland, means that every third inspection requires a little extra work. Trying to keep as labor-friendly as possible.
  - Verification is a key variable
  - As more and more practices are built, how will local governments keep up?
  - If a government doesn't have a MS4, now will have to do a lot of new work with no previous experience in verification. Training may be needed.
- *Principles for verifying stream restoration projects (draft) (HGIT, 2013)*
  Panel Discussion
  - This is a draft document presented to the CBP EPA Verification Committee
  - Can use pieces of this report for the expert panel verification piece in the report

4. Scott Hardaway Review
   - *Bank erosion study (Hardaway et al., 1992)*
     Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
     - Assumed that the structures worked: bulkheads, etc.
     - Most practices to study are based on bulkheads and revetments since these were the most common BMP
     - Cost was based on ~ $100/ft

     Panel Discussion
     - 1992 cost number – not sure where the number came from
     - $400/lb for reduction in Balitmore Co
   - *Shoreline Management in Chesapeake Bay (Hardaway and Byrne, 1999)*
     Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
     - Reach has different definitions
     - Cannot deal with protection by a reach basis because split into multiple lots
     - Fetch categories are different based on agency – low, medium, and high are different based on the agency
     - Sea level rates are at the old level, not updated level

     Panel Discussion
     - Wave energy – need some ancillary info like grain size
     - 40-70 feet includes the sill – could have greater or lesser and needs to be sight specific, 10:1 slope to mid-tide could be needed
     - Work done has a cost to it
   - *Tidal sediment yield estimate methodology in Virginia for the Chesapeake Bay Program Water Quality Model (Hardaway et al., 2009)*
     Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
     - 65%:35% from USACE report in the 1990s (J. Halka)
     - 35% is below high/low water
     - Should have updated kg/m/day numbers based on different bank heights – need more research

     Panel Discussion
     - Where did the 65%:35% come from? Original USACE estimate had these values was flipped (i.e., 35%:65%) (J. Halka)
     - A bulkhead could protect the fastland erosion, but could make the nearshore worse
     - No eroding values for nearshore; very few things that could stop nearshore erosion; may be more a function of wave energy, weather, etc.
     - Not all sediment is a negative; sands are important in nearshore environment
   - *Design and performance of headland bays in Chesapeake Bay, USA (Hardaway and Gunn, 2010)*
     Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
     - When adding a breakwater, figure out where the sand is going and then how to deal with the drift

Panel Discussion
- The projects were mostly in western shore of MD
- Now how to handle VA shore that is much more sandy – need to minimize the downdrift
  - Are we moving the breakwater closer to the shore?

- *Living shoreline design guidelines for shore protection in Virginia's estuarine environments (Hardaway et al., 2010)*
  Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
  - Living shorelines need maintenance, planting, etc.

5. George Janek Review
   - *Ecological and erosion protection functions of Chesapeake Bay living shorelines (Bilkovic and Mitchell, 2012)*
     Panel Discussion
     - Reducing footprint of sill: habitat protection or living shoreline?
     - If sill lessens, will marsh be kept there? If to design a living shoreline, but lose a chunk of shoreline due to erosion, then not stopping erosion or improving the shore.
   - *Developing Alternative Shoreline Armoring Strategies: The Living Shoreline Approach in North Carolina (Currin, Chappell, and Deaton, 2010)*
     Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
     - Cumulative effect of bulkheads needs more research
     - Living shoreline permits can take 30-60 days compared to 2 days for bulkhead
     - NC will partially reimburse construction costs for living shorelines
     - NC USACE would not give up their review for permit for living shoreline and NC Division of Coastal Management is working on a living shoreline permit and/or guidance now
     - VA – review of permitting 2009-2011, permits for shoreline stabilization were approved where there was no erosion occurring
     - Want the living shoreline projects to be successful so take longer look at those projects before issuing permit
     - Bulkhead monitoring is not required but living shoreline is, and monitoring increases cost or time commitment, then property owner will more likely choose bulkhead because have less hassle.
6. Pam Mason Review
   - *Flow dynamics and sedimentation in Spartina alterniflora and Phragmites australis marshes of the Chesapeake Bay (Leonard, Wren, and Beavers, 2002)*
   - *Literature Review: Policy and Science of Living Shorelines (Mason, 2012)*
     Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
     - Majority of sedimentation occurs at the leading edge of the marsh
     - Fringing marshes can uptake nutrients (nitrates) from groundwater
     - Should come back to policy report section after panel has load reduction numbers

     Panel Discussion
     - **Panel should consider nutrient update within plantings for shoreline erosion control practices in addition to the sediment reduction** (Kevin Dubois)
     - How much will it cost for TMDL goals? Can living shorelines get credits for multiple benefits?
     - Can projects on private property help the state meet the TMDL goals?
     - Can be similar to Balt. Co program with dredging – have a lien on the property for homeowner to help pay for dredging near their pier (S. Stewart)
     - Cannot obtain a permit in Maryland for living shoreline unless there is erosion (K. Smith)
     - **Panel should make recommendations for which projects qualify for credits and decrease the chance of unintended consequences (e.g., practices implemented in areas with no erosion)**
     - **Panel still needs to decide what TN, TP, and TSS removal credits (efficiency) will be assigned for shoreline erosion control practice**
     - Sea level rise (SLR) will give a lot more subtidal habitat – but not all subtidal habitats are created equal; SLR can impact where the project is placed
     - The group should not incentivize habitat conversion that is not needed
     - There is potential for private landowners to produce offset credits for a trading and offset market
     - **Panel can also consider a filtration credit (e.g., based on practice width)**
   - *Study of tidal shoreline management in Virginia: Recommendations for living shorelines and tidal resources sustainability (VIMS, 2010)*
     - Policy paper – did not review
7. Jana Davis Review
   - *The functions and values of fringing salt marshes in northern New England, USA (Morgan, Burdick, and Short, 2009)*

Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
- Compared factors of fringe vs. meadow marshes
- Sediment (did not look at nitrogen or life span)
- Slightly more sediment trapping with fringe marsh per unit area than meadow marsh
- Meadow marsh – first 3 meters has a majority of the sediment trapping
- Both marshes have wave dampening

Panel Discussion
- Two more papers that were referenced that panel should review were
  - Davis, J., B. Nowicki, and C. Wigand. 2004. Denitrification of fringing salt marshes of Narragansett Bay, Rhode Island, USA. Wetlands 24(4): 870–878.
  - Lyons, J., J. Ahern, J. McClelland, and I. Valiela. 1995. Macrophyte abundances in Waquoit Bay estuaries subject to different nutrient loads and the potential role of fringing salt marsh in groundwater nitrogen interception. Biological Bulletin 189: 255–256.

- *Fisheries habitat impacts of marsh sills (living shorelines) as a shoreline stabilization/restoration alternative to bulkheads (Peterson and Bruno, 2012)*

  Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
  - Biological questions and stability of living shorelines
  - Not a very relevant paper for panel's work
  - Fringe marsh practice exported sediment during first few years from implementation

  Panel Discussion
  - Hurricane Irene – living shorelines performed better than bulkheads
  - Should fisheries habitat be looked at with this group? Could bring in experts to discuss, if so. (L. Karrh)
  - High variability in reported efficiencies; **panel should make a strategy to deal with variable data in recommended TN, TP, and TSS efficiency** (e.g., remove outliers) – idea for consideration (J. Davis)
- *Sedimentation and erosion in a Chesapeake Bay brackish marsh system (Stevenson, Kearney, and Pendleton, 1985)*

  Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
  - Sediment export from a meadow marsh, Blackwater Refuge; should look at sediment and biological process
    - J. Halka can present some data on Blackwater Refuge and sediment export estimates
  - Very localized rates

  Panel Discussion
  - Can use nutrient and sediment efficiency for natural fringe marshes since we do not have a lot of living shoreline data
  - Another paper cited that panel should look at that found 15% sediment reduction in Chesapeake Bay marshes
    - Nixon, S.W. 1980. Between coastal marshes and coastal waters- a review of twenty years of speculation and research on the role of salt marshes in estuarine productivity and water chemistry. *In*: P. Hamilton and K.B. MacDonald (Editors). Estuarine and Wetland Processes. Plenum, New York, N.Y. pp. 437-525. *Not found.*
- *Sediment transport and trapping in marsh systems: Implications of tidal flux studies (Stevenson, Ward, and Kearney,1988)*

  Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
  - Regional review of marshes from New England to florida coast
  - Rates of sediment trapping and erosion
  - Marshes are producer or sink of sedimentation? All over the map – lots of variability
  - Marshes trap 5 – 11% of Chesapeake Bay sediment
  - More papers cited in this paper for further review:
    - Axelrad, D.M., K.A. Moore and M.E. Bender. 1976. Nitrogen, phosphorus, and carbon fluxes in Chesapeake Bay marshes. Virginia Water Resources Research Center Bulletin 79: 1-82. *Uploaded to SharePoint.*
    - Gleason, M.L., D.H. Elmer, N.C. Pien and J.S. Fisher. 1979. Effects of stem density upon sediment retention by salt marsh cord grass, *Spartina alterniflora* Loisel. Estuaries 2: 271-273. *Not found.*
    - Jordan, T.E., D.L. Correll and D.F. Whigham. 1983. Nutrient flux in the Rhode River: Tidal exchange of nutrients by brackish marshes. Estuarine Coastal Shelf Science 17: 651-667. *Uploaded to SharePoint.*
    - Jordan, T.E., J.W. Pierce and D.L. Correll. 1986. Flux of particulate matter in the tidal marshes and subtidal shallows of the Rhode River estuary. Estuaries 9: 310-319. *Uploaded to SharePoint.*
    - Pethick, J.S. 1980. Salt-marsh initiation during the Holocene transgression: the example of the North Norfolk marshes, England. Journal of Biogeography 7:1-9. *Not found.*

  Panel Discussion

- Should note that some sediment is needed, panel should not try to eliminate all sedimentation but will need to account erosion control from the practice (e.g., TSS efficiency)
- **Panel should consider if a project provides valuable sediment to a nearby marsh**
- **Panel should provide a range of TN, TP, and TSS efficiency numbers based on parameters of project**

8. Lee Karrh Review
   - *Effects of the invertebrate infauna on early saltmarsh plant colonization of managed realignment areas in south-east England (Paramor and Hughes, 2005)*
     Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
     - Not as relevant for this location – study done in British Isles
   - Tracking the fate of a high concentration groundwater nitrate plume through a fringing marsh: A combined groundwater tracer and in situ isotope study (Tobias et al., 2001)
     Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
     - Quantifies the amount of nitrogen being processed by the marsh
     - Rapid cycling of nitrate in a small area
     - Natural marsh – have larger carbon source to help with denitrification
     - Groundwater interaction with nearshore waters

     Panel Discussion
     - Is groundwater input to tidal waters in the Water Quality and Sediment Transport Model (aka Estuary Model)?
       - Jeff Sweeney answered, yes it is.
     - The first few centimeters is the most important for nutrient attenuation
   - *Variations in sedimentary environments and accretionary patterns in estuarine marshes undergoing rapid submergence, Chesapeake Bay (Ward, Kearney, and Stevenson, 1998)*
     Key Points - reviewer provided key points that are in Appendix A; additional key points inlcuded:
     - Paper may deserve a higher applicability rating
     - Paper was not looking at biology as much as sedimentation rates
     - Some marshes are sediment limited

     Panel Discussion
     - Results of paper are opposite of what was expected

Literature Review Update and Volunteer Assignments, Sadie Drescher

- Sadie will follow up with Jana to get the extra papers cited and Jana's literature review summaries
- Volunteers and papers to review included:
  - George Janek can review 1-2 papers
- All panel members that didn't review a few papers to coordinate with Sadie before next meeting
  - Expert panel members to coordinate reviews with Sadie
  - Sadie to provide literature review guidance and solidify papers reviewed with members
    - Use the panel literature review matrix as per the WQGIT Expert Panel protocol
    - "Water Quality Goal Implementation Team (WQGIT) BMP review protocol" (2010 with 2011 addendum)
    - Each resource summary should contain the two to three key findings
- SharePoint site with existing documents and meeting information is online.
  - **SharePoint Site Information**

https://sites.tetratech.com/projects/100-CB_BMP_Review/default.aspx
General username: ttsvcs\cbuser
General password: Review2012

- Panel is under the "Urban Folder"
- Panel members can download papers
- Let Sadie know if you have any problems

Wrap Up, Sadie Drescher

- **Mark your calendars**: Panel meetings scheduled for the last Monday of every month from 1:00 PM to 4:00 PM (EST).
  - The next panel meeting is April 29th in the Fish Shack at 410 Severn Avenue, Annapolis, MD.
  - The panel agreed to use 3 hours for the literature review work session and this should be discussed/confirmed at the 4/29 meeting for the 5/20 meeting.
  - April through November meeting dates are: 1) 4/29; 2) 5/20; 3) 6/24; 4) 7/29; 5) 8/26; 6) 9/30; 7) 10/28; and 8) 11/25
- Sadie to follow up with panel member(s) that could not attend.
- Sadie to coordinate with presenters for the next meeting.
- Sadie to provide panel with meeting minutes, next meeting logistics, and action items by 4/22/13.

Meeting Minutes
Shoreline Erosion Control Expert Panel
Meeting 4
Monday, April 29, 2013

EXPERT BMP REVIEW PANEL **Shoreline Erosion Control Practices**		
Panelist	***Affiliation***	**Present?**
Jana Davis, Ph.D.	CBT/HGIT	Yes
Kevin Du Bois, PWS, PWD	City of Norfolk, VA	Yes
Jeff Halka	MD Geologic Survey	Yes
Scott Hardaway, P.G.	VIMS Shoreline Studies Program	Yes
George Janek	USACOE, Norfolk District	Yes
Lee Karrh	MD DNR	Yes
Evamaria Koch, Ph.D.	UMCES	Yes
Lewis Linker	CBPO	Yes
Pam Mason	VIMS Center for Coastal Resource Mgt	Yes
Ed Morgereth, MS ISS	Biohabitats	Yes
Daniel Proctor, P.E.	Williamsburg Environmental Group	No
Kevin Smith	MD DNR	Yes
Bill Stack, P.E.	CWP, CBPO	No
Steve Stewart/Nathan Forand	Baltimore County Dept of Environmental Protection and Sustainability	Yes/Yes
Bill Wolinski, P.E.	Talbot County Dept of Public Works	No
Sadie Drescher	CWP (facilitator)	Yes
Non - Panelists: Hannah Martin (CWP, support)		

ACTION ITEMS by DISCUSSION AREA

Review of Action Items, Panel Updates, Approve Minutes, and Announcements

- The panel approved the last meeting minutes (3/25/13)
- Mark your calendars for upcoming panel meetings that are held on the last Monday of the month from 1pm to 4pm; Next meeting is May 20th 1pm to 4pm in Room 305 A and remote using AdobeConnect/conference call. Last Monday in May is Memorial Day; panel scheduled May's meeting on May 20th.
    - **June through November meeting dates are: 1) 6/24; 2) 7/29; 3) 8/26; 4) 9/30; 5) 10/28; and 6) 11/25**

Panel Members Literature Review Report Out

- Review definitions of living shorelines at next meeting
- Put mesohaline SAV article (Polinkas and Koch, 2010) in SharePoint
- SEC types were grouped and panel should include similar type of grouping; Sadie and Kevin to find

Literature Review Update and Volunteer Assignments

- All panel members that didn't review a few papers to coordinate with Sadie before next meeting

Next Steps Needed for the Panel Charge Work (Sadie Drescher)

- Sadie will pull together outline for next meeting
- Additional literature review material should be sent to Sadie to review

Start to Synthesize and Organize Findings

- Sadie will provide outline and begin to pull together straw man for next meeting(s)

Next Meeting Topic(s)

- Steve Stewart, Daniel Proctor, Bill Wolinski, and Bill Stack will present literature reviews.
- Discuss panel report outline and next panel actions

Wrap Up

- Expert panel members to coordinate reviews with Sadie
- Sadie to provide literature review guidance and solidify papers reviewed with members
- Sadie to coordinate with presenters for the next meeting
- Sadie to follow up with panel member(s) that could not attend
- Sadie to provide panel with meeting minutes, next meeting logistics, and action items by 5/13/13

MINUTES

(action items underlined and panel considerations bolded)

Welcome, Review of Action Items, and Approve Minutes

- Reviewed action items
- Meeting 3 minutes approved
- Next meeting dates announced: Last Monday of each month, except May (see top of notes for dates)

Panel Members Literature Review Report Out

This meeting focused on the panel member's presentation of the key points for each of the literature they reviewed and then the panel members will discuss. Literature review guidance was provided for each panelist. For each review, the panelists considered the content in the context of the expert panel charge; panel recommendations; and final report to CBPO. The format for each review was: 1) panel member provided the key points for each paper (3 to 5 min per review); and 2) panel discussed each review. Panel members that provided a literature review did this with one or two PowerPoint slides per review, the literature review guidance document for each review, or verbal review only.

9. Jeff Halka Review
   a. A summary report of sediment processes in Chesapeake Bay and watershed (Langland and Cronin, 2003)
      Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
      - A summary report from 2003 of sediment processes in Chesapeake Bay and watershed. It was published by USGS and meant to be an overview by pulling various information and sources and compiling in one document. This report was sediment focused with no focus on nutrients.
      - Not all sediment is detrimental—sand component, healthy SAV
      - Fastland:Nearshore erosion ratio not spatially explicit. Sediment bulk density properties not spatially explicit and differed for MD and VA.
      - Total sediment loading from shore erosion approximately ½ of that reported in the USGS 2003 report.

      Panel Discussion
      - Lewis Linker turns to this report time and time again because it is very useful.
      - Are riverine sediments accounted for? They are delivered by the watershed model. This is just the shore erosion in the eutrophication model.
      - DNR website in MD that gives you spatially explicit transect with erosion rates at the transects. VA-series of shore reports for 20 areas around the bay with database that can be used to measure erosion rate for most areas. For Norfolk, the Shoreline Evolution report only applies to the bayfront shoreline. It does not include all the creekfront shorelines.
      - NOAA has done new shorelines for some counties. Working to incorporate into historical database to calculate erosion, but will be several years before it will be applicable here.
   - Cerco, Carl F., Sung-Chan Kim, and Mark R. Noel. 2010. The 2010 Chesapeake Bay Eutrophication Model: A report to the US EPA CBPO and to the USACE Baltimore District. US ACE and Development Center. Vicksburg, MS.
     Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
     - Updated the Chesapeake Bay Eutrophication model with spatially explicit shore erosion inputs
     - This is the basis for the Bay TMDL procedure
     - **Using loading from the model report for the shore erosion BMP's would make Panel recommendations consistent with model.**

     Panel Discussion
     - Panel discussed the data origin and if updates were made
     - Marsh erosion - Bulk densities from large embayed marshes; How would you know that the process is erosion or subsidence? As inundation is occurring, the marshes are just evacuating into the bay. That is what the estimate was meant to provide.
   - CBP. 2007. An introduction to sedimentsheds: Sediment and its relationship to Chesapeake Bay Water Clarity. Chesapeake Bay Program Sediment Workgroup. Chesapeake Bay Program. Annapolis, MD.
     Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
     - STAC workshop aimed to identify relatively small scale, spatially explicit sources of sediment in nearshore SAV growth areas but concluded that this could not be assessed; only a broad scale analysis could be done

     Panel Discussion
     - None

- Lewis Linker Review
  - Sediment in the Chesapeake Bay and Management Issues: Tidal Erosion Processes (CBP, 2005)
    Key Points - Reviewer provided key points that are in Appendix A
    Panel Discussion
    - None
  - Best Management Practices for Sediment Control and Water Clarity Enhancement (CBP, 2006)
    Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
    - Since this 2006 report, SAV spotty establishment has continued.

    Panel Discussion
    - There is a movement to seed restored marshes with mussels to make them more erosion-resistant. Do the mussels also help to reduce turbidity and consolidate water-borne sediments?
  - Management modeling of suspended solids in the Chesapeake Bay (Cerco et al., 2013)
    Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
    - TBD

    Panel Discussion
    - You need to know where the erosion is coming from. We should plant SAV in near shore instead of hardening shorelines. Getting percentage right is essential on where the sediment originates.
    - **Need to get practitioners, ecological engineers involved.**
    - We should consider climate change effects when considering SAV efforts.

10. Kevin Smith Review
    - Sediment deposition and accretion in a mid-Atlantic (U.S.A.) tidal freshwater marsh (Neubauer et al., 2002)
      Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
      - Sediment deposition was evident everywhere in marsh and especially in areas adjacent to the creek. Summer was more effective season to trap sediments due to vegetation. Historic analysis of vegetation shows that it has grown vertically with sea level rise.

      Panel Discussion
      - None
    - Nutrient and particulate fluxes in a salt marsh ecosystem: Tidal exchanges and inputs by precipitation and groundwater (Valiela et al., 1978)
      Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
      - Significant changes take place in the nutrient loads of seawater entering and leaving the marsh. A lot of shoreline and marsh creation and narrow fringe marsh have different dynamics and result in turn of nutrient cycling. Marshes were all very flat systems, while shoreline marshes are sloped.

      Panel Discussion
      - Fringe Marsh Data—Eva spoke about a student and her thesis that may or may not be published that would have this data
      - Different dynamic of tidal fresh, more riverine environment, you have typical erosion one site and not on the other.
      - **We need erosion rates, nitrogen values, etc. If we are looking at nutrient efficiencies, we may not be able to get there. We do have good data on erosion rates. Interested to look at intercepting groundwater flow because it could be significant.**
      - **We need engineers, modelers, ecologists all at the table to scratch the surface of this issue.**
      - **This panel's charge is erosion CONTROL, not erosion panel. Erosion is essential for some things; in other words not all sediment is bad in the nearshore ecosystem, but it is not all good.**
      - **Laws and tax incentives could be important to consider.**
    - Welsh, B. 1980. Comparative nutrient dynamics of a marsh-mudflat ecosystem (Welsh, 1980)
      Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
      - Interesting that the sea lettuce would pick up and increase surface area greatly, which has a lot to do with reductions and cycling going on. The nutrients were derived from the channel. This did not answer questions about open and closed systems.

      Panel Discussion
      - **These wetland systems reviewed and generally studied/published tend to be larger, flatter, and a different ecosystem than the shoreline erosion control sites that are not wide, have sloping sides, and are more like fringe systems; therefore the results could not be translated**

11. Ed Morgereth Review

12. Living shorelines for the Chesapeake Bay watershed (CBF, 2007)
    Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
    - CBF living shorelines for Chesapeake Bay watershed, purpose to inform landowners on living shorelines
    - This was not a technical study; no data to reference
    - Ecosystem approach to living shorelines

    Panel Discussion
    - SEC types were grouped and panel should include similar type of grouping; Sadie and Kevin to find
13. Fisheries habitat impacts of marsh sills (living shorelines) as a shoreline stabilization/restoration alternative to bulkheads (Gittman, 2012)
    Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
    - Did report organic matter at different sites, used pre and post Irene to shape conclusions

    Panel Discussion
    - Jana sat in on a call with definitions in gulf region for living shoreline and whether hybrid living shorelines count. Findings were not completely relevant to this panel, but they are dealing with reductions and using oysters for sills. Definitions are state by state even though this is a national debate. Different geographic regions call for different methodology
    - The VA definition for living shorelines does not prevent structures that would break the continuity between riparian and marine habitats. Living shoreline means a shoreline management practice that provides erosion control and water quality benefits; protects, restores or enhances natural shoreline habitat; and maintains coastal processes through the strategic placement of plants, stone, sand fill, and other structural and organic materials.
    - Review SEC definitions at next meeting

14. Eva Koch Review
    a. SAV Breakwater Research (Koch et al.)
       Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
       - Look for best way to protect shoreline while creating SAV habitat.
       - In nature, some of the best SAV occur in areas protected by sandbars. The sandbar acts as a source of sand in areas where SAV grow. The sand deposits and dilutes negative effects of fine sediment and organic matter resulting in a thriving SAV bed.
       - Breakwaters have the potential to create suitable SAV habitat under certain circumstances. While breakwaters can improve SAV, they also can have no impact or can be detrimental.
       - If fetch is higher than 10K, breakwater=beneficial. Low fetch=detrimental.
       - Put mesohaline SAV article (Polinkas and Koch, 2010) in SharePoint

       Panel Discussion
       - Those sites were not originally built/intended for SAV? Most of them are for shore protection or marina improvements. Other presentations state we have protocols to build living shorelines for marsh restoration efforts, maybe we can do this for SAV efforts. Natural habitat has variability and it is important to keep that diversity when creating living shorelines.
       - SAV establishment could reduce shore erosion but has not been done as restoration practice.
       - **Before we recommend a particular strategy, we must think about why the habitat is not suitable any longer and avoid creating a problem by trying to solve another problem.**
       - This seems like a straight forward management practice-simple experiment to run.
       - Benthic population needs specific sediment so we cannot look for a one size fits all

    b. Non-linearity in ecosystem services: temporal and spatial variability in coastal protection (Koch et al., 2009)
       Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
       - Wave attenuation/coastal protection by coastal vegetation varies over space and time
       - Maximum wave attenuation/coastal protection provided by coastal vegetation may not coincide with the season of maximum winds/waves/erosion
       - Whole coastal ecosystem needs to be considered when evaluating coastal erosion as there is synergism between communities
       - Suggestions were: 1) temporal and spatial non-linearity as well as cumulative effects in wave attenuation must be accounted for if we can accurately estimate the value of coastal protection and incorporate it into management decisions; 2) call for new field in Ecosystem Based Management (EBM) where environmental management decisions are based on the quantification of non-linearities in ecosystem functions and services; 3) suggest

combination of dynamic ecological modeling, greater field-based testing of the functional relationships of ecosystem services and economic valuation of the services to increase ability to accurately value coastal ecosystems and refine EBM practices

Panel Discussion
- None

- Sediment accumulation rates and submersed aquatic vegetation (SAV) distributions in the mesohaline Chesapeake Bay, USA (Palinkas and Koch, 2012)

  Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
  - Depositional rates > 9 mm/yr are beneficial for SAV
  - Not all sediment are equal. Sediment type eroded matters.
  - Erosion of mud leads to higher turbidity – bad for SAV; erosion of sand – to a certain extent – good for SAV
  - SAV needs > 65% sand; <5% organic matter
  - SAV needs good water quality, water depth for submersion at low tide, sandy (<35% silt + clay) with low organic matter (<5 to 8% organic matter) over time
  - SAV needs long fetch (>10km)
  - Shoreline characteristics are important to consider
    - If eroding marsh, a layer of sand should be added to cover the marsh peat in sub-tidal (2cm, Wicks et al., 2009)
    - If sandy beach, breakwater beneficial to SAV when fetch > 10 km
    - If cliffs, base of cliff should be stabilized to reduce sediment input and shoaling breakwater – protected area

  Panel Discussion
  - None

15. Steve Stewart Review - NEXT MEETING

Next Steps Needed for the Panel Charge Work (Sadie Drescher)
- Sadie will pull together outline for next meeting
- Additional literature review material should be sent to Sadie to review

Start to Synthesize and Organize Findings (Sadie Drescher)
- Sadie will provide outline and begin to pull together straw man for next meeting(s)

Next Meeting Topic(s) (Sadie Drescher)
- Steve Stewart, Daniel Proctor, Bill Wolinski, and Bill Stack will present literature reviews.
- Discuss panel report outline and next panel actions

Literature Review Update and Volunteer Assignments (Sadie Drescher)
- All panel members that didn't review a few papers to coordinate with Sadie before next meeting
  - Expert panel members to coordinate reviews with Sadie
  - Sadie to provide literature review guidance and solidify papers reviewed with members
    - Use the panel literature review matrix as per the WQGIT Expert Panel protocol
    - "Water Quality Goal Implementation Team (WQGIT) BMP review protocol" (2010 with 2011 addendum)
    - Each resource summary should contain the two to three key findings
- SharePoint site with existing documents and meeting information is online.
  - **SharePoint Site Information**
    https://sites.tetratech.com/projects/100-CB_BMP_Review/default.aspx
    General username: ttsvcs\cbuser
    General password: Review2012
    - Panel is under the "Urban Folder"
    - Panel members can download papers
    - Let Sadie know if you have any problems

Wrap Up (Sadie Drescher)
- **Mark your calendars**: Panel meetings scheduled for the last Monday of every month from 1:00 PM to 4:00 PM (EST).
  - The next panel meeting is May 20th in Room 305 A 410 Severn Avenue, Annapolis, MD.

  - The panel agreed to use 3 hours for the literature review work session and this should be discussed/confirmed at the 5/20 meeting.
  - June through November meeting dates are: 1) 6/24; 2) 7/29; 3) 8/26; 4) 9/30; 5) 10/28; and 6) 11/25
- Sadie to follow up with panel member(s) that could not attend.
- Sadie to coordinate with presenters for the next meeting.
- Sadie to provide panel with meeting minutes, next meeting logistics, and action items by 5/13/13.

Meeting Minutes
Shoreline Erosion Control Expert Panel
Meeting 5
Monday, May 20, 2013

EXPERT BMP REVIEW PANEL **Shoreline Erosion Control Practices**		
Panelist	***Affiliation***	**Present?**
Jana Davis, Ph.D.	CBT/HGIT	Y
Kevin Du Bois, PWS, PWD	City of Norfolk, VA	Y
Jeff Halka	MD Geologic Survey	Y
Scott Hardaway, P.G.	VIMS Shoreline Studies Program	N
George Janek	USACOE, Norfolk District	Y
Lee Karrh	MD DNR	Y
Evamaria Koch, Ph.D.	UMCES	N
Lewis Linker	CBPO	Y
Pam Mason	VIMS Center for Coastal Resource Mgt	Y
Ed Morgereth, MS ISS	Biohabitats	N
Daniel Proctor, P.E.	Williamsburg Environmental Group	Y
Kevin Smith	MD DNR	Y
Bill Stack, P.E.	CWP, CBPO	Y
Steve Stewart/Nathan Forand	Baltimore County Dept of Environmental Protection and Sustainability	Y/Y
Bill Wolinski, P.E.	Talbot County Dept of Public Works	Y
Sadie Drescher	CWP (facilitator)	Y
Non - Panelists: Hannah Martin (CWP, support)		

ACTION ITEMS by DISCUSSION AREA

Review of Action Items, Panel Updates, Approve Minutes, and Announcements

- The panel approved the last meeting minutes (5/20/13)
- Next meeting is July 16th based on panel recommendation to hold a longer meeting and subsequent panel availability. This meeting will be at MD DNR from 10 am to 4 pm. We will use remote using Adobe Connect/conference call.
  - **July through November meeting dates are: 1) 7/16; 2) 8/26; 3) 9/30; 4) 10/28; and 5) 11/25**
  - Mark your calendars for upcoming panel meetings that are held on the last Monday of the month from 1pm to 4pm.

Panel Members Literature Review Report Out

- Bill will send paper of Dr. Jordan from 2010 with efficiency curves
- Ask Lewis how sediment deposition and re-suspension are modeled once you are in near shore area.
- Bill W to follow up with authors (Anderson, 1997)
- Panel to compile and review additional tidal fringe marsh/wetland literature
- Sadie to review the erosion rate numbers from Wells et al. (2002)
- Sadie to send fringe marsh/wetland papers to Jana.

Next Steps Needed for the Panel Charge Work (Sadie Drescher)

- Panelists split into two teams to tackle the panel charge work. The teams will meet in between now and Meeting #6. At Meeting #6 the groups will report to the panel their findings, recommendations, and data gaps. The panel will discuss and come to consensus on decision points for the panel charge work.
- Additional literature review material should be sent to Sadie to review or delegate review

Start to Synthesize and Organize Findings

- None

Panel Memo Outline

- Revisit and discuss in Meeting #6

Next Meeting Topic(s)

- Panelists to work in smaller groups to use current information and work on the panel charge.

Wrap Up

- Sadie to coordinate with Team 1 & Team 2 to work on the panel charge in smaller groups
- Panelists to meet in smaller teams, further the panel charge, and present to panelists at the Meeting #6
- Sadie to organize Meeting #6
- Sadie to follow up with panel member(s) that could not attend
- Sadie to provide panel with meeting minutes, next meeting logistics, and action items by 6/24/13

MINUTES

(action items underlined and panel considerations bolded)

Welcome, Review of Action Items, and Approve Minutes

- Reviewed action items
- Meeting 4 minutes approved
- Panelists reported several inquiries about the panel work that indicates interest in the panel's recommendations
- Meeting #6 - Panel decided to have a longer meeting on July 16 from 10 am to 4pm at MD DNR.
- Panel to work in smaller groups leading up to Meeting #6 and Sadie to synthesize findings and draft outline.
- Meeting dates from August to November were announced and are the last Monday of each month

Panel Members Literature Review Report Out

This meeting focused on the panel member's presentation of the key points for each of the literature they reviewed and then the panel members will discuss. Literature review guidance was provided for each panelist. For each review, the panelists considered the content in the context of the expert panel charge; panel recommendations; and final report to CBPO. The format for each review was: 1) panel member provided the key points for each paper (3 to 5 min per review); and 2) panel discussed each review. Panel members that provided a literature review did this with one or two PowerPoint slides per review, the literature review guidance document for each review, or verbal review only.

16. Bill Stack Review
    17. Quantifying the role of wetlands in achieving nutrient and sediment reductions in Chesapeake Bay (CBP, 2008)

    Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
    - Tidal wetlands have tremendous potential to reduce nutrients and sediment but permanency of sediment stayed deposited in wetlands. There were also sinks and sources during different seasons (more research needed). Paper contained useful information, but it is dated. Since this was published, Tom Jordan from Smithsonian developed protocol for CBP for wetlands and nutrients. Developed efficiency curves that we currently use for TP, TSS, and TN. This is good background information.

    Panel Discussion
    - Land use changes, so if we have the wetlands curve, do we use this for removal rate? We should talk to Matt Johnson. Bill will send paper of Dr. Jordan from 2010 with efficiency curves. Wetlands are currently a land use change credit in the Watershed Model, but Jordan's research and others indicates that certain ratio of drainage area to wetland could be used; panel needs clarification.
    - This report focused on non-tidal, but did cover tidal. It did not parse out details to define upstream watershed, this study was mostly riverine. Paper was not directly transferable because we are looking at tidal.

- Shoreline erosion and Chesapeake Bay water quality: A scientific evaluation of prediction uncertainty, potential for improvement, and management implications (Sanford and Phillips, 2003)

  Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
  - Summary of STAC workshop held in 2003. Intent was to provide recommendations and inform the plan for changes in CB model. Technical review for potential shoreline erosion reductions to achieve improvements in water clarity and dissolved oxygen. The effectiveness of shoreline vs. watershed reductions of sediment for improving Bay water.

  Panel Discussion
  - No consideration for lag time? General issue that CB Watershed Model does not adequately address lag time. The 2012 fall STAC workshop addressed sediment and lag time.
  - Bank erosion sites, when erodes into near shore beach profile, not a lot of discussion on nutrient load immediately released or if it builds up. Current model has transport function built in but working to enhance transport and deposition. Cannot answer how sediment deposition and re-suspension are modeled once you are in near shore area. Question for Lewis.
  - How does the panel define spatial extent of end point of tidal shoreline area? Does it include riverine rivers, tidally influenced rivers? It can, but shoreline erosion control projects are usually implemented in areas with enough fetch.
  - Is anyone engaged in innovative designs that maximize factors? Marsh surface or roughness reduces erosion potential; coastal project instead of plantings. Is there a way to design projects to make the marsh more rough and detention times greater? Is anyone researching design parameters that make marshes more effective for these uses?

- Pam - Looking at this in non-tidal wetlands. Detention time is problematic if wetland is designed for erosion control because the wetland will be inundated twice a day in tidal areas. This is a tradeoff because created wetland but it is not entirely a wetland. Interesting idea, but concerned that trying to maximize microtopography and the difference in six inches would make it no longer a wetland.
- Kevin D.-Thinking about natural shoreline where trees fall down, the decaying tree adds roughness to the marsh.
- Steve - Need to be careful of historic salt marsh studies since along the coast they may provide basis of food web for economically important fisheries. We do not want to cut off the nutrient food source and end up causing damage (i.e., unintended consequence).
- Kevin S - Must realize that we provide credit, not every inch of shoreline will be protected to get the credit.
- Jeff - How do we offer credit for natural function?
- Pam – We should be careful to define the spatial context and be aware that communities differ.

- Bill Wolinski Review
  - Oyster reefs as natural breakwaters mitigate shoreline loss and facilitate fisheries (Scyphers et al., 2011)

    Key Points - Reviewer provided key points that are in Appendix A
    - Mitigating shoreline loss and facilitating fisheries by using oyster reefs as natural breakwaters. Project was designed statistically well. Three year study period. Looked at physical conditions of the shoreline marsh symptoms and did extensive work on fisheries to look at response of fisheries under different treatments.
    - Basic finding was that one of the two sites showed efficiency at a 40% of loss of shoreline vegetation. It was a high energy high wave environment. This site did not retain structure over the three years. Various designs in the future to withstand the high energy environment were provided.

    Panel Discussion
    - N/A
  - Physical effects of leaf litter of nitrogen dynamics in freshwater tidal wetlands (Turner and Findlay, 2003)

    Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
    - Study in Hudson River system that researched the lab and field determination physical effects of leaf litter on diffusion on ions and oxygen. This was a year-long investigation with chemical sampling to determine movement of ions from surface water to sub-surface.
    - Leaf litter did not prevent diffusion, but did demonstrate impairment diffusion of oxygen from surface to sub-surface. These factors can impact denitrification.

    Panel Discussion
    - This is something to take into consideration with living shorelines and tidal wetlands. Ultimate effectiveness, recommendation to look at permanence of BMP pollutant load reductions and how much nutrients are released through the gross solids or leafy material.
  - Utilization of oyster shell to suppress estuarine shoreline erosion (Anderson, 1997)

    Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
    - South Carolina, estuarine system that researched oyster shell application along eroding shorelines to minimize erosion. This was a limited study in terms of project extent. Bill W. called the authors to see if they followed through with monitoring. Bill W to follow up with authors (Anderson, 1997).
    - Elaborate survey with reference points along the marsh.

    Panel Discussion
    - Potential to use reef construction but needs further development here in the CB; other areas such as the US south are using oyster restoration as a shoreline protection strategy.

18. Steve Stewart Review
    a. Wetland nutrient removal: A review of the evidence (Fisher and Acreman, 2004)

       Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
       - What is the difference between riparian wetland and a marsh? Riparian involved with stream system with floodplain adjacent to stream. Marshes have diffuse drainage, groundwater source, and have extensive surface area, rather than linear, slim (i.e., not wide) shape. There are different sources of water.
       - Spring and summer results showed nutrient reduction due to vegetation. However, fall and winter showed nutrient exports to nearshore waters.

       Panel Discussion
       - Were tidal wetlands referenced? No, no reference to review of tidal either. Panel to compile and review additional tidal fringe marsh/wetland literature.

- Year round monitoring is important.
- Panel may need to look at total N and total P.

- Evaluating ecological impacts of living shorelines and shoreline habitat elements: An example from the upper western Chesapeake Bay. *In* Management, policy, science and engineering of nonstructural erosion control in the Chesapeake Bay (Davis et al., 2007)
  Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
  - This study focused on the fish community and found that bulkheads reflect energy, while marsh absorbs energy. The marsh had shallower water depth than bulkheads. The marsh had resident population and colonized the living shoreline. The biological habitat type resulted in densities that were highest in oyster reef and provided a benthic habitat. Structural habitats were found to be best for blue crabs because of collection of detritus.

  Panel Discussion
  - Living shorelines provide the habitat and habitat objectives are part of restoration for the CB. Panel should include multiple type habitats; woody debris, oyster shells, etc. The more habitat type provided by the SEC, the greater diversity of species in the area.
- Flow and sediment transport on a tidal salt marsh surface (Christiansen, et al., 2000)
  Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
  - This paper focused on tidal salt marsh and found that reduced velocity led to reduced turbulent flow to enhance deposition. Different than "typical" shoreline erosion control projects that do not have tidal creek influence. This paper is likely not useful to the panel.

  Panel Discussion
  - Consistent that the edges are sites for deposition of sediment. SECs build edges so panel should use edge numbers.

19. Daniel Proctor Review
    a. Evolution of equilibrium slopes at Calvert Cliffs, Maryland: A method of estimating the timescale of slope stabilization (Clark et al., 2004)
    Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
    - Understanding effects of beach offshore of bluff and how this impacts the eroding bank to a stable bank. There was limited data. This is a quick stabilization process.

    Panel Discussion
    - N/A
    - Sediment and nutrient contributions of selected eroding banks of the Chesapeake Bay estuarine system (Ibison et al., 1990) Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
      - See Appendix

      Panel Discussion
      - Compare how the findings with other studies through various modeling efforts. Estimated that out of total loads going into CB shoreline erosion was around 5%.
    - Shoreline erosion as a source of sediments and nutrients Northern Coastal bays, Maryland (Wells et al., 2002)
      Key Points - Reviewer provided key points that are in Appendix A; additional key points inlcuded:
      - See Appendix

      Panel Discussion
      - Erosion Rates-Difference in volumes. Sadie to look at numbers.

Next Steps Needed for the Panel Charge Work (Sadie Drescher)

- Sadie provided a "Sediment Erosion Control Expert Panel: Review and Plan" presentation that is provided in the Appendix A. This presentation reviewed outline for the panel's memo. The panel provided feedback and developed next steps.
- Jana wants to hear more about tidal fringe marsh/wetland N and P removal—Sadie to send fringe marsh/wetland papers to Jana.
- Jana-Make sure we do not recommend to harden shorelines. Living shorelines trap sediment from adjacent shoreline, aggregate sediment coming from elsewhere; prevent shoreline erosion, nitrogen value. Need to find N number.
  - Credit for trapped sediment
  - Credit for nitrogen biological process
  - Credit for prevention of erosion
- Location specific due to factors such as: lower energy environment, different factor than high energy environment. Therefore there are different reduction factors that apply.
- Do we ignore public policy impacts? Should we only provide credit for living shoreline solutions? Should we encourage living shorelines? Living shorelines are the preferred method in VA.

  - Something we can discuss eventually. Bulkheads should not get credit. Give credit for reduction of sediment, but negative for other factors like bulkhead. Confounding factor that living shoreline will not work in some areas and must be revetment. Therefore, living shorelines and other SEC will be implemented for other reasons than getting credit in the model for those locations.
- Currently, there is a reporting issue for SEC at CBP. Panel will refine the credit based on best info available. Need to recognize differentiation between good and bad sediment (i.e., sediment can be good for marsh accretion and nearshore habitat).
- Default Credit – This may be needed for accounting purposes and should be lower than what you can achieve. To get high pollution load reduction credit there should be monitoring. This monitoring can provide site specific information to generate more data and potentially allow for greater pollution load reduction credit at the project site.
- The Watershed Technical Workgroup suggested the panel should move pollution load reduction credit to the Estuary Model.
- Shoreline Erosion Control Definition—Important to define as well as living shoreline inclusion/definition.

Start to Synthesize and Organize the Findings

- Sadie presented an overview of the panel charge, the need for the SEC update and panel work, the panel's work to date, draft protocol and potential refinements, and discussed immediate next steps with panelists
- Expert Panel Team 1 & Team 2 Work & Assignments
  - Team 1: Karrh, Smith, DuBois, Halka, Mason, Linker, Halka, Davis, Koch, Hardaway, and Morgereth

    Panel Charge Work Description: Provide a specific definition of what constitutes a shoreline erosion control practice, describe the shoreline erosion control practices' geographic boundary, and determine the qualifying conditions under which a locality can receive a nutrient and/or sediment reduction credit.

  - Team 2: Forand/Stewart, Stack, Wolinski, Proctor, Janek

    Panel Charge Work Description: Evaluate whether the existing CBP approved removal rates for shoreline erosion control practices are suitable for qualifying projects or whether a new protocol needs to be developed to define improved rates. In doing so, the panel should consider project specific factors such as physiographic region, landscape position, stream order, and/or type of shoreline erosion control protection practices employed.
- Panel agreed to hold a longer meeting in lieu of the June 24th meeting in order to accommodate more in-depth panel topic discussions.
- Several panelists would like to see sea level issues addressed and the lifespan of projects. Kevin D.,Sadie, Bill W., and Lewis to compile a draft write up for panel review.

Panel Memo Outline (Sadie Drescher)

- Memo outline was provided and will be discussed in more detail at the next meeting; Panel Meeting #6 on July 16th

Next Meeting Topic(s) (Sadie Drescher)

- Panelists decided to hold a longer meeting (i.e., longer than the current panel meetings that are 3 hr) to discuss the panel's work, issues, and come to consensus for the panel charge work. The panelists agreed that more time was needed and agreed to provide their availability for this longer meeting.
- Panelists to work in smaller groups to use current information and work on the panel charge. To do this the panel will use the panel's expertise, literature review, and panel work to date.

Wrap Up (Sadie Drescher)

- Panelists to provide availability to Sadie for Team 1 & Team meetings
- Panelists to provide availability to Sadie for Meeting #6
- Next meeting is July 16th based on panel recommendation to hold a longer meeting and subsequent panel availability. This meeting will be at MD DNR from 10 am to 4 pm. We will use remote using Adobe Connect/conference call.
  - **July through November meeting dates are: 1) 7/16; 2) 8/26; 3) 9/30; 4) 10/28; and 5) 11/25**
  - Mark your calendars for upcoming panel meetings that are held on the last Monday of the month from 1pm to 4pm.
- Sadie to follow up with panel member(s) that could not attend.
- Sadie to coordinate with presenters for the next meeting.
- Sadie to provide panel with meeting minutes, next meeting logistics, and action items by 6/24/13.

Meeting Minutes
Shoreline Erosion Control Expert Panel
Meeting 6 at Tawes Building at MD DNR

Tuesday, July 16, 2013
11 am to 5 pm

EXPERT BMP REVIEW PANEL **Shoreline Erosion Control Practices**		
Panelist	***Affiliation***	**Present?**
Jana Davis, Ph.D.	CBT/HGIT	Y
Kevin Du Bois, PWS, PWD	City of Norfolk, VA	Y
Jeff Halka	MD Geologic Survey	N
Scott Hardaway, P.G.	VIMS Shoreline Studies Program	Y
George Janek	USACOE, Norfolk District	Y
Lee Karrh	MD DNR	Y
Evamaria Koch, Ph.D.	UMCES	N
Lewis Linker	CBPO	Y
Pam Mason	VIMS Center for Coastal Resource Mgt	N
Ed Morgereth, MS ISS	Biohabitats	Y
Daniel Proctor, P.E.	Williamsburg Environmental Group	Y
Kevin Smith	MD DNR	Y
Bill Stack, P.E.	CWP, CBPO	Y
Steve Stewart/Nathan Forand	Baltimore County Dept of Environmental Protection and Sustainability	Y/Y
Bill Wolinski, P.E.	Talbot County Dept of Public Works	Y
Sadie Drescher	CWP (facilitator)	Y
Non - Panelists: Hannah Martin (CWP, support), Matt Johnson (CBPO, University of Maryland)		

The agenda in Appendix A (p. 12) and the associated referenced documents are on SharePoint (Urban→SEC→Admin and Meetings→ July 16 Agenda and Meeting Docs).

- **SharePoint Site Information**
  https://sites.tetratech.com/projects/100-CB_BMP_Review/default.aspx
  General username: ttsvcs\cbuser
  General password: Review2012

Abbreviated notes follow (p. 2-3) and more detailed notes are provided on p. 4 to p. 11.

Panel Meeting #6 (7/16) Highlights (Abbreviated/Annotated Notes)

Decision Points:

- Panel to be called, Shoreline Management expert panel instead of Shoreline Erosion Control
- Definition, "Any tidal shoreline practice that prevents and/or reduces tidal sediments to the Bay" These practices will meet certain qualifying conditions that promote non-structural but allow structural practices as a last resort.
- Bulkheads and revetments to receive a TBD pollutant load reduction (based on member vote; 9 to 3). Strict qualifying conditions (e.g., historically industrialized port) will be outlined since vegetative shorelines are preferred practice in MD and VA.
- Geographic boundary can be based on wave energy and qualifying conditions (see Hardaway, Smith, Lee, and 7. VIMS_Du Bois_Mason on SharePoint). Following the meeting Lewis Linker and Matt Johnson worked to develop a map showing the tidal areas in MD & VA; this is still in progress.
- SAV and erosion presented by Lee to be modified and re-presented to panel.
- Draft protocol 1, 2, 3, and 5 were approved with suggested refinements (based on member vote)
  - Draft protocol 5 was presented by Dan and relates to volume of sand not transported (i.e., disruption of longshore sediment transport)

- Draft protocol 4 to be considered based on additional research by Bill W
- Panel questions resolved were:
  - 1) Q: What efficiency to use for draft Protocol 1? A: 100% and/or add 1 meter to bank height to account for
  - 2) Q: How to account for missing shoreline erosion rates in VA used in draft Protocol 2? A: Use existing closest data from VIMS and point to Hardaway's new data set (i.e., AMBUR)
    - VIMS data: 1) The two links are to summaries of publications on erosion from a series known as Shoreline Situation Reports http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/virginia/scan_reports/SSRSummary.pdf http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/virginia/scan_reports/TidewaterShorelineErosion.pdf 2) This link is to a series of publications known as Shoreline Evolution Reports http://web.vims.edu/physical/research/shoreline/Publications-Evolution.htm
  - 3) Q: Do or should these practice account for upland flow? If so, how to account for it? A: Yes, a potential to treat upland flow. General rule of thumb is ~ 2% contributing drainage area (CDA). Provide guidance for CDA, sizing, and residence time.
- Project specific factors such as physiographic region, landscape position, stream order, and/or type of shoreline erosion control protection practices employed are NA – George
- Meeting #5 notes, report outline, and Sea Level Rise write up were approved

Action Items:
- Panelists to refine work presented based on feedback and ask for panel help when needed; present at Meeting 7
- Sadie to work with panelists to compile a draft report for review/comment at Meeting 7
- Panelists to work together, as appropriate, for the remaining panel charge (see bullets here) and present findings at Meeting 7; no formal Team calls scheduled, rather we will work on this together as a group at our next panel meeting (8/26)
  - Define the proper units that local governments will report shoreline erosion control practices to the state to incorporate into the CBWM. (*Tentative team to address are Lee, Steve, Bill S., Dan, Jeff*)
  - Recommend procedures to report, track and verify that shoreline erosion control practices are actually being implemented and maintained during construction and after construction. (Team to address are Kevin D., Bill W., Bill S. Nathan, Steve, and Lewis)
  - Critically analyze any unintended consequences associated with the nutrient and sediment removal rates and any potential for double or over-counting of the credit. (*Tentative team to address are* Jana, George, Kevin S., Ed, Steve, and Eva)

Other Items:
- New wetlands expert panel was requested from the Habitat Goal Implementation Team to the CBPO. This panel will expand on our panel and other panels that touch on wetland protocols.
- Several future research needs were compiled and will be included in the panel report
- Process for BMP efficiency update: 1) request new panel; or 2) update panel findings with future panel
- Adaptive management will be used. This calls for updates to the panel report recommendations, however the panel will keep in mind that limited time, budgets, priority, etc. can slow this process.
- Provide and/or mention DE and DC in panel recommendations
- Outstanding questions and work items for panel:
  - Resolve the timeframe used for shoreline erosion rates
  - Recommend soil testing for site specific TN, TP, and/or bulk density
  - What is the value for TSS, TN, and/or TP pollutant load reduction for bulkheads?
  - Refine the draft protocols and their use (i.e., additive and/or negative value in some cases)
  - Others?

Panel Meeting #6 Descriptive Notes
Action items underlined

- Welcome, Review of Action Items, Panel Updates, and Approve Minutes
  - Team 1 and Team 2 reporting on individual work
  - Relevant Update: Sadie -Wetland expert panel was requested. She met with Deb Hopkins (USFWS) and Denise Clearwater (MDE) to discuss synergy with this panel and that this panel will address living shorelines. They will move our recommendations forward.
- Panel Charge and Getting Started (Sadie)
  - Phase II WIPs, there are zero reported so far at the CBPO level. State level accounting may be accounted for as wetland restoration and then stormwater MS4 permits. That goes from State to NEIN and shoreline erosion control (shoreline mgt) guidance has not been updated in NEIN. Important in draft protocols to figure out how to report these things accurately.
  - VA-TMDL. No standard way to report these things. We track them, but hoping there will be value in future. VA-LS is preferred but not required. If value exists, city gets credit and that has value and more living shorelines (LS) will be developed instead of development.
  - Bill-Talbot County is working with student at Salisbury Univ. for a tracking program. Meant to be comprehensive mechanism, included Shoreline erosion practices and have it GIS based to position us to get credits.
    - Include all types of shoreline practices? Yes
  - We track as marsh in acres in MD for the counties where we do work, will want to use those practices to meet TMDL requirements.
  - Draft Report Outline was reviewed, discussed, and approved by panel
  - Panel Name changed to Shoreline Management (suggested by Lewis and all panelists agreed) NO OBJECTIONS. ACTION
  - Lewis—always use estimates instead of rates. Estimates are soft but they are best we've got. Likes the addition of examples.
  - Identifying research funders-do we talk to people about this? We should list research needs.
  - Urban stream restoration—had 6 month trial period.
  - Once this panel's recommendations are established is there a continuum to revisit practices that have been refined? Should be spelled out. Adaptive management will be used as per the WTWG/USWG protocols.
  - Steve-Process at two levels. State level process and then CBP process how it gets data into model. Process in this document--Should we as a panel write it?
    - No—this is beyond the panel, Ag workgroup, USWG. We submit data, what happens to the data?
- Team 1 Work
  - Definition –Ed presented the Team 2 work to define shoreline erosion control. He also presented variations to improve definition and structural/nonstructural examples.
    - Variation 1…Concept of projects that intentionally target accretion as opposed to shoreline erosion protection. (Bill W)
    - Kevin S.-likes the team's broad definition.
    - Lewis-agrees, broad definition is good. Accretion in wetlands, have to acknowledge sea level rise and creation and accretion. Guidance need to include climate change and sea level rise
    - Ed-Charge includes broader management charge
    - VA-Sea level rise is important and this can be accomplished through tracking and verification since conditions change over time.
    - Structural Components and Non Structural Components presented. Other elements to be considered Non Structural? Leave open ended so that local gov'ts can decide what is appropriate if/when new practices emerge. Living shorelines- Important to note that non-structural were actually non-structural as Ed presented them. This is not always the case in state examples (i.e., non structural practices contain structural components)
  - Geographic Boundary – CBPO has the river segment figure (presented) and is working on a tidal map with boundaries for the group. Team 2 discussed this and thought that there was currently no good map or boundary for shoreline management practices.
  - Qualifying Conditions (Kevin D, Kevin S, Lee, Scott)

- Kinds of conditions you look at to determine what type of practice you want to pursue. Standard (fetch, depth offshore, erosion rate, shoreline sediment, nearshore bottom, Tidal range, shoreline morphology, bank conditions, boat traffic…etc)
- LS Protection act of 2007 defined a LS
- Included "Another Definition"—maintain coastal process, must have enough tidal interaction to do that. Inherently means you will have exchange
- Lewis—Are we saying since 2008, it means it won't be bulkheads? You cannot put new bulkhead, but you can replace. There are waivers for living shorelines.
- Bill S.—What degree of SAV restoration plays into this? Existing SAV should be considered but maybe SAV restoration is not.
- Bill-How do you properly put this into process? Regulatory staff look at time series. If SAV doesn't exist but did in past couple years, regulatory agencies may ask for some SAV surveys.
- Lee-if we keep moving structures further into shallow water, we reduce the area and get to a point where we cannot achieve water clarity goals.
- Permit Requirements and VIMS Guidance - Flow chart exists, but can be confusing. There are 8 different ways to get out of doing a LS, but only one to do a LS. Haven't seen the flow chart in regulation anymore. In house they use it. Wouldn't the landowner benefit?
- Yes, you can find it online. First parameter was how deep is nearshore. It had diagrams as well. Denise Clearwater presented to the panel and suggested that guidance was forthcoming.
- VA-proximity of improvements to edge of shoreline should take into account if house is less than 2 feet away from shoreline. MD Geological survey data rates based on that data.
- Lewis-MGS data. Is it only high, moderate or low? Do they have a rate? It is categorically. That could be important in our work.
- Lee-MGS is starting process to redo these? We should request more qualitative.
- Kevin: Info Structural Proximity should be on list
- VA-credit other structure if it's the only option? Foundation of that discussion is work of Jeff Halka and Scott. Looked at 2 components of sediment delivered to bay. TABLE THIS FOR BULKHEAD DISCUSSION
- Scott-Premise is okay for some period of time. But future, bulkhead will likely fall down.

- Sadie: The qualifying conditions in the panel's recommendations can align with current regulations to support them.
  - Kevin: This is determining what you do at a site. If you get credit, we are wrestling with. Question. Bulkhead/revetment; would we want to walk away as those categorized as BMP?
  - Lee-Bulkheads are not BMP. But it would reduce sediment load. Shoreline management practice, yes. Bulkheads should not get a full pollutant load reduction; it would reduce some level of sediment into bay. Regulations point to using bulkheads less.

- Sadie—The panel could use a short-term adaptive management practice. For example the urban stream restoration panel did a 6 month test drive period. Bill Stack—Streams were complicated, the panel thought up the test drive. Initially 6 months, ended up more like 8-9 months. Good feedback from Williamsburg Environmental Group (WEG) and others. No other panel has done this. Its part of the adaptive management process.

- BULKHEADS—Jana and Kevin D (Jana not here yet)
  - In teams we discussed if bulkheads should get credit.
  - Kevin D thought they should but not as much as LS or other ecological options.
  - Circumstances/conditions in which bulkheads would be appropriate. (See attachment "6. TMDL credit matrix for shoreline stabilization methodsv2_Kevin D_draft") explains TMDL credit conditions vs no TMDL credit. Does not offer a way to actually credit, but only under which conditions a credit may be an option.
  - General consensus that bulkheads should not get a credit in earlier Team 1 and Team 2 calls. However, the original charge to prevent sediment and bulkheads stop erosion.
  - Lewis— Issue is if there is a TMDL credit vs no TMDL credit. Shoreline is no longer receding with bulkheads. It is not a BMP but it is a shoreline control practice.
  - Kevin D.—If we don't provide credit, document should explain why we don't support it. Provide the reason not to credit bulkhead even though it does control erosion. Not a BEST management practice.
  - Bill S-If you have a failing bulkhead that is eroding or unstable shoreline, and there are no other alternatives, putting in a bulkhead would reduce erosion and probably nutrient reduction.
  - Steve S—If the major function of the bulkhead is to safeguard structures on site, you aren't looking at other environmentally friendly options. Should you receive credit if primary goal isn't sediment reduction?

  - Jana—Team 1 debated this and eventually voted on it. The vote was not to credit bulkheads.
  - Kevin D-Our job is to scientifically say that this is the load reduction associated with practice and you get this many credits. This is just one of a suite of practices that will be used to meet the TMDL. Don't feel that bulkhead can be given ZERO because it does prevent sediment.
  - Jana- We know that it has negative impact on other things. We have the data to show it; as a result we can say we will give it zero.
  - Bill W-In literature in coastal areas they are having success with establishing reef systems with bulkheads? Don't use a flat front bulkhead.
  - Jana-Maybe there will be enhancement in future, we can be open for innovative practices, but currently bulkheads have negative impact.
  - Scott—Somewhere in all this reduction is missing a time element. Limited timeframe applicable for bulkhead.
  - Steve-Bay restoration is more than TMDL. Some of these practices augment meeting other goals. Bulkhead does not augment other goals, based on that basis alone, discount of credits because you don't achieve these other goals with the practice.
  - Kevin D—This debate is about money. There are SOME situations where bulkheads are only option (see "6. TMDL credit matrix for shoreline stabilization methodsv2_Kevin D_draft.doc" attachment)
  - Steve S—Bulkheads will be put in no matter what. They are considered because of economic reasons not bay restoration.
  - Bill S—Compromise may be that bulkheads are currently discouraged however there are times when necessary.
- Sadie-Does this panel want to recommend a pollutant load reduction credit for bulkhead? Does this panel want to recommend a pollutant load reduction credit for revetments?
  - VOTE: Answer to both questions was yes, based on member vote; Yes =9 to No = 3).
  - Should be strict qualifying conditions (e.g., historically industrialized port) will be outlined since vegetative shorelines are preferred practice in MD and VA.
- VA shoreline erosion update - Scott Hardaway
  - Explained the new AMBUR tool and capabilities for future use. DSAS is program to calculate loading rates, but you don't get all the spaces. We adopted new program called AMBUR that you can follow shoreline and you get more shoreline and get more data. However analysis on the Potomac as a pilot to determine shoreline management geographic extent with AMBUR is unlikely. Scott to keep us updated on this work.
  - Wave energy regime table was presented and is a good idea, but does not fit into the draft protocol structure that the panel is working on now.
  - Lewis—What if X was MGS data? This is useful for engineering studies. This is how you look at fetch and X is recession rate from MGS. This would be a look up table, not in the model. Improvement is needed in the erosion rates for panel's purpose (i.e., prevented sediment and to input in the CBWM and WQSTM
  - Another issue is that we do not have a good idea when bulkheads/revetments were built for older structures.
  - Time is critical thing for this model. If you have a structure, how is it impacts sediment loading?

Sadie-Propose that we go to protocols since Steve has to leave.

- Team 2 Work - Bill Stack (Intro to Protocols)—The following draft protocols are presented to the panel for approval and feedback will be used to update protocols that are approved. There are four protocols that provide a pollutant load reduction credit based on prevented sediment and the associated TN and TP. The 1st protocol is based on prevented sediment, the 2nd, 3rd, and 4th protocols are additive to protocol 1 and each other and represent pollutant removal and/or uptake from the water column from living shoreline practices that contain plants. The 5th protocol represents volume of sand not transported (i.e., disrupted sediment transport). These draft crediting protocol were developed with known and acknowledged uncertainty in the supporting data. Other panels choose err on side of caution, provide conservative pollutant load reduction credits, provide qualifying conditions to prevent unintended consequences, and promote reporting, tracking, and verification to ensure implementation that is consistent with original BMP goals. See attachments "11. Draft Protocol 1_N Forand" and "12. Draft protocols 2 3 4_Stewart_vSRD" for more information on each protocol presented.

PROTOCOL 1-Credit for prevented sediment. Nathan.

- Estimate shoreline sediment erosion rate. (using DNR coastal Atlas or VA erosion data/shoreline reports)
- Convert shoreline erosion to nutrient loading
- Estimate shoreline erosion control efficiency (panel to discuss)

- Steve-what timeframe do we use for shoreline erosion rate. Short term or long term. NEEDS TO BE SPECIFIED. **– Sadie to ask the modeling team.**
- Theoretically, we should use whatever is in the model.
- Sadie—How hard would it be to add % silt/clay?
- Lee-Silts and clay are only loads we count for water clarity.
- Sadie/Ed—N and P testing would be about $80 per site for more specific TN and TP results in lieu of estimates based on sediment.
- Lewis-If a landowner doesn't do the test, use a default value.
- Steve-If county projects do the testing; you get better data for the default value.
- Sadie—I hear that everyone agrees on this protocol. We are missing erosion rates in VA and what conservative erosion rate we should include?
- Steve-Because we are only accounting fastland erosion, we have a conservative value in terms of what we are achieving because not accounting for subtidal.
- Lewis-We could add 1 meter to the bank height to account for the nearshore erosion.

PROTOCOL 2 Denitrifying Credit—Steve Stewart

- Acres of wetland planting times lbs/acre denitrified per year
- Outliers—Would we move this or go with median value from literature?
- Panel recommended using the median value.

PROTOCOL 3 Sediment Trapping Credit—Steve

- Acres of wetlands restoration times lb/sediment/acre.
- Could we give an associated phosphorous credit? (Steve) Haven't explored that far.
- Jana-Accretion credit is way lower than preventative sediment?
- Steve-Yes, different. But it is additive.
- Lewis-Is this organic matter or sediment?
- Steve-Combination of organic and suspended sediment.
- Lewis-I think you need bulk density? To get organic carbon and sediment amount.
- Steve-Yes, there is trouble with conversion on this because surface is usually mostly organic matter and I'm currently working to figure out the conversion. This is likely associated with the stem density for planting.

PROTOCOL 4 Vegetative Uptake Credit – Steve

- Nutrients are temporarily stored in vegetation. A lot of that nutrient amount is in roots. So detritus is usually nutrient poor. Initially. Doesn't take it out of water column for forever, it goes back. Is there a timing of release? Not sure whether this is worth pursuing.
- Sadie-Sounds like it isn't a good option. Lewis-Seems non standard option.
- Margin of safety in crediting. Question for floating wetlands—Do you harvest every year to credit, or let it go back into water column?
- Sadie-To support the denitrification protocol #1 we reviewed a lot of tidal fringe marsh literature. See attachment, "13. Tidal Marsh Lit Summary with DNR table_062813." The wetland literature review determined that wetland research is not as applicable as fringe marsh literature, therefore this additional literature review was compiled.
- Dan-Some of these other protocols 2,3,4 could be given a negative credit if/when you are losing marsh because of project.

PROTOCOL 5 Shoreline downdrift and design storm – Dan

- Dan presented protocol 5 logic to the panel. The panel agreed that it made sense and he should further develop to present at the next meeting.
    - How does model deal with wetland loss over time? We have no wetland land use; we assume they are forest. (Matt Johnson)
    - What about with erosion and storms and that loss and sea loss drowning? Bay Program models are silent on that. NLCD landuse will change in models. Update model with NLCD data. (Matt Johnson)
    - In 2017-Lewis, should have some estimate mid point with projections of loss from sea level rise. Lewis will present sea level rise and modeling information to the panel at the next meeting.

Sadie-Do we agree these protocol approaches?

- Jana-Seem logical, but these are complicated issues. Denitrification one makes the most sense.
- Nathan-Need to think on it more. Protocol 4 should be scrapped.
- Dan-On right track, protocol 4-There may be some oyster reef that may spin into different protocol. Can it be quantified? Yes. Lee doesn't know if its worthwhile. Oyster sequestration, they still die. But there are some TMDL communities to use oysters. No oyster BMP credit. STAC report were not favorable? Check into it.
- Bill W-Thinks protocol 4 shouldn't be scrapped, and will do more research.
- Scott H—I think they are great. On the right track. Protocol4—50/50, defer to others.
- Kevin D-Concerned about 4. But overall likes the protocols. Part of vegetative uptake would come from atmospheric deposits, how would you separate it out? Unless you can parse that out, Don't know how you would quantify effectively.
- George-First 3 are good. I like Dan's new idea because there are projects we are working on, hard to quantify, but if there was a simplified formula it's a good idea.
- Ed-Agree with general premise, biggest questions on 4.
- Bill S-1-3 make sense. 4 is sketchy. Might consider "biological uptake" if include oysters. Wait for Steve S to get back to us with lit review on 4.
- Lee- Agree with 1-3, but not 4.
- Matt-These all sounds great, but if you can put on local govt hats we also have to remember, no matter how well science is or how you quantify, CBPO we need to track it and put in model. The protocols need to be easy enough for local govt to send to state to send to CBPO. Defaults for each protocol are important. Complicated math might not be willing to be done by local govt.

Sadie- Bill W to work with Steve on Protocol 4. Sadie will share email with supporting research done to date for #4 protocol with Bill W.

VIMS Guidelines – Kevin D (Pam proxy)

- VIMS has several guidance documents available for shoreline management.
- What VIMS has done in terms of defining practices and boundary conditions (fetch) into some tools that homeowners can use. On VIMS website. Decision tree for undefended shorelines and those with failed structures. Decision trees for currently defended shorelines.
- Here is the website: http://ccrm.vims.edu/decisiontree/index.html
- No bulkhead anywhere in recommended strategy. There are revetments.
- JANA-MDE used this VIMS flow chart for similar work in MD recently. VA and MD have differences. MD is required to do LS unless impossible.

SAV and Erosion—Lee

- Climate change and water temp are complicated variables for SAV/erosion
- See "SAV and erosion" attachment for details
- Dan-2ft/yr, is there way we could convert into tonnage of foot per year. No analysis to back it up.
- Bill S-Nathan, do you recall erosion rates for your projects? Less than 2 ft per year? Nathan-Can't be sure.
- Lee-Do we want to encourage installing a structure in place it is not necessary for a TMDL credit.
- Kevin D.-Assess negative footprint/impact, but overall benefit may be better. We could apply a negative factor because it's impacting another resource.
- Jana-This will take out most projects out of commission because of the 2 feet per year.
- Panel thought this management strategy should be updated and represented at next meeting; do not want to prohibit shoreline management everywhere (i.e., be too restrictive)

Lee – I could map this on Potomac. Provide next meeting.

SEC practice applied for two reasons – Jana

- Jana-intent of shoreline erosion control or wetland restoration
- Conversation in Team 1 work, we realized we can't do this in isolation without considering wetland restoration?
- Erosion Control (e.g., Cheston Point living shoreline project in the West River) and wetland habitat creation (e.g., Shady Cove wetland project in the West River) were presented as case studies where application, process, intent, and project outcomes were compared with special attention to panel's work/implications

- Sadie – A future wetland panel will start up ~2013 winter can build on this panel's research and fill in gaps. We need to make sure numbers are consistent across all the panels.

Sadie: Another issue is if shoreline management practices CAN and/or SHOULD treat contributing drainage area (CDA) vs. just sediment from shoreline erosion?

- Steve- There is usually no CDA to shoreline projects, however if the designer can prove in the permit process that the project treats additional CDA then that could be considered.
- Usually about 2% of CDA is a good rule of thumb (Dan/Steve/Bill S)

Sea Level Rise - Kevin D, Lewis, and Sadie

- Drafted this section based on available science and applicability to the panel. The panel agreed that the text was relevant and should be included in the panel report. See attachment "SLR Considerations for SEC_070913.doc."

Action Items:

- Panelists to refine work presented based on feedback and ask for panel help when needed; present at Meeting 7
- Sadie to work with panelists to compile a draft report for review/comment at Meeting 7
- Panelists to work together, as appropriate, for the remaining panel charge (see bullets here) and present findings at Meeting 7; no formal Team calls scheduled, rather we will work on this together as a group at our next panel meeting (8/26)
  - Define the proper units that local governments will report shoreline erosion control practices to the state to incorporate into the CBWM. (*Tentative team to address are Lee, Steve, Bill S., Dan, Jeff*)
  - Recommend procedures to report, track and verify that shoreline erosion control practices are actually being implemented and maintained during construction and after construction. (Team to address are Kevin D., Bill W., Bill S. Nathan, Steve, and Lewis)
  - Critically analyze any unintended consequences associated with the nutrient and sediment removal rates and any potential for double or over-counting of the credit. (*Tentative team to address are* Jana, George, Kevin S., Ed, Steve, and Eva)

Other Items:

- New wetlands expert panel was requested from the Habitat Goal Implementation Team to the CBPO. This panel will expand on our panel and other panels that touch on wetland protocols.
- Several future research needs were compiled and will be included in the panel report
- Process for BMP efficiency update: 1) request new panel; or 2) update panel findings with future panel
- Adaptive management will be used. This calls for updates to the panel report recommendations, however the panel will keep in mind that limited time, budgets, priority, etc. can slow this process.
- Provide and/or mention DE and DC in panel recommendations
- Outstanding questions and work items for panel:
  - Resolve the timeframe used for shoreline erosion rates
  - Recommend soil testing for site specific TN, TP, and/or bulk density
  - What is the value for TSS, TN, and/or TP pollutant load reduction for bulkheads?
  - Refine the draft protocols and their use (i.e., additive and/or negative value in some cases)

Meeting Minutes
Shoreline Management Panel
Meeting 7 at Joe Macknis Memorial Conference Room (Fish Shack)
Monday, August 26, 2013
1 pm to 4 pm

EXPERT BMP REVIEW PANEL **Shoreline Erosion Control Practices**		
Panelist	***Affiliation***	**Present?**
Jana Davis, Ph.D.	CBT/HGIT	Y
Kevin Du Bois, PWS, PWD	City of Norfolk, VA	Y
Jeff Halka	MD Geologic Survey	N
Scott Hardaway, P.G.	VIMS Shoreline Studies Program	Y
George Janek	USACOE, Norfolk District	Y
Lee Karrh	MD DNR	Y
Evamaria Koch, Ph.D.	UMCES	Y
Lewis Linker	CBPO	N
Pam Mason	VIMS Center for Coastal Resource Mgt	Y
Ed Morgereth, MS ISS	Biohabitats	N
Daniel Proctor, P.E.	Williamsburg Environmental Group	Y
Kevin Smith	MD DNR	Y
Bill Stack, P.E.	CWP, CBPO	Y
Steve Stewart/Nathan Forand	Baltimore County Dept of Environmental Protection and Sustainability	N/Y
Bill Wolinski, P.E.	Talbot County Dept of Public Works	Y
Sadie Drescher	CWP (facilitator)	Y
Non - Panelists: Hannah Martin (CWP, support), Matt Johnson (CBPO, University of Maryland), Albert McCullough, P.E. (Sustainable Science, LLC), and Guido Yactayo (CBPO Watershed Data Modeling Specialist, University of Maryland Center for Environmental Science (UMCES))		

ACTION ITEMS by DISCUSSION AREA

Review of Action Items, Panel Updates, Approve Minutes, and Announcements

- The panel approved the last meeting minutes (7/16/13) with minor revisions
- Next panel meeting is September 30th and we will use remote using Adobe Connect/conference call.
  - **September through November meeting dates are: 1) 9/30; 2) 10/28; and 3) 11/25**
  - Mark your calendars for upcoming panel meetings that are held on the last Monday of the month from 1pm to 4pm.

Guest Presentations by Albert McCullough, P.E. (Sustainable Science, LLC), Guido Yactayo (CBPO and UMCES), Matt Johnson (CBPO and UMCES)

- Panel to view/review the tidal map provided by Guido and provide input for use

Draft Panel Report Content Updates for Section 6 and Section 7

- Refine the draft protocols based on panel input, seek help from panelists where needed, and present any new information at September's meeting (Nathan, Steve, and Dan)
- Ed, Scott, Dan, Nathan, Steve, Bill S., and Pam to compile a sediment sampling basic design to include in the panel report by the next panel meeting.
- Scott to provide language for this from his previous work/reports for comprehensive approach.

Draft Panel Report Work Session for Sections 3, 4, 5, 8 and 9

- Lee, Dan, and Eva to refine the SAV qualifying conditions
- Pam to review Jana's habitat write up & Jana to draft habitat degradation from bulkheads and revetments Kevin S to QA/QC the Section 5 table he provided at the last meeting and fill in gaps.
- Panelists to review Section 8 and 9; send edits to Sadie by 9/23

- Sadie to contact DE and DC; RE: permits/policy
- Sadie to make edits to report and send panelists draft report by 9/25

Wrap Up (Sadie Drescher)

- Next panel meeting is September 30th and we will use remote using Adobe Connect/conference call.
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- Sadie to follow up with panel member(s) that could not attend.
- Sadie to coordinate with presenters for the next meeting.
- Sadie to provide panel with meeting minutes, next meeting logistics, and action items by 9/16/13.

NOTE: All panel meeting materials are on the SharePoint.

- https://sites.tetratech.com/projects/100-CB_BMP_Review/default.aspx
- General username: ttsvcs\cbuser & General password: Review2012
- File location is Urban→SEC→Admin and Meetings→ 082613 Meeting 7

MINUTES

(action items underlined and panel considerations bolded)

Agenda is in Appendix A

Review of Action Items, Panel Updates, Approve Minutes, and Announcements

- The panel approved the last meeting minutes (7/16/13) with minor revisions
- Review of the Meeting 6 major points, action items, and meeting notes
  - The panel was changed to "Shoreline Management"
- Sadie will discuss the panel at the VA Association of Wetland Scientists (9/27) in Richmond VA, Mid-Atlantic Living Shorelines summit (12/10 or 12/11) in Cambridge, MD, and Coastal Estuarine Research Federation (11/6) in San Diego, CA
- Next panel meeting is September 30th and we will use remote using Adobe Connect/conference call.
  - **September through November meeting dates are: 1) 9/30; 2) 10/28; and 3) 11/25**
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Guest Presentations by Albert McCullough, P.E. (Sustainable Science, LLC), Guido Yactayo (CBPO and UMCES), Matt Johnson (CBPO and UMCES) – Presentations in Appendix B

Albert McCullough, P.E. (Sustainable Science, LLC), "Navigating the shoreline management process: A ground level perspective"

- Albert presented his approach to shoreline projects from the design process to working with the landowners to constructing the actual project.
- There is a defensive approach in US where use revetments and bulkheads most often but that is changing in MD and VA with new regulations
- Most important to have pre-application meeting with regulatory agency to make the permitting process run smoothly and figure out how to address any regulatory constraints
- DISCUSSION
  - Eva-Do you take into account the sediment type? Yes, if it is stable or not. Typically for sediment, we bring in sand. A: Washed concrete sands.
  - Eva-If you have peat type sediment do you cover it? A: We don't excavate, we usually just fill. The sand would go over peat.
  - Eva-SAV likes this, sand provides good habitat for SAV.
  - Albert uses a woven fabric that is tough to hold the material well when the sediment isn't as stable. There are different thicknesses for different applications.
  - Sadie: Permitting—what has been your experience? A: Work mainly in MD, so know this policy best. Recently, the joint permit application is integrating the critical area. The process is relatively seamless. If there is some pushback from regulatory agencies, then you have to adjust accordingly. At the local level, each county is different. Interaction with property owner is a key factor in the process.
  - Nathan-Do you have to determine erosion rate at each site? Is that a requirement for every project? A: I look at historic images and find the strong and weak points of the shoreline and use wave analysis with that. Not looking at rates, but at point in time.
  - Scott-Do you find yourself in a position where you accommodate environmental constraints to the designs? A: SAV is a concern especially since it is considered in the permitting process. Do you account for sea level rise in the designs? A: We try to account for SLR.

Guido Yactayo (CBPO and UMCES), "Tidal waters map: A first draft presented and panel input needed"

- P532 watershed model segments adjacent to tidal waters
- Lewis asked Guido to identify tidal segments with a shoreline for the panel
- Guido used aerial imagery to review all the tidal segments to perform quality control; he created an online file that is available for panel review and edit
- Guido presented specific cases where he made judgment calls (e.g., a dam present then considered no shoreline area) and asks the panel to use their expertise to check these and make any other edits to this map
- This online map for panel review and input is online here: https://archive.chesapeakebay.net/Modeling/phase5/Phase532/Segmentation/p532_shoreline_v1.zip
- DISCUSSION
  - Sadie: This map is an effort to define the geographic boundary as part of our charge . Is this worth pursuing?
  - Bill Stack: There are similarities between these issues and stream restoration. Third order and smaller streams are not represented in model. The issue is from reporting standpoint from manager's perspective.

- Matt Johnston: Some state agencies are 20 steps removed from field. We are asked to place in correct model area. We have 2200 segments in the Bay. This map will provide the available domain where the shoreline erosion is available for project implementation. Lat and longs will help define this. It would be good if states would review this and use (e.g., as guidance or in another way).
- Kevin Smith-Is there a tidal boundary in the model? Matt-Guido was saying that the model ends the tidal line but its not completely correct to align with shoreline practices.
- Sadie: Is this something that would be useful? Too many unknowns? A: Matt-Not a change in modeling structure. This is different than any other BMPs. Shoreline control can't go anywhere.
- Lee-How many segments did you find that had to be manually included? A: A few, not a lot.
- Lee-Interesting point about reservoir.
- Bill Stack: Issue is one of reporting and crediting. If you have project outside of segmentation will that prevent TMDL pollutant load reduction (aka credit)? If jurisdiction can report a project it should be ok. The question is if the shoreline goes into other segments. Can we tell if it's an appropriate location for a shoreline project to be implemented?
- Matt: If you don't want to go segment by segment you can go county by county. Any projects in the county, it could go into model.
- Pam-County would work for VA
- Scott-Need to figure out when to get credit. This can be worked around and used as guidance.

Matt Johnson (CBPO and UMCES), "Reporting, tracking, and verification: How it is SUPPOSED to work"

- DISCUSSION
- Matt discussed the watershed model and water quality and sediment transport model (aka Estuary Model) to include the history, known complications related to the shoreline management practices, reporting, and tracking.
- MD and VA only states with shoreline erosion control.
- National Environmental Information Exchange Network (NEIEN) can accept shoreline management projects, however since the load reduction for shoreline management has been equal to stream restoration and no shoreline management projects have been reported to CBP (through NEIEN), then it is likely the states reported shoreline management as stream restoration in the past. This could and should be changed and shoreline management should be reported as its own practice. And this panel's recommendations can be used to calculate the load reduction for each project.
- Matt discussed that the load was in the Estuary model but the shoreline management load reduction was in the watershed model. Matt, Lewis, Bill, Sadie, and Steve Stewart discussed this and Lewis thought it was best to keep the load and load reduction in the respective model, but explained that the model team would use an "alteration" so that the model continues to correctly account for the shoreline management credit and load.
- Sadie: Is there an easy way to pull out the shoreline management practices out of stream restoration practices as currently reported to CBPO? A: That is a state question.
- Action: Select panelists to review the information and report back to the group. Suggest Scott Hardaway and Kevin Smith.

Draft Panel Report Introduction (Sadie Drescher)

- Sadie introduced the panel outline, report sections, and goals for the panel review and input today. She asked for any major gaps or portions of the report to address now. None were voiced.

Draft Panel Report Content Updates for Section 6 and Section 7 (Sadie Drescher) – See Appendix C for draft protocol 1 and draft protocol 5 that are discussed here. See Appendix D for panel qualifying conditions from Lee and Jana.
Section 6. Recommended Protocols for Pollution Reduction

- Protocol 1 (Nathan and Dan)
  - Nathan gave an update for Protocol 1 based on last meeting's feedback.
  - MD's shoreline erosion rates can be easily found from DNR's website, but VA's shoreline erosion rates are in several reports. These two links are to summaries of publications on erosion from a series known as Shoreline Situation Reports. http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/virginia/scan_reports/SSRSummary.pdf http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/virginia/scan_reports/TidewaterShorelineErosion.pdf This link is to a series of publications known as Shoreline Evolution Reports http://web.vims.edu/physical/research/shoreline/Publications-Evolution.htm
  - Step #2 is to convert shoreline erosion to nutrient loading. Dan and Nathan discussed this protocol. Several suggested edits related to site specific nutrient information needs and/or bulk density needs. Should we recommend site specific soil samples for TN, TP and bulk density?
    - Sadie: What are the pros and cons for recommendations from the panel to take soil samples vs using a set value (for TN and TP concentration).

        - All depends on cost of sampling.
        - Bill S. – There could be local resistance to this if this is time and/or cost prohibitive.
        - Cost is nominal compared to cost of the projects. It's a lot to ask for but it is necessary.
        - Daniel Proctor: There is a benefit to test for nutrient concentrations due to variability.
        - Kevin Du Bois: Recommendation is for projects that would want to make a claim would have to do site specific soil testing? For example, if there is a living shoreline project where private landowner is stabilizing using living shoreline. However, the municipality wants to get the credit, would they get right of entry to go do soil testing?
        - Bill-Local gov't is permitted, that would give rights to access sites for inspection or testing.
        - Scott: Sampling is fairly easy and consists of taking a soils sample from the exposed bank with a bag.
        - Ed, Scott, Dan, Nathan, Steve, Bill S. and Pam to compile a sediment sampling basic design to include in the panel report by the next panel meeting.
    - Efficiencies for coarse vs. fines.
        - In the last meeting we discussed using a multiplication factor to account for the fines, course, and sand sediment parts. However, since the panel recommends soil testing, this is not needed.
            - Lee-With protocol 1, you would have to core the bank samples and that makes the price higher.
            - Sadie-Should we use default Ibison numbers? A: No. The panel decided that we are trying to get away from those values since they are highly variable and site specific (i.e., to where they were taken in VA).
            - Kevin D: In protocol 1, is a 50% efficiency rate used? No; that was from older notes.
            - Kevin S: There are soil surveys, it would be nice to use them
            - Lee-Those surveys do not go into the coastal banks.
            - Result: No need to do this since the panel recommends site specific soil testing.
    - Average bank height should be obtained from the site plans. Could provide guidance to use natural breaks in the shoreline management design for the average bank height. The guidance should be straight forward and as simple as possible so that it is easily interpreted and followed.
        - Bill W-LIDAR could be used. It's applicable from large scale modeling perspective.
- Protocol 2 and 3 (Steve S)
    - Steve had to miss the meeting and will follow up with panel in September's meeting
- Protocol 4 (Bill W)
    - Bill W has contacted several experts in the field and is waiting for their summary results to report to the panel for this protocol. There seems to be agreement with the experts that vegetative uptake could result in TN and TP storage in biomass.
      Discussion
    - Will there be separate committee looking at wetlands? A: Yes, and they will build on the existing wetland cross over in panels, including this panel.
    - In past meetings, we've discussed oyster reefs or other biological practices to be considered for shoreline management. Add these to the report.
    - Bill also shared the Talbot County GIS BMP tracking report done by Environmental Concern's graduate student. This is on the SharePoint in Meeting 7 folder.
- Protocol 5 (Dan)

Recommendation is to not have separate protocol. Pursue this as protocol 1 with a qualifying condition.

- Bill S: Existing protocols, which protocol do these types of practices fit under? Protocol 1.
- Jana: Seems arbitrary to give credits to some structures but not all?
- Jana: Would this be a qualification or a recommended protocol? A: Likely a qualification.
- Lee-There could be shoreline management practices that function as designed but could be impacts the shoreline in other areas.
- Basic qualifying conditions can address these concerns.
- Bill S: We should come up recommendations that prevent problems as much as possible using our qualifying conditions.
- Scott-A comprehensive assessment of the shoreline is the answer. We should recommend dealing with shoreline erosion on reach basis; however, reality is that this does not happen because many landowners exist per reach. We could recommend a comprehensive approach and Scott to provide language for this from his previous work/reports.
    - Bill- The stream panel elected to choose reach projects. However, shoreline projects are different and this approach may not make sense.

- Jana- If we can't predict the outcome of the project, the effects of that project, we shouldn't be hasty to provide the credit.
- Unintended consequence of putting that threshold on the credit, fewer living shoreline projects. We want to encourage living shorelines, credit is one way of doing that.
- Our report can cite that the recommendations of the panel are an ongoing process and adaptive management is needed.
- Kevin S- We should work at comprehensive reach level. In reality we cannot do that yet.
- Future research need!
- Panel recommended to pursue this idea as a qualification in Protocol 1. Dan to draft language.

Draft Panel Report Work Session for Sections 3, 4, 5, 8 and 9 (Sadie Drescher)

- Sadie led the panel through the draft report sections to address comments called out by Lisa Fraley-McNeal (Center) and Bill Stack (Center). Additional comments and feedback were solicited from the panel.
- Panel members presented their contributions for Section 5 Basic Qualifying Conditions for Individual Projects, as follows
  - SAV and erosion (Lee)
  - SAV and shoreline management options (Eva) – will consult with Lee and present update at next panel meeting
  - Shoreline Management Habitat draft language (Jana) – Pam to review

Section 8. Reporting, Tracking, and Verification

- Units for local governments to report to state.
  - Bill W-The county also struggling with tracking method. However, we have a tracking report for all BMPs. The county needs a comprehensive method to aggregate all projects at the local level for reporting, tracking, and verification.
  - Sadie- Report has generic tracking pieces because local reports are different
  - There should be initial performance verification and future field verification to ensure project performance
  - Sadie: Panel to review and provide feedback to Sadie.
  - Look at project lifespan.
  - Verification: Should we use 5 years? A: Yes. This aligns with other panel reports.
  - Stream restoration panel added "unless there is a catastrophic event" language that is relevant here. Add to report.
  - Add into research needs – Determine the lifespan of the shoreline management practice.
  - State localities responsibility. A: Everyone agrees this is reasonable.

Section 3. Shoreline Erosion Control in the Chesapeake Bay

- Modeling language is currently lacking in this section. Sadie asked Lewis and Matt to provide their input and edits.
- Kevin D: Have minor edits that will send to Sadie. Sadie to incorporate into draft report.

Section 4: Review of Available Science

- Sadie to compile the annotated bibliography, but the references cited in the report focus on research that applies to panel recommended protocols.
- Adaptive management will be recommended so that updates are done every two years. Sadie to add language

Section 5: Basic Qualifying Conditions for Individual

- Have to leave in policy and permits section.
- Need DE and DC permit information. Who should we contact about this?
  - Panel recommended: Melanie Stiles for DE.
  - Steve Saari DC and/or Pete Hill DC
  - Sadie to contact.
- Basic qualifying conditions were discussed.
- Kevin S to QA/QC the table he provided at the last meeting and fill in gaps.
- Jana—We should summarize the impacts of hardened shorelines. There is missing information for some impacts based on lack of science. Jana to draft habitat degradation from bulkheads and revetments
- Lee- Presented a decision tree for shoreline management practices and SAV impacts. This could be added to the qualifying conditions to protect Bay SAV. There are shoreline management practices that can negatively impact SAV. The aim is to ensure that the shoreline management project proposed will not impact nearby resources, such as SAV.

- Does the panel agree? If so, where does this qualifying condition go in the report?
  - Historic, recent, current used in the decision tree. What is a recent occurrence? A: We can go back to 1984 with aerial survey.
  - Scott: This makes sense to me. SAV is key for water quality.
  - Jana- Should this be in the qualifying conditions? Are we driving toward one project?
  - Lee to write this in summary form, refine, and work with Eva.
  - What do we consider recent, historic and apportion credit reduction? A: 5 years is recent.
  - Jana – This makes sense.
  - Daniel-I have concerns with thresholds. The 2 ft per year erosion rate, specifically, because it doesn't reflect bank height. However, I am comfortable with this qualifying condition, if with bank height parameter included. Lee- I don't know how you would get that with current information. That's future research. Sadie will add to future research. Dan, Eva, and Lee to discuss offline.
- Panel to review Section 9. Send Sadie edits and comments.
- Sadie: Want a better report for everyone by next meeting. Panel to send report edits to Sadie by Sept 23. Sadie to send panel draft report for review by September 25 for review before our next meeting on Sept 30.

Wrap Up (Sadie Drescher)

- Next panel meeting is September 30th and we will use remote using Adobe Connect/conference call.
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Meeting 8 at Joe Macknis Memorial Conference Room (Fish Shack)
Monday, September 30, 2013
1 pm to 4 pm

EXPERT BMP REVIEW PANEL **Shoreline Erosion Control Practices**		
Panelist	***Affiliation***	**Present?**
Jana Davis, Ph.D.	CBT/HGIT	Y
Kevin Du Bois, PWS, PWD	City of Norfolk, VA	Y
Jeff Halka	MD Geologic Survey	N
Scott Hardaway, P.G.	VIMS Shoreline Studies Program	Y
George Janek	USACOE, Norfolk District	Y
Lee Karrh	MD DNR	N
Evamaria Koch, Ph.D.	UMCES	Y
Lewis Linker	CBPO	Y
Pam Mason	VIMS Center for Coastal Resource Mgt	Y
Ed Morgereth, MS ISS	Biohabitats	N
Daniel Proctor, P.E.	Williamsburg Environmental Group	N
Kevin Smith	MD DNR	Y
Bill Stack, P.E.	CWP, CBPO	Y
Steve Stewart/Nathan Forand	Baltimore County Dept of Environmental Protection and Sustainability	Y/Y
Bill Wolinski, P.E.	Talbot County Dept of Public Works	Y
Sadie Drescher	CWP (facilitator)	Y
Non - Panelists: Hannah Martin (CWP, support), Matt Johnson (CBPO, University of Maryland), Gene Slear (COO for Environmental Concern, Inc.)		

Notes by DISCUSSION AREA

Review of Action Items, Panel Updates, Approve Minutes, and Announcements

- The panel approved the last meeting minutes (8/26/13)
- Next panel meeting is October 28th and we will use remote using Adobe Connect/conference call.
  - **Next meeting two panel meetings are: 10/28 and 11/25 from 1pm to 4pm**

Matt Johnson (CBPO, University of Maryland), Modeling Update

- Sadie, Matt, and Lew will work together on this

Steve Stewart, Draft Protocol 2 and 3 Updates

- Steve to review the data and present draft protocol 2 and 3 at next panel meeting

Bill Wolinski and Gene Slear, Draft Protocol 4: Vegetative Uptake Update

- Bill W will further research this and present draft protocol 4 at the next meeting

Eva Koch, Sands vs Fines

Steve and Eva to refine this idea

Draft Panel Report Work Session for Sections 3, 4, 5, 8 and 9

- Lee, Dan, and Eva to refine the SAV qualifying conditions
- Panelists to review Sections 2 through 9; send edits to Sadie by 10/11
- Sadie to make edits to report and send panelists draft report by 10/18

Wrap Up (Sadie Drescher)

- Other –

  - Jana: Based on the panel's work there are levels of consensus for the panel's recommendations. Is there a need to capture dissenting opinions? I am on an AGU panel discussing dissent, have discussed this with Sadie, and would like to explore an option to provide the minority opinion for issues that the panel encounters (e.g., hardened structures receiving pollutant load reductions).
  - Sadie, Jana, and Pam to discuss offline and bring a proposal for capturing levels of consensus to the next panel meeting.
- Next panel meeting is October 28th and we will use remote using Adobe Connect/conference call.
  - **Next meeting two panel meetings are: 10/28 and 11/25 from 1pm to 4pm**
  - Mark your calendars for upcoming panel meetings that are held on the last Monday of the month from 1pm to 4pm.
- Sadie to follow up with panel member(s) that could not attend.
- Sadie to coordinate with presenters for the next meeting.
- Sadie to provide panel with meeting minutes, next meeting logistics, and action items by 10/21/13.

MINUTES

(action items underlined and panel considerations bolded)

Review of Action Items, Panel Updates, Approve Minutes, and Announcements

- The panel approved the last meeting minutes (8/26/13)
- Sadie presented the panel updates to the VA Association of Wetland Professionals in Richmond, VA on 9/27/13; Jana and Kevin are on the steering committee for the Living Shoreline Summit in Cambridge, MA on 12/10 & 12/11; Sadie will speak here about the panel
- Last meeting action items and updates:
  - Sadie checked with DE and DC about their shoreline management policy and permit; gave update to panel and will input this in panel report
  - Sadie has updated the panel report with panel input and addressing comments from Lisa Fraley-McNeal and Bill Stack who reviewed the draft version
- Next panel meeting is October 28th and we will use remote using Adobe Connect/conference call.
  - Next meeting is November 25 (11/25) from 1pm to 4pm
- Panel agenda was reviewed; agenda is in Appendix A

Matt Johnson (CBPO, University of Maryland), Modeling Update

- Each panel report will have an appendix that details how the findings will be implemented in the model
- Have not reviewed this report yet, but still in process
- Sadie, Matt, and Lew will work together on this
- Kevin D: Many local governments did not think living shorelines would be credited, so it was not included in some WIPs. However, there is a rate and this panel is updating it, so we should get the news out.
  - Steve: We have rates now from the urban stream restoration rates; this should help local governments meet their WIPs.

Steve Stewart, Draft Protocol 2 and 3 Updates

- Draft Protocol 2: Denitrification update and Draft Protocol 3: Sedimentation update
  - Still finalizing the available information and drafted these protocols
  - Draft Protocol 3, we need to figure out pounds per acre and how to measure the acres of vegetative plantings. We also need to figure out how to verify to ensure that everything is functioning
  - Lew-Is there enough in literature to discern between different salinity systems?
  - There are sufficient studies, many are not for fringing marshes
  - Scott Hardaway: Is it good to have two species in there for denitrification? Biodiversity is good, so it is better to have more species.
  - Kevin Smith: We are assuming the living shorelines are going to be dominated by marsh vegetation. However, in our experience we know that living shorelines have an array of types.
  - Sadie: These are good considerations to add to qualifying conditions of report.
  - Eva: We can include the vegetation and what benefits they provide.
  - Kevin S: The current protocols have one prevented sediment pollutant load reduction and additive reductions for vegetation.
    - Vegetated reports: Even vegetated shoreline might not contain a diverse array of vegetation. We are basing efficiency number on fringe marsh. Not same components every time. Depends on energy regimes and multiple factors.
    - Shore protection: Wave control could be dampened by SAV, oyster reefs, etc.
- Steve to review the data and present draft protocol 2 and 3 at next panel meeting

Bill Wolinski and Gene Slear, Draft Protocol 4: Vegetative Uptake Update

- Bill W and Gene presented the literature review (Appendix B)
- Steve: When the marsh vegetation dies back, the detritus washes out and provides carbon base for other nutrient cycle in terms of microbial system and creates fish nutrition.
- Gene: In my experience there is not a lot of migration of detrital material to open water at least in a constructed marsh with stone containment structure.
- Bill W: This is an aspect we are struggling with, i.e., plants have an undisputed role in denitrification and the panel is trying to split out the cycles for pollutant load reduction based on available literature/information.

- Lew: Appreciate the difficulty in trying to tease out studies, sounds like maybe if you take info as a whole that 40% retained and 60% denitrified. Denitrification is a large marsh nutrient removal system.
  - Denitrification does not occur if there is not a significant amount of carbon and an oxygen zonation for the microbes to switch to using denitrification.
- Bill W.: I will do more research on Gene's literature review and report to the group at the next meeting.
- Bill S: We might want to look at literature from study of leaves from terrestrial systems.
- Sadie: We need literature/information to support the panel's recommendations here.
  - Steve: N vs. P sequestration for different salinity regimes
  - Lew: Base the reduction on marsh square feet
  - Kevin D: Draft protocol 4: Vegetative Uptake is important to include if we think it provides these functions, because this additional pollutant load reduction will make vegetative shoreline BMPs more cost effective than hardened structures. Additive credits for vegetation, can promote living shorelines.
  - Pam: Draft protocol 4: Vegetative Uptake is a protocol the panel should continue to research it and include in the recommendations.
- Bill S: The panel has an offer from Bill W. and Gene within next month to look at this.
- Bill W will further research this and present draft protocol 4 at the next meeting
  - Kevin S: Carbon is important for living shoreline projects. Most vegetated systems have plenty of carbon for denitrification. How does this play into our discussion of denitrification?
  - Kevin D: When you mention need for carbon, when we build living shorelines it is 100% sand until vegetation matures and builds up. The Living Shoreline Summit is coming up in December and this could be a discussion issue (e.g., using carbon amendments for living shoreline projects).
  - Bill Stack: This is a similar issue we had in the urban stream restoration panel. Could not figure out the optimal amount of carbon for the system. The panel decided to only could recommend that carbon is critical to design and recommend future research and future panel work.
  - Steve: There is a question of timescales for the BMP pollutant load reduction over time.
  - Lew: The models assume that the pollutant load reduction occurs immediately.
  - Steve and Kevin D: Lag times for BMP efficiency to be realized (e.g., vegetation establishment) would better represent real world conditions. This issue is ecological processes vs model parameters.

Lewis Linker, Assessment of the influence of sea level rise in the Chesapeake Bay
Assessment of Sea level rise in CB (Appendix C)

- There are many drivers for updating the bay models for future sea level rise (e.g., Executive Order, 2010 TMDL CBP Commitments, EPA OW CC Strategy, The White House Council on Environmental Quality, State specific strategies (e.g., MD strategy), and STAC's interest in climate change)
- Sea level rise is a research need and not accounted for in the model yet
- CBP Model assessments will likely include:
  - Current efforts are to frame an initial future climate-change scenario based on estimated 2050 conditions.
  - Conditions to be described include land use, rainfall, air temperature, water temperature, sea level rise, and wetland loss due to sea level rise.
  - The Watershed Model will be employed to predict flows and loads from the watershed based on the projected conditions of temperature, precipitation, and PET.
  - New tidal Bay hydrodynamics will be required based on projected flows, sea level, and shoreline geometry.
  - Multiple eutrophication model and living resource model runs will be made based on the projected conditions and management plans including the TMDL.
  - Particular attention will be devoted to the effects of climate change on living resource regions including SAV beds and wetlands.
- Assessment of impact of sea level rise is one of the assessments on the impact of climate change on the Chesapeake Bay ecosystem.
- The work involves adjusting the ocean boundary conditions of water elevation and salinity of the CH3D simulation to represent the 2050 condition. Subsequent work will link the watershed and water quality models.
- Air and water quality standards will not change; we must adapt strategies based on climate change in order to achieve standards.
- New tidal bay hydrodynamics will be required based on projected flows, sea level and shoreline geometry.
- Conclusions:

  - Multiple stressors, such as continued population growth in addition to warming and sea-level rise associated with global change, will be challenges to the restoration efforts in Chesapeake Bay.
  - Changes in precipitation intensity, flow, and temperature could change nutrient and sediment loads. Higher temperatures are already placing stress on *Zostera* (eel grass) a key SAV species.
  - Our objective for the 2017 Midpoint Assessment is to provide decision makers our best assessment of the influence climate change will have on the Chesapeake TMDL.
- Goal is to get a tool out to help plan for and estimate wetland loss
- DISCUSSION
  - Bill W-Loss of forest as well based on salinity
  - Kevin D: Research Needs: insure they are long lasting even in presence of sea level rise. What do we do to maintain these projects? Adaptive strategies to continue TMDL credits
  - Sadie: The panel included sea level rise as part of this report and the research needs
  - Inspection every 5 years, that is where the sea level rise recommendations/information can be updated
  - The panel's inclusion of sea level rise in the report is a good idea.
  - Kevin S: We have to address sea level rise in the report

Scott Hardaway, Comprehensive Approach and Sediment Sampling and Tidal Map Update (Appendix D)

- Scott presented language to include in the report for a shoreline management comprehensive approach discussed in Meeting #7 and presented a draft sediment sampling protocol
- The comprehensive approach language and sediment sampling protocol are provided in Appendix D
- The panel discussed using a default value versus site specific sampling:
  - Steve: For planning purposes, the local government needs a default value
  - Sediment sampling: Maintain vertical integrity. This adds to the cost with each sample you have to take because of bank size.
  - Kevin D: Does the panel recommend or require sediment sampling? If private property owners that want to do shoreline management have to spend more funds to implement living shorelines because of soil sampling and who will pay the cost?
  - Pam: The local government would have to pay for it because they are getting the pollutant load reduction for the TMDL.
  - Kevin D: Then, that is less money they local government can use for incentives.
  - Kevin D: We should use a default so that the local government has a choice to spend funds for sampling or not.
  - Sadie: Sounds like the panel wants to recommend a default value based on the Ibison values and recommend sediment sampling for site specific information. The panel can provide Scott's sediment sampling protocol as an example/guidance.
- The tidal waters map Guido presented in Meeting #7 makes sense as guidance for shoreline management

Kevin Smith, Qualifying Conditions and Tidal Map Update

- Will review the qualifying conditions in Section 5 of the report and update
- The tidal waters map Guido presented in Meeting #7 makes sense as guidance for shoreline management

Eva Koch, Sands vs Fines (Appendix E)

- Eva presented a framework for pollutant load reduction that takes into account that sands can be good for nearshore habitat and fines negatively impact the nearshore habitat and fines are associated with most of the nutrient pollutants.
- The matrix is in Appendix E
- Kevin D: Understand concept, but relating to TMDL, how do we discount credit to encourage ecosystem services not related to sediment reduction or N or P reduction. How within confines of our mission we can discount practices that are equally effective in reduction because of biology. That is not part of our charge
- Eva: Our charge is to improve the Bay.
- Scott Hardaway: Is cost part of the equation? No—how much fines and sand are going in the Bay. Sand is "good" and fines are "bad."
- Steve: We should revisit data on N and P content and look at relation to particle size distribution from standpoint you might typically association N and P with fines, sand just does not have N and P high levels. Then you get differential in terms of sand component.
- Eva: Some projects do not let sand erode, detrimental effect of biology so it will not be there to take up N and P.
- Bill Stack: not sure we have the scientific support to support this table with the highest to none credit.

- Steve: Is there something we can use that is similar to the retrofit curve?
- Scott Hardaway: The Ibison (1990) report has a regression for sediment size and pollutant load.
- Kevin S: Can the panel support this matrix, scientifically? And implement in a way that does not require a lot of work on municipality or landowners part. Do we have literature to back this up?
- Eva: We have couple of thresholds for erosion rates.
- Sadie: How does this discussion support or add to other protocols?
- Kevin D: I do not see where it fits in our charge. Biologically ecosystem service, does not relate specifically to N and P and sediment and erosion control.
- Kevin S: would like to support this idea but need science to back it up
- Lew: In terms of the matrix content the current draft protocols support this idea.
- Eva: We should give pollutant load reductions for allowing sand to enter nearshore waters.
- Steve: Local governments need to meet the TMDL and consider the impacts of resuspension.
- Eva: Sand is needed for SAV, marshes, beaches and should not be combined with the fines that are more associated with TSS, TN and TP pollutant load.
- Sadie: What is the decision point?
- Bill Stack: We are almost near a consensus if we use the Ibison (1990) curve.
- Steve: Should we only be giving credit for silt/clay component?
- Lew: Sand is not a problem for the Bay.
- Steve: TSS is based just on fines? Lew: Yes. We could refine this based on % fines and there is a default value for that. We could also have a refinement by just doing particle size analysis.
- Sadie: Steve and Eva to refine this idea

Pam Mason and Jana Davis, Habitat Information for Shoreline Type and Qualifying Conditions (Appendix F)

- Pam, Jana, Kevin D, and Sadie refined the Habitat write ups to include in the report; these are on the panel's SharePoint website and in Appendix F for panel review/input

Draft Panel Report Work Session for Sections 3, 4, 5, 8 and 9

- Lee, Dan, and Eva to refine the SAV qualifying conditions
- Panelists to review Sections 2 through 9; send edits to Sadie by 10/11
- Sadie to make edits to report and send panelists draft report by 10/18

Wrap Up (Sadie Drescher)

- Other –
  - Jana: Based on the panel's work there are levels of consensus for the panel's recommendations. Is there a need to capture dissenting opinions? I am on an AGU panel discussing dissent, have discussed this with Sadie, and would like to explore an option to provide the minority opinion for issues that the panel encounters (e.g., hardened structures receiving pollutant load reductions).
  - Sadie, Jana, and Pam to discuss offline and bring a proposal for capturing levels of consensus to the next panel meeting.
- Next panel meeting is October 28th and we will use remote using Adobe Connect/conference call.
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NOTE: All panel meeting materials are on the SharePoint.

- https://sites.tetratech.com/projects/100-CB_BMP_Review/default.aspx
- General username: ttsvcs\cbuser & General password: Review2012
- File location is Urban→SEC→Admin and Meetings→ 093013 Meeting 8

Meeting Minutes
Shoreline Management Panel
Meeting 9 at Joe Macknis Memorial Conference Room (Fish Shack)
Monday, October 28, 2013
1 pm to 4 pm

EXPERT BMP REVIEW PANEL **Shoreline Erosion Control Practices**		
Panelist	***Affiliation***	**Present?**
Jana Davis, Ph.D.	CBT/HGIT	Y
Kevin Du Bois, PWS, PWD	City of Norfolk, VA	Y
Jeff Halka	MD Geologic Survey	N
Scott Hardaway, P.G.	VIMS Shoreline Studies Program	Y
George Janek	USACOE, Norfolk District	Y
Lee Karrh	MD DNR	N
Evamaria Koch, Ph.D.	UMCES	Y
Lewis Linker	CBPO	Y
Pam Mason	VIMS Center for Coastal Resource Mgt	Y
Ed Morgereth, MS ISS	Biohabitats	N
Daniel Proctor, P.E.	Williamsburg Environmental Group	Y
Kevin Smith	MD DNR	Y
Bill Stack, P.E.	CWP, CBPO	N
Steve Stewart/Nathan Forand	Baltimore County Dept of Environmental Protection and Sustainability	Y/Y
Bill Wolinski, P.E.	Talbot County Dept of Public Works	Y
Sadie Drescher	CWP (facilitator)	Y
Non - Panelists: Hannah Martin (CWP, support)		

Action Items by DISCUSSION AREA

Review of Action Items, Panel Updates, Approve Minutes, and Announcements

- The panel approved the last meeting minutes (9/30/13)
- Next panel meeting is November 25th and we will use remote using Adobe Connect/conference call.
  - **Mark your calendar for the next meeting 11/25 from 1pm to 4pm**

Sadie Drescher & Nathan Forand, Draft protocol 1: Prevented sediment update

- None

Steve Stewart, Draft protocol 2: Denitrification update

- Steve/Sadie to refine the DNR rates by 11/15
- Steve to share the conversion excel spreadsheet with panel

Steve Stewart, Draft protocol 3: Sedimentation update

- Steve to send out the sedimentation literature to panel to Sadie to upload to SharePoint for panel
- Sedimentation (draft protocol 3) team to meet, work, and provide a draft protocol by 11/15
  - Sadie to plan a conference call w/ team to include Steve, Bill W., Pam, and Jana by 11/1.

Bill Wolinski, Draft protocol 4: Vegetative Uptake update

- Panel come to review Bill W's presented literature, meet to work on this protocol, and draft a protocol for panel review w/in 2 weeks (by 11/15).
- Bill W to send out Vegetative Uptake papers to Sadie to upload to SharePoint for panel by 11/1

Dan Proctor, SAV qualifying conditions update

- Dan will continue with this analysis and provide Lee with the information

- Lee, Dan, and Eva (if needed) to present the information to the panel w/in 1 week (by 11/4)

Sadie Drescher, Pam Mason, and Jana Davis, Consensus, dissent, and recording the panel's results

- Jana to develop as appropriate (e.g., if needed) and per panel consensus

Draft Panel Report Work Session – Panel reviewed report sections, provided feedback, suggested edits

- Sadie to make these updates to the report
- Sadie to complete the annotated bibliography for the panel report
- Jana to update Table 4 Shoreline management strategies by 11/4
- Kevin S., Scott, and Kevin D to refine the Basic Qualifying Conditions based on Kevin D's
- Sadie to start this qualifying conditions discussion through email with Kevin S., Scott, and Kevin D and draft work product to be completed by 11/4
- Kevin D to send Nationwide 19 language in VA that promotes living shorelines by 11/1

Other considerations included:

- Sadie to follow up with Nathan and Dan to work on example hardened and vegetative "sample" projects that use the draft protocols to provide at the next meeting and to provide as examples in Section 7 of the report.
- Sadie to find out the panel public comment and if other EPA CBP GITs than WQGIT will review the panel report.

NOTE: All panel meeting materials are on the SharePoint.

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- General username: ttsvcs\cbuser & General password: Review2012
- File location is Urban→SEC→Admin and Meetings→ 102813

MINUTES

(action items underlined and panel considerations bolded)

Review of Action Items, Panel Updates, Approve Minutes, and Announcements

- The panel approved the last meeting minutes (9/30/13)
- Last meeting action items and updates were reviewed and included:
  - Sadie to work with Matt Johnson and Lewis Linker, as appropriate, to draft a companion modeling document - ongoing
  - Bill W researched draft protocol 4: vegetative uptake
  - Steve and Eva to continue refining sands vs fines
  - Lee, Dan, and Eva refined the SAV qualifying conditions
  - Panelists provided Sadie with draft report edits
  - Sadie provided a draft panel report to panelists prior to the meeting
  - Sadie, Jana, and Pam discussed panel levels of consensus
- Panel agenda was reviewed; agenda is in Appendix A
- Relevant meetings were discussed and included:
  - Dan presented at a local seminar in Norfolk, VA hosted by the Lorman group; he mentioned the panel work;
  - Jana and Kevin are on the steering committee for the Living Shoreline Summit in Cambridge, MA on 12/10 & 12/11; Sadie will speak here about the panel; several panelists will speak and attend (e.g., Eva, Scott, Pam)
  - Sadie will speak about the panel at the Coastal Estuarine Research Federation Nov 6
- Next panel meeting is November 25th and we will use remote using Adobe Connect/conference call.
  - **Mark your calendar for the next meeting 11/25 from 1pm to 4pm**

Sadie Drescher & Nathan Forand, Draft protocol 1: Prevented sediment update

- Sadie and Nathan presented updates to Protocol 1: Prevented Sediment
  - Panel agreed with the Protocol 1: Prevented Sediment edits to include:
    - Allow default, conservative Ibison TN and TP numbers, but promote site specific sediment sampling and point to Hardaway protocol in report appendix
    - Use 100% efficiency – rationale discussed/agreed to in previous meetings
    - Use a multiplication factor from Cerco (2010) to remove % sand from the TSS
      - Steve: This multiplication factor to adjust TSS credits works fine.
      - Eva: Is this site specific?
      - Sadie: No, if there is site specific data the site specific data should be used, but if not use these default values.
      - Steve: Site specific sampling may occur but if the results yield lower pollutant load reductions, then the value may not be used. This will skew the data available for consideration next time this panel meets to update the credit. Could look at soil median values, but there is not currently enough data. **This is a research need.**
      - Sadie: This method is a good compromise to account for sand eroding as part of the natural shoreline process and therefore does not impact the pollutant load.
      - Eva: This method is a good compromise for the sands vs fines discussion until we have better research.
      - Dan: **Panel to consider unintended consequences for sandy beaches/beach renourishment gathering pollutant load reductions.**

Steve Stewart, Draft protocol 2: Denitrification (DNR) update

- Steve presented the DNR data and a conservative TN pollutant load reduction based on the best available DNR information focused on tidal marshes and fringe tidal marshes as much as possible in the Chesapeake Bay region
- Steve/Sadie to refine the DNR rates by 11/15 that includes study information, if available for: 1) verify/report if studies are tidal vs non tidal and season; 2) verify and report if the study is high marsh, low marsh and the area represented; 3) ensure the weight of values used is equitable for the final value; and 4) present only one final value for use
- Steve to share the conversion excel spreadsheet with panel
- **In report text, need to discuss: 1) the lag time for plant establishment and that there is not precedent for BMPs to have lag times in the model even though there is likely a lag time prior to reaching the pollutant load reduction credited in many practices; 2) C substrate needed for DNR; and 3) both of these are future research needs. Another research need was to determine a median value for silt, clay, and loam.**

Steve Stewart, Draft protocol 3: Sedimentation update

- Steve reviewed the literature (20 to 25 papers) and needs to refine the data to provide a TSS and TP load reduction based on available information
  - **The following research needs were identified: 1) better understand the time it takes for C accumulation in living shorelines and 2) better understand the amount of carbon that facilitates DNR and other sediment/nutrient removal/change processes**
  - Steve to send out the sedimentation literature to panel to Sadie to upload to SharePoint for panel
  - Sedimentation (draft protocol 3) team to meet, work, and provide a draft protocol by 11/15
    - Sadie to plan a conference call w/ team to include Steve, Bill W., Pam, and Jana by 11/1. Other panelists can join the discussion.
  - **Dan: Panel to consider sedimentation for structures that protrude but may not be associated with vegetation. Steve: Could recommend periodic surveys to measure accretion.**

Bill Wolinski, Draft protocol 4: Vegetative Uptake update

- Based on the 13 relevant papers Bill summarized three that were geographically located in/near the Bay to report the N removal rates
- **Panel thinks that vegetative uptake is important and is difficult to separate vegetative uptake from other processes in the literature. However, the panel agrees (majority consensus agreement) to try to consider but that the scientific data may not be definitive. Panel to review these papers and make a decision on the validity of this protocol and if panel decides to pursue this protocol the panel to decide the threshold recommendation.**
- Scott: Fresh and saltwater will likely have different vegetative uptake values. There is a conversion of inorganics to organics.
- Nathan: Is there over or double counting for draft protocol 2 (DNR) and draft protocol 4 (vegetative uptake)? Response: No, these will be different and hence the difficulty to parse out in the literature.
- Panel suggested that this protocol's process and reported findings were difficult to separate from the entire nutrient budget. Bill W suggested that the panel review these papers and Sadie suggested the panel come to review Bill W's presented literature, meet to work on this protocol, and draft a protocol for panel review w/in 2 weeks (by 11/15).
- Bill W to send out Vegetative Uptake papers to Sadie to upload to SharePoint for panel by 11/1

Dan Proctor, SAV qualifying conditions update

- Dan Proctor led Williamsburg Environmental Group (WEG) staff (pro bono work) to analyze the shoreline study area that Lee provided in SAV basic qualifying conditions presented in previous panel meetings (7/16/13 and 8/26/13). This analysis by Dan is to provide a volume per year per linear foot of shoreline value instead of an erosion rate (e.g., 2 ft/yr). Lee can compare the results to the SAV areas and identify what kind of volumetric loading threshold could be more appropriate than the 2 ft/yr of erosion.
- Kevin S: Lee provided the SAV presence and erosion rate relationship. Is there a similar relationship with SAV presence and bank height?
- Dan: Likely, since volumetric loading will drive conditions.
- **Scott: Consider that when practices are implemented the tidal erosion rate is zero. Therefore, if the structure is not on SAV there may be no or little SAV impact.**
- Eva: This WEG analysis will be useful information.
- **Jana and Pam: It seems skewed to provide basic qualifying conditions for SAV presence and not for other habitat considerations (e.g., fish). If panel adds SAV as a qualifying condition the panel should add language to the report that SAV is a placeholder for other habitat considerations not quantifiable at this time.**
  - Panel Decision Point/Vote
    - Q: Do we have enough SAV science related to sediment from shoreline erosion to continue to pursue this research for shoreline management qualifying condition for SAV?
    - A: Yes (majority consensus); Panel needs more information to make a decision
  - Dan will continue with this analysis and provide Lee with the information

- Lee, Dan, and Eva (if needed) to present the information to the panel w/in 1 week (by 11/4)
- **The panel will decide what if any SAV basic qualifying condition can be drawn from this information.**

Sadie Drescher, Pam Mason, and Jana Davis, Consensus, dissent, and recording the panel's results

- Sadie, Pam, and Jan discussed capturing the level of consensus, dissent, etc. in the panel's process
  - Sadie reviewed the panel process/protocol (WQGIT, 2010) and the Simpson and Weammert (2009) reports that support the panel process and discussed the call Sadie, Jana, and Pam had on 10/8 that included Jana's work with AGU's panel on this topic.
  - Two main panel decision points that **could** be included in a dissent statement are: 1) providing TMDL pollutant load reductions for prevented sediment when that tidal erosion could include sand that is needed for natural nearshore processes and 2) providing TMDL pollutant load reductions for hardened shorelines. In addition, other panel decision points that **could** be included in a dissent statement may arise OR these decision points may be worked out in the panel process.
  - The idea to capture levels of consensus/levels of dissent is to:
    - document the areas of consensus as well as areas of dissent so that the consent/dissent points;
    - document the degree of consensus;
    - document the reasons for dissent;
    - facilitate panel report review; and
    - connect these discussions to future research needs.
  - Should this information (i.e., decision point levels of consensus/levels of dissent) be captured in the panel report as narrative and as panel member discussion in the meeting notes OR as a separate, short document? A short document is one or two pages.
  - The panel discussed levels of consensus/levels of dissent, how they were present in this panel's discussions and process to date, and how to incorporate these ideas in the findings. This information (i.e., decision point levels of consensus/levels of dissent) can be used to:
    - 1) support panel's recommendations for future research;
    - 2) document the panel process;
    - 3) (if short document is approved by panel) provide an easily referenced management document to explain the what, when, where, how for panel's decision points and levels of consensus/levels of dissent; and/or
    - 4) *can be used to* serve as a template for other panels, if/when appropriate.
  - Sadie: Original plan as per EPA CBP process and per previous panel meeting discussions with the USWG, other expert panelists, and panel facilitators is to include decision points that included dissenting decisions, the reason for dissent, the link to any future research needs in the report text. In addition, the panel meeting notes capture all the discussions that are part of the panel report.
  - Pam: Like the idea to include the process in the report and in the notes. Report should point to future research needs that were contentious decision points.
  - Jana: We should include a separate dissent paper that is short (e.g., 2 pages or less) and serves as a management guide.
  - Panel and Facilitator/Coordinator (Sadie) would like to work through dissenting issues as much as possible to reduce and/or eliminate dissent (i.e., reach consensus as much as possible).
  - George: If a short document can be done and also included in the panel report that may work.
  - Steve: These views should be part of the report, too.
  - Kevin D: Should the panel restrict/decide if/when to use our proposed protocol 1?
  - Jana: What is the process for panel report acceptance at the EPA CBP? Do the HGIT have to approve the panel report? Is there a public review process?
  - Sadie: The process has been described in past panel meetings and is included in the draft panel report section 2 with references/resources. However, I will check on the process for public comment and other GITs comment (other than USWG, WQGIT, WTWG).

- Should the panel capture and document dissent? Everyone agreed that we should do this. If so, should this be: 1) In the descriptive text in the panel report that link to future research needs and in the meeting minutes that are part of the report as an appendix? Or 2) A separate, short document developed by and approved by the panel in addition to the descriptive text in the panel report that link to future research needs and in the meeting minutes that are part of the report as an appendix?
- Panel Decision Point/Vote
  - Q: Should the panel develop a separate, short document that outlines the areas/levels of dissent?
  - A: Yes (majority consensus)
  - Jana to develop as appropriate (e.g., if needed) and per panel consensus

Draft Panel Report Work Session – Panel reviewed report sections, provided feedback, suggested edits

- **Sadie to make these updates to the report**
- **Sadie to complete the annotated bibliography for the panel report**
- **Jana to update Table 4 Shoreline management strategies by 11/4**
- **Kevin S., Scott, and Kevin D to refine the Basic Qualifying Conditions based on Kevin D's "TMDL credit matrix for shoreline stabilization methodsv2"** and incorporate Scott H's "Wave Energy Regimes," Kevin S's "Qualifying Conditions for Shoreline Erosion Control Practices.doc," and other panel resources/documents
  - **Dan: When we voted to allow TMDL pollutant load reductions for hardened structures we did not vote on qualifying conditions. Sadie: The qualifying conditions are where the panel can/should put bounds on practices to prevent poor practice implementation, unintended consequences, or other considerations. The panel will approve the qualifying conditions per the panel process in the next meetings and draft report iterations.**
- Sadie to start this qualifying conditions discussion through email with Kevin S., Scott, and Kevin D and draft work product to be completed by 11/4
- Need to add panel areas of decision points, discussion, and levels of consensus/levels of dissent
- Need to add SAV qualifying conditions
- Kevin D to send Nationwide 19 language in VA that promotes living shorelines by 11/1

Other considerations included:

- Dan suggested the panel could provide guidance for specific computations and design criteria
  - **Sadie to follow up with Nathan and Dan to work on example hardened and vegetative "sample" projects that use the draft protocols to provide at the next meeting and to provide as examples in Section 7 of the report.**
    - If possible, design criteria could be included in Section 7
- **Kevin S suggested a protocol that provides "credits" for maintaining natural shoreline sediment budgets/systems; Panel discussed this related to draft protocol 5 presented by Dan Proctor and thought that this would be too ambiguous, hard to determine, hard to track, and opens the door to many other processes (See Appendix C in Meeting 7 Notes, 8/26/13)**
- Panel asked what the panel process was for our panel. Panel asked what the comment process was for our report. Sadie to find out the panel public comment and if other EPA CBP GITs than WQGIT will review the panel report.
  - The process has been described in past panel meetings and is included in the draft panel report section 2 with references/resources and includes the following, **"**While conducting its review, the Panel followed the procedures and process outlined in the Water Quality Goal Implementation Team (WQGIT) BMP review protocol (WQGIT, 2010). The process begins with BMP Expert Panels that evaluate existing research and make initial recommendations on removal rates. These, in turn, are reviewed by the Urban Stormwater Workgroup (USWG), the Watershed Technical Workgroup (WTWG) and the WQGIT to ensure they are accurate and consistent with the CBWM framework."
  - After discussions with Bill S, RE: public comment and other GITs comment (other than USWG, WQGIT, WTWG).
    - The public comment is through the panelists representing representative stakeholder (e.g., local government, research, policy, etc.) viewpoints

- Panelists should consider the panel process as a closed system in that the discussions and recommendations are draft and still forming through the panel process. Panelists should be careful to gather appropriate information to bring back to the panel for consideration in the recommendations in order to maintain the integrity of the panel recommendations outlined in the final report.

Wrap Up (Sadie Drescher)

- Review of Meeting 9 Action Items:
  - Denitrification (draft protocol 2) refine the DNR rates by 11/15
  - Sedimentation (draft protocol 3) team to meet and develop a draft protocol by 11/15; Steve to send Sadie sedimentation papers
  - Bill W to send Vegetative Uptake (draft protocol 4) three reviewed papers to panelists for review/consideration with this protocol and panel to provide input
    - Panel to come to consensus on this protocol via lit review, email exchange, and calls (if needed) by 11/15
  - Dan to share info with Lee; Lee to provide panel with information for SAV threshold based on this analysis by 11/4
  - Qualifying conditions team to refine the TMDL matrix and provide to the panel by 11/4
  - Jana to develop as appropriate (e.g., if needed) and per panel consensus dissenting decision points
  - Jana to update draft report's Table 4 by 11/4
  - Sadie to find out and report back to the panel details about/for a panel public comment and if other EPA CBP GITs than WQGIT will review the panel report
  - Kevin to send Nationwide 19 language in VA that promotes living shorelines by 11/1
- Additional Meeting 9 Action Items:
  - Sadie to provide panel with meeting minutes, next meeting logistics, and action items by 11/5/13.
  - Panelists to send Sadie draft report edits using tracked changes by 11/11
  - Sadie to put all papers on SharePoint and let panel know where they are located by 11/11
  - Sadie to pull together an annotated bibliography by 11/18
  - Sadie to incorporate panel edits and provide draft to panel by 11/18
  - Sadie to follow up with panel member(s) that could not attend.
  - Sadie to coordinate with presenters for the next meeting.

NOTE: All panel meeting materials are on the SharePoint.

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Meeting Minutes
Shoreline Management Panel
Meeting 10 at Joe Macknis Memorial Conference Room (Fish Shack)
Monday, November 25, 2013
1 pm to 4 pm

EXPERT BMP REVIEW PANEL **Shoreline Erosion Control Practices**		
Panelist	***Affiliation***	**Present?**
Jana Davis, Ph.D.	CBT/HGIT	Y
Kevin Du Bois, PWS, PWD	City of Norfolk, VA	Y
Jeff Halka	MD Geologic Survey	N
Scott Hardaway, P.G.	VIMS Shoreline Studies Program	Y
George Janek	USACOE, Norfolk District	Y
Lee Karrh	MD DNR	Y
Evamaria Koch, Ph.D.	UMCES	Y
Lewis Linker	CBPO	N
Pam Mason	VIMS Center for Coastal Resource Mgt	Y
Ed Morgereth, MS ISS	Biohabitats	N
Daniel Proctor, P.E.	Williamsburg Environmental Group	Y
Kevin Smith	MD DNR	Y
Bill Stack, P.E.	CWP, CBPO	Y
Steve Stewart/Nathan Forand	Baltimore County Dept of Environmental Protection and Sustainability	Y/N
Bill Wolinski, P.E.	Talbot County Dept of Public Works	N
Sadie Drescher	CWP (facilitator)	Y
Non - Panelists: Hannah Martin (CWP, support), Jeff Sweeny (CBPO)		

Action Items by DISCUSSION AREA

Review of Action Items, Panel Updates, Approve Minutes, and Announcements

- The panel approved the last meeting minutes (10/28/13)
- Next panel meeting is January 2014 (TBD) and we will use remote using Adobe Connect/conference.

Sadie Drescher: Panel Progress and Decision Points

- Sadie presented the panel's work to date, decision points made, major panel research has ended, and consensus for final recommendations are needed. The panel process was discussed.

Steve Stewart and Sadie Drescher, Draft protocol 2: Denitrification (DNR) and Draft protocol 3: Sedimentation update

- Protocol 2 – Denitrification data was updated based on panel feedback. Panel to review the studies and flag considerations. Sadie to group studies and provide a median value.
- Protocol 3 – Sedimentation data gathered by Steve. Panel to send Sadie and Steve additional papers related to sedimentation and/or ideas for analyzing existing data for a protocol. Steve to send sedimentation spreadsheet to the group. Synthesize studies by Dec 6.

Sadie Drescher (for Bill Wolinski), Draft protocol 4: Vegetative Uptake update

- Protocol 4 – Marsh Redfield Ratio will represent the TN and TP system removal for the vegetative surface area in a shoreline management practice. This will be a onetime pollutant reduction credit.
- Sadie to research this with panel's input and present to the panel for refinement.
- Sadie to check with CBPO modelers to see if a onetime credit is feasible.

Dan Proctor, Section 6 Example to Use the Protocols for Pollutant Load Reduction & Project Examples from VA and MD

- Dan reviewed the VA protocol examples
- Dan, Nathan, and Sadie to refine the example based on updated Protocols and MD example format

Dan Proctor and Lee Karrh (input from Eva Koch, Jana Davis, and Pam Mason), SAV and Qualifying Conditions Update

- SAV/erosion information presented; panel agreed that Dan and Lee should refine the data analysis and present to panel
- This work is to determine a basic qualifying condition for horizontal erosion threshold that protects SAV beds. This threshold could be used as a qualifying condition for CB TMDL pollutant load reduction credit. Lee will re-run the SAV/erosion analysis for the Potomac and share data with Dan.
- Dan will use Lee's data, refine the edge used, refine the bank heights used, and groundtruth bank heights with known data to calibrate the model.

Draft Panel Report Work Session – Panel to review the sections and provide content, feedback, and suggested edits for the report sections and Wrap Up (Sadie)

- Reviewed panel report sections, panel edits, held a work session with panel, and developed next steps.
- Need to discuss the tracking, verification, and reporting section. Panel to do this next meeting.

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MINUTES

(action items underlined and panel considerations bolded)

Review of Action Items, Panel Updates, Approve Minutes, and Announcements

- The panel approved the last meeting minutes (10/28/13)
- Last meeting action items and updates were reviewed
- Panel agenda was reviewed; agenda is in Appendix A
- Relevant meetings and topics to the panel were discussed:
  - Many panelists will attend the Living Shoreline Summit in Cambridge, MD (Dec 10-11)
- Next panel meeting is January 2014 (TBD) and we will use remote using Adobe Connect/conference call.

Sadie Drescher: Panel Progress and Decision Points

- Sadie presented the panel's work to date, decision points made, major panel research has ended, and consensus for final recommendations needed
- Today's meeting will focus on refining the report content and hold a work session for report area's that are incomplete
- The panel process was discussed and the opportunity for input from groups outside the panel. Also, the panel's report to the USWG and WTWG will likely require refinement based on their feedback.

Steve Stewart and Sadie Drescher, Draft protocol 2: Denitrification (DNR) and Draft protocol 3: Sedimentation update

- Protocol 2. Denitrification studies were updated based on panel input and literature reviews. The median value was used. Panel to review the studies and flag any considerations. Sadie to group the studies so that one denitrification value is used to calculate the median.
- Protocol 3. Sedimentation studies are presented in various formats. Steve is working to compile a list of studies based on his research and the panel's input. Steve will continue to refine the sedimentation study's findings and group the findings in a reasonable way. There are considerations related to the study methods, bulk density, reported values, and other considerations. The study values will be converted to sediment per acre per year. Then the phosphorus data available will be used to calculate a TP pollutant load reduction value.
- The panel discussed sedimentation, accretion, nutrient cycling, storms, and other considerations related to this sedimentation protocol.
- Panel agreed that accretion was an important protocol to capture and offered to help Steve refine the data for this protocol.
- Due to the large variability, the median will be used as a conservative estimate for this protocol.
- Lewis will send a Jug Bay high mars/low marsh paper to Sadie to include.
- Large variability with the data. May want to leave higher numbers in the chart in order to be conservative. How expansive should this data review cover? Steve only used inorganic material (IM) numbers as opposed to including organic material (OM) data.
- Jana suggests doing a power analysis of these data in order to have a more comprehensive and accurate dataset. Steve needs to look over the data and look at type of study, sediment and particle size, freshwater vs. saltwater tidal marshes, monitoring methodologies, qualifying conditions specific to particular study.
  - Next Steps: The variability of many of the studies is high. Synthesize the information and come up with one rate. Are we excluding eroding marshes? Should we include them in the data pool when developing this rate?
  - Literature—if there are additional CB marsh accretion paper focused in Chesapeake Bay region, get into Sadie. Send Sadie papers and add into sedimentation table by COB Nov 26th.
  - We should average within each study to get one number for each study.
  - Steve will send out spreadsheet to Sadie and look at methodologies of the ten studies.
  - Synthesize studies and come up with a range by next Friday, Dec 6th.
  - Designing these projects to not erode, does sill structure prevent from having natural process? Scott: you could get accretion of finer materials behind sill but depends on bank (graded or not) and if bank is providing material. Fine sediment could be suspended during storm events. Kevin Du bois: Marshes with sills are higher and only subject to a smaller portion of the tide

Sadie (instead of Bill Wolinski), Draft protocol 4: Vegetative Uptake update

- Panel has researched and heard from experts in the field to try to tease out the vegetative uptake for a separate protocol
- The research is not conclusive enough to warrant a vegetative uptake protocol
- However, the panel held a work session around the idea of a onetime TN and TP pollutant load reduction based on the marsh Redfield ratio

- This Marsh Redfield Ratio protocol is based on the total TN and TP likely removed in a vegetative portion of the shoreline management practice. This TN and TP removal is based on the vegetative surface area and multiplied by the estimated marsh Redfield ratio (i.e., TN and TP)
- Perhaps the floating wetland panel has this information?
- What if you don't have an intertidal marsh plant component vs. high/low marsh vegetation? Can we tease that out through this process?
  - Base the protocol on the shoreline management's vegetative surface area
- Sadie to check with CBPO modelers to see if a onetime credit is feasible
- Sadie to lead panel team (e.g., Jana, Pam) to determine the plan biomass per surface area of vegetation and the TN and TP associated with this area based on marsh Redfield ratio data.

Dan Proctor, Section 6 Example to Use the Protocols for Pollutant Load Reduction & Project Examples from VA and MD

- Dan reviewed the VA protocol examples
- Dan, Nathan, and Sadie to refine the example based on updated Protocols and MD example format

Dan Proctor and Lee Karrh (input from Eva Koch, Jana Davis, and Pam Mason), SAV and Qualifying Conditions Update

- Lee gave an overview of the SAV/erosion issue and progress to research a threshold for horizontal erosion and SAV protection to include in the basic qualifying conditions
- Lee and Dan have worked on this qualifying condition with their respective teams and datasets
- Lee: The issue with considering shoreline management as a BMP is to ensure that other habitats are protected. The idea is to use the SAV Bay TMDL goals as a surrogate for other habitats to protect since we have data on SAV. The research done on the Potomac used MGS erosion data and SAV data to determine a 2 ft/yr erosion rate as a threshold for SAV in nearshore waters.
- Dan: Used the data Lee presented and took this one step further to incorporate a shoreline height with the best available MGS erosion data and LIDAR information. The bank height was estimated with LIDAR data and should be groundtruthed and refined. This bank height estimate may be inaccurate. Based on this analysis, the equivalent volume threshold for Lee's earlier reported 2 ft/yr erosion was 23 ft3/yr. However, based on panel feedback and known errors this will be re-analyzed, discussed with the panel, and reported at our next panel meeting.
- The panel's concern with a 2 ft/yr erosion rate as a threshold (i.e., no pollutant load reduction if area has < 2 ft/yr erosion) is that most study sites including past sites would not qualify for a CB TMDL pollutant load reduction credit. The tradeoff is that some threshold should exist as a habitat protection threshold and qualifying condition.
- The Potomac case study researched here is a good representative for the Chesapeake Bay watershed.
- Lee will re-run the SAV/erosion analysis for the Potomac and share data with Dan.
- Dan will use Lee's data, refine the edge used, refine the bank heights used, and groundtruth bank heights with known data to calibrate the model.
- The panel discussed the worth of a SAV/erosion qualifying condition. Is this too prescriptive? If there is no SAV/erosion qualifying condition, then what is the habitat protection consideration? There could be panel recommendation for the local government to analyze the location and make the decision.
- Sediment type offshore also drives where SAV will grow. A survey could be done to see if offshore SAV is present at the site. Depth of the nearshore water is also a SAV presence factor.
- SAV/erosion threshold should capture the ability for SAV to grow in nearshore waters in the future and not solely rely on if SAV is currently present in the nearshore waters. (Lee)
- Erosion can be good for SAV in nearshore waters (Eva)
- Use a 3 year timeframe; same as modeling (Eva)

Draft Panel Report Work Session – Panel to review the sections and provide content, feedback, and suggested edits for the report sections

- Basic qualifying conditions table were discussed and refined
- The general idea is that state policy and the panel report recommendations call for vegetated shoreline management practices where possible. The basic qualifying conditions drive this point home. In addition, the draft protocols 2, 3, and 4 allow additional TSS, TN, and TP for the vegetative portion of the shoreline management practices. Hard armor practices should be an option only when vegetated options are not possible. Finally, shoreline practices should follow these basic qualifying conditions to determine if the practice is eligible for the pollutant reduction credits outlined in protocols 1 through 4.

Wrap Up (Sadie Drescher)

- Other considerations as we work through the protocols are the cost per pound for these practices. We need to make sure the magnitude of the proposed Ches Bay TMDL pollutant load reduction credit makes sense relative to other BMPs. (Jana)
- Need to discuss the tracking, verification, and reporting section. Panel to do this next meeting.

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Meeting Minutes
Shoreline Management Panel
Meeting 11 at Joe Macknis Memorial Conference Room (Fish Shack)
Friday, January 24, 2013
1 pm to 4 pm

EXPERT BMP REVIEW PANEL **Shoreline Erosion Control Practices**		
Panelist	***Affiliation***	**Present?**
Jana Davis, Ph.D.	CBT/HGIT	Y
Kevin Du Bois, PWS, PWD	City of Norfolk, VA	Y
Jeff Halka	MD Geologic Survey	Y
Scott Hardaway, P.G.	VIMS Shoreline Studies Program	Y
George Janek	USACOE, Norfolk District	Y
Lee Karrh	MD DNR	Y
Evamaria Koch, Ph.D.	UMCES	N
Lewis Linker	CBPO	Y
Pam Mason	VIMS Center for Coastal Resource Mgt	Y
Ed Morgereth, MS ISS	Biohabitats	Y
Daniel Proctor, P.E.	Williamsburg Environmental Group	N
Kevin Smith	MD DNR	N
Bill Stack, P.E.	CWP, CBPO	Y
Steve Stewart/Nathan Forand	Baltimore County Dept of Environmental Protection and Sustainability	Y/Y
Bill Wolinski, P.E.	Talbot County Dept of Public Works	Y
Sadie Drescher	CWP (facilitator)	Y
Non - Panelists: Hannah Martin (CWP, support)		

Action Items by DISCUSSION AREA

Review of Action Items, Panel Updates, and Approve Minutes

- Meeting 10 minutes were approved
- Meeting 11 objective was to review protocols, talk about research needs, discuss the qualifying conditions, and discuss next steps to present the recommendations to the Urban Stormwater Workgroup on 2/18/14

Panel Progress and Urban Stormwater Work Group Update (Sadie)

- No action items

Panel Protocol Updates (Sadie and Steve)

- Steve to complete protocol 2

Qualifying Conditions (Lee and Dan)

- The panel does not recommend a SAV basic qualifying condition for this BMP.
- Lee to write up the SAV findings in the panel report body and in the research needs w/ Sadie.

Review panel report content and get feedback (Sadie)

- Sadie to make basic qualifying conditions more prominent in the examples.
- Sadie to work with Bill S and Lewis to explain how this BMP differs from other urban BMPs in the Executive Summary.
- Jeff, Jana, Scott and other engineers/scientists to research and discuss the angle of response refinement to protocol 1 (prevented sediment) via email and make a recommendation to the group.
- Everyone to review the reporting parameters

Other topics to cover or work on in this meeting (Sadie)

- Jana to lead a dissenting panelists call to capture and vet the dissenting views from these panelists in a 1-2 page document.

Wrap Up (Sadie Drescher)

- Next Steps to Complete Panel Report & Action Items (Sadie)
    - Dissenters to meet and discuss the draft dissent view document
    - Jeff, Jana, Scott and other panelists to develop a refinement for protocol 1 – prevented sediment's angle of repose
    - Sadie to edit panel report based on the action items today, send to USWG by 2/11, and present the panel recommendations on 2/18

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MINUTES

(action items underlined and panel considerations bolded)

Review of Action Items, Panel Updates, Approve Minutes, and Announcements

- Meeting 10 minutes were approved
- Meeting 11 objective was to review protocols, talk about research needs, discuss the qualifying conditions, and discuss next steps to present the recommendations to the Urban Stormwater Workgroup on 2/18/14
- Relevant meetings included: 1) Kevin D. will give a webinar next week on living shorelines and 2) Lee's SAV Work Group meeting next Tuesday will hear the Shoreline Management panel update from Sadie

Panel Progress and Urban Stormwater Work Group Update (Sadie)

- The panel charge, Water Quality Goal Implementation Team's protocol for developing, reviewing, and approving loading and effectiveness estimates for nutrient and sediment controls in the Chesapeake Bay watershed model (WQGIT, 2010), and panel work to date were reviewed
- The panel's focus today and ultimate goal to finalize the Shoreline Management panel report recommendations to present at the next Urban Stormwater Work Group (USWG) meeting
    - USWG meeting will be held February 18th (2/18/14)
    - Panel report will need to be completed and sent to the USWG by 2/11/14

Panel Protocol Updates

- Draft protocol 2: Denitrification (Sadie)
    - Sadie reviewed the denitrification literature summary that the panel did, decisions to group data points, and decision to use the median for the protocol's TN pollutant load reduction
    - Panel agreed with this approach; no discussion or questions
- Draft protocol 3: Sedimentation (Steve)
    - Still reviewing the studies; there is a wide disparity of information based on how the study was conducted to determine accretion rates
    - Top layers have different bulk density than what is used by US ACE
    - Accretion is not due to sediment deposition; there is up to 80% accretion due to vegetative growth; attempting to include stem density factors in the recommendations
    - Once the data is further refined from the literature, Steve will summarize the literature review (as the panel has discussed in detail in past meetings) and provide the final TN and TSS pollutant load reductions per acre marsh plantings per year
    - Discussion:
        - Kevin D- Wetlands scientists will track this information including stem density and the parameter will be a new one for them. How do we ensure accurate data is collected and reported? How do we define success? We should find proxies for success that non technical can report.
        - Steve – This could be included in the recommendations rather than in the requirements.
        - Kevin – Project's need permits and would the permit require replanting? Cannot maintain every two years since this would be a failure and permit noncompliance.
        - Pam – Permit compliance and BMP monitoring success are two different things. Where can we capitalize on what is required by regulatory agencies and incorporate this information in these BMP guidelines?
        - Bill S. – The stream restoration permits are robust, but the stream monitoring guidelines vary.
        - Sadie – We will look at this protocol and attempt to develop monitoring vs regulatory requirements.
        - Lewis – Can we use the US ACE rates that we have from literature of the composition of nutrients?
        - Pam – This depends on where the studies were conducted. For example, research in marshes with high concentration of peat and organic matter are common in older, "natural" marshes vs man made marshes such as associated with living shorelines that will not have this component.
        - Reminder that the panel recommends these results should be reassessed in two years to account for better science and information
        - Bulk density is a factor in this protocol that we should address.
            - Could use the marsh bulk density that Jeff Halka presented the the panel last year
            - Use the whole core
            - Lower the bulk density, lower the credit
            - Need to determine what bulk density we will use for the top layer (0 to 10 cm)

- Pam- If we use this surface bulk density it will be smaller and represent a conservative value for the pollutant load reduction. In addition, the impact of inorganic vs organic will be lessened.
  - Panelists agree
- Jeff will recheck the bulk density and report to Steve for protocol.
- What core depths should we use?
  - **Panel decided: 0 to 10 cm**

▪ Although, the protocol is not completed, Steve reported that the pollutant load reduction will likely be in the 1,000lb/acre range
- Panel thought this value was high compared to other urban BMPs
- Will see what the value is and discuss at that time
- Will see what the other WGs (e.g., USWG) think of the findings from our literature review

o **Steve to complete protocol 2**

- Draft protocol 4: Marsh Redfield Ratio (Sadie)
  - In our last meeting, we decided to use a marsh Redfield ratio to account for the nutrients that are removed from the system due to marsh vegetation. We held a quick work session. Jana, Pam, and Sadie continued to review the literature and develop this protocol.
  - Pam, Jana, and Sadie discussed the protocol to include the data used, how this protocol was calculated, and the caveats.
  - The marsh Redfield ratio for N:P was 23:1; using the above ground and below ground marsh productivity (g dry matter /m2-yr) from the extensive literature review that Pam provided, this marsh Redfield ratio was converted to TN and TP lb removed
  - This protocol is a one-time credit that can be recognized in the first year
  - The one-time credit takes the specific vegetative uptake parameter out of the factors for the value
    - Discussion:
      - Steve: Are there any values subtracted from the plantings?
        - This is annual productivity. Some values are peak biomass and were converted for annual productivity. How much growth w/in a year? About 50% biomass is below ground. There is dieback, but also standing dead (e.g., cellulose high grass).
        - Detritus is an issue when first released in to the system this is poor and degrades with time.
        - Lewis – This protocol looks good to me and reasonable. A one-time credit makes sense. Steve's question is a good one, too.
        - Bill S. – This protocol for this BMP removed nutrients and sediment from the estuary not the watershed; should be clear on this point when presenting to the workgroups.
        - This protocol is conservative and therefore defensible.

Qualifying Conditions (Lee and Dan)

- SAV qualifying conditions update
  - Lee presented the SAV analysis that he and Dan (and WEG, now Stantec) performed to refine the tidal shore erosion volume and associated SAV presence/absence in nearshore waters (See Appendix B)
  - The reason for this analysis was to find a threshold that the panel could use to determine a tidal shore erosion volume that determined if SAV habitat would be impacted and therefore, no CB TMDL pollutant load reduction should be allowed
  - Lee – Tried to develop this protocol threshold based on our discussions since July 2013. The 2 ft/yr tidal erosion rate as a threshold was previously voted down by the panel. Therefore, this analysis was conducted. The exercise while valuable, did not find a tidal shoreline volumetric threshold to use for this purpose.
  - Lee reanalyzed the updated LIDAR data from Dan and Dan's group for the 5 yr composite time from 2008 to 2013 and the 10 year time for the study area. Used a 100 meter buffer to analyze this information.
  - Steve- The idea here is that if SAV is present then this would be a qualifying condition so that no CB TMDL credits were received? In Baltimore County the shoreline projects we built in the 1990's and monitored for SAV showed an increase in SAV in the nearshore waters.

  - Lee- Studies are conclusive that at many scales when shoreline projects are implemented with elements of stone or armor, the SAV is impacted.
  - See Table 10 (p. 15) that shows the basic qualifying conditions where very few armored practices would ever receive CB TMDL credit
  - Steve- The proposed thresholds would preclude our (Baltimore Co) projects from receiving CB TMDL credits, when we have monitoring that shows that the SAV improved in our project areas.
  - Kevin D- Is there research that demonstrates this point?
  - Lee- The research that we conducted shows that shoreline practices with hard areas are detrimental to SAV. Even the hybrid practices that have hard structures are detrimental. This research is forthcoming and findings were added to the panel report. The Baltimore Co would be interesting to add to the study. This map includes what has been seen in the last 5 to 10 years and is more conservative than other methods used.
  - Pam – If hard structures, including those used for breakwaters, impacts SAV then we should not allow these structures to have CB TMDL credits. We can specify this in the basic qualifying conditions. In VA it is illegal to place a breakwater on SAV.
  - Lee- Recent research found that there were SAV impacts for breakwaters on the Potomac and these were permitted in MD. Therefore, the presence of SAV adjacent to shorelines does not always preclude shoreline management practice.
  - Research finds that hardened structures have negative impacts to SAV.
  - This information will be presented in the body of the report and in the research needs (e.g., SAV and shoreline management practices)
  - Lee- The analysis we did was useful and should be continued.
- Do we have a threshold for the qualifying condition? Panel to decide
  - The panel discussion centered on the argument that there was not enough scientific research to demonstrate the link between shoreline management BMPs and negative impacts to SAV at this time.
  - Bill S. - The panel again pointed to the recommendation to reconvene in two years and discuss other issues as well as this SAV (and habitat) threshold.
  - Based on the analysis by Lee and Dan as well as the panel discussion from July through January 2014 – **The panel does not recommend a SAV basic qualifying condition for this BMP.** However, this will be added to the future research needs.
  - Lee – Future research that is currently being written points to the impact that hardened structures have when armored >5.4% on the SAV abundance. This has been an accepted finding and published. Shoreline types and landuse/landcover is currently under review and the full research study will be published soon.
    - **Lee to write up the SAV findings in the panel report body and in the research needs w/ Sadie.**

Review panel report content and get feedback (Sadie)

- Examples to use protocols for pollutant load reduction, Section 6 (Sadie)
  - Reviewed the pollutant load reduction examples from MD and VA and the resulting credits expected from these examples
  - Pam – Suggest making the basic qualifying conditions more prominent in the report since the practice must first past all basic qualifying conditions prior to attaining pollutant load reductions per the protocols. **Sadie to make basic qualifying conditions more prominent in the examples.**
  - The panel discussed the example pollutant load reductions and that these values seemed high compared to other urban BMPs. Bill S mentioned the distinction between other urban BMPs that have a sediment delivery factor and this practice that does not have a sediment delivery factor. In other words, the higher erosion values recognized at the watershed/estuary interface directly enter the receiving waters and any practice that prevent these pollutants can have a greater impact to prevent pollutant loads from the receiving waters.
    - Action: **Sadie to work with Bill S and Lewis to explain how this BMP differs from other urban BMPs in the Executive Summary.**
  - The panel discussed the pollutant load reduction values from the MD and VA examples and their management impact (e.g., unintended consequences).
  - The panel discussed pollutant load reduction values for other urban BMPs and how they compared to the proposed values in these draft MD and VA examples based on the draft protocols.
  - The potential low cost per pound of pollutant removed could drive management decisions that implement higher shoreline management practices than plausible. In addition, if more shoreline management practice implemented than plausible, there will be a negative impact on the natural resources (e.g., SAV, fish, etc).

        - Estimated costs for this BMP based on the current draft protocols and examples discussed today, means that this BMP could be up 3 to 10 times more cost effective than other urban BMPs.
    - Steve – Local governments are bound by other limiting factors and considerations (than the CB TMDL) so that there is unlikely to be a huge increase in shoreline management practices due to local constraints such as local TMDLs, private property where shoreline practices could be implemented, and local gov't resources.
    - Jeff and Jana - A possible sediment and nutrient pollutant load reduction for protocol 1 – prevented sediment would be to consider the angle of repose. The angle of repose is based on a Calvert Cliffs study and aims to account for the unstable shoreline bank and associated pollutant load to the receiving waters when shoreline management practices are not properly graded properly vegetated, and the extra sediment from construction is not removed.
    - What is the geometry of the cliff and what value is a default to use for the entire Chesapeake Bay shoreline?
        - Could use a minimum bank height and angle. The zone of influence is linked to the bank height.
    - **Jeff, Jana, Scott and other engineers/scientists to research and discuss the angle of response refinement to protocol 1 (prevented sediment) via email and make a recommendation to the group.**
- Reporting, Tracking, and Verification, Section 7 (Sadie)
    - Reviewed the section and solicited feedback
    - All panel reports include these sections
    - Verification is critical and addresses some of the concerns (e.g., built as designed, functioning) raised earlier in the meeting
    - Reporting – should determine the minimum information needed to report to the state gov't and then to CBP. The minimum reporting elements proposed by panel should not interfere with the permitting process.
    - Tracking
        - VMRC does not do BMP tracking to our knowledge; MDE does track BMPs
        - States discussed tracking with CBP
        - DEQ will be at the SAV meeting Tues
        - When we present to the USWG if there is too detailed tracking and verification requirements this could garner discussions
        - If a state wants to receive and continue to receive credits then they must have tracking and verification
        - Need HUC code and other info for tracking
        - Change JPA to include necessary information
    - The verification principles will be developed through a separate process for this BMP
    - **Everyone to review the reporting parameters**
    - Verification recommendation is to be done every 5 years. Credit should last for 5 years.
        - Permits in VA are for 3 years
- Future Research and Management Needs, Section 8 (Sadie)
    - Pam – Maybe stream needs additional credits due to the type of sediment.
    - Bill S – Urban Stream Restoration panel and CWP/CBPO Sediment and Stream Coordinators are working with CBPO to refine the stream load in the model
- Technical Requirements for Entering the Shoreline Management Practice into Scenario Builder, Appendix E progress/update (Lewis)
    - Briefly outlined the technical appendix and future updates that are to be made with the Work Groups, CBPO modelers, and others

Other topics to cover or work on in this meeting (Sadie)

- Other panel content, dissenting opinions, etc.
    - Jana – Based on this discussion and previous panel meetings, there are still panelists that hold dissenting views for the panel's recommendations. **Jana to lead a dissenting panelists call to capture and vet the dissenting views from these panelists in a 1-2 page document.** This dissenting view document will be reviewed by the entire panel and added to the panel report.
    - Kevin S – Documenting the dissent is important for those that review the panel's recommendations.
    - The panelists also discussed that the panel charge was focused to determine a pollutant load reduction for the BMP based on the best available science to inform the CB TMDL.

- Kevin D. – In VA, the CB TMDL incentive is important since without this revetments would be very prevalent.
- Lewis – The TMDL process does limit the scope and vision. In addition, there are certain tradeoffs that are recognized and made during this CB TMDL process.
- Minor grammatical and/or content edits were provided
- Should data be collected for the net increase of the vegetated marsh surface area that will be credited in protocols 2, 3, and 4
  - Yes

Wrap Up (Sadie Drescher)

- Next Steps to Complete Panel Report & Action Items (Sadie)
  - **Dissenters to meet and discuss the draft dissent view document**
  - **Jeff, Jana, Scott and other panelists to develop a refinement for protocol 1 – prevented sediment's angle of repose**
  - **Sadie to edit panel report based on the action items today, send to USWG by 2/11, and present the panel recommendations on 2/18**

NOTE: All panel meeting materials are on the SharePoint.

- https://sites.tetratech.com/projects/100-CB_BMP_Review/default.aspx
- General username: ttsvcs\cbuser & General password: Review2012
- File location is Urban→SEC→Admin and Meetings→ 012414

Meeting Minutes
Shoreline Management Panel
Meeting 12 at Joe Macknis Memorial Conference Room (Fish Shack)
Friday, March 21st, 2013
1 pm to 3 pm

EXPERT BMP REVIEW PANEL **Shoreline Erosion Control Practices**		
Panelist	***Affiliation***	**Present?**
Jana Davis, Ph.D.	CBT/HGIT	N
Kevin Du Bois, PWS, PWD	City of Norfolk, VA	Y
Jeff Halka	MD Geologic Survey	Y
Scott Hardaway, P.G.	VIMS Shoreline Studies Program	N
George Janek	USACOE, Norfolk District	Y
Lee Karrh	MD DNR	Y
Evamaria Koch, Ph.D.	UMCES	N
Lewis Linker	CBPO	Y
Pam Mason	VIMS Center for Coastal Resource Mgt	N
Ed Morgereth, MS ISS	Biohabitats	Y
Daniel Proctor, P.E.	Williamsburg Environmental Group	Y
Kevin Smith	MD DNR	Y
Bill Stack, P.E.	CWP, CBPO	Y
Steve Stewart/Nathan Forand	Baltimore County Dept of Environmental Protection and Sustainability	Y/Y
Bill Wolinski, P.E.	Talbot County Dept of Public Works	Y
Sadie Drescher	CWP (facilitator)	Y
Non - Panelists: Hannah Martin (CWP, support)		

Action Items by DISCUSSION AREA

Review of Action Items, Panel Updates, and Approve Minutes

- Meeting 11 minutes were approved
- Sadie to share report using dropbox

Panel Progress and Urban Stormwater Work Group Update (Sadie)

- None

Report Content – Overview (Sadie)

- Sadie to update the panel report based on panel meeting

Updates (Sadie)

- None

Technical Requirements for Entering the Shoreline Management Practice into Scenario Builder, Appendix C progress/update (Lewis)

- Steve suggested adding language specifying the local TMDLs vs Chesapeake Bay TMDLs – this was done and the content fit better in the Basic Qualifying Conditions report section (completed)

Urban Stream Restoration vs Shoreline Management (Bill Stack)

- Bill S to send CBWM and the sediment delivery factor explanation to the panel (completed 3/25)

Dissenting View Document (Sadie)

- Dissenting panelists agreed and will vet with the full dissenting view document panelists
- Dissenting view document panelists to refine the dissenting view document and submit to Sadie and the panel for inclusion in the panel report as an appendix

Wrap Up (Sadie Drescher)

- Next Steps to Complete Panel Report & Action Items (Sadie)
  - Dissenters to finalize the draft dissent view document
  - Sadie to edit panel report based on the action items today, send to USWG by 3/7/14, and present the panel recommendations on 3/15

NOTE: All panel meeting materials are on the SharePoint.

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- File location is Urban→SEC→Admin and Meetings→ 032114

MINUTES

(action items underlined and panel considerations bolded)

Review of Action Items, Panel Updates, and Approve Minutes

- Meeting 11 minutes were approved
- Meeting 12 objective was to review report refinements, discuss the dissenting view document, and discuss next steps to present the recommendations to the Urban Stormwater Workgroup on 3/15/14
- *Sadie to share report using dropbox*

Panel Progress and Urban Stormwater Work Group Update (Sadie)

- Dissenting view document panel authors requested a panel vote to keep or discard protocol 1 prevented sediment; this was completed and all panelists voted; the panel decided to keep protocol 1
    - Vote Results

      PANEL VOTE ITEM

      KEEP PROTOCOL 1 PREVENTED SEDIMENT IN THE PANEL RECOMMENDATIONS?

      VOTE OPTIONS: 1) YES OR 2) NO

      YES NO NO VOTE
      9 5 1

      Panel Decision as of 3/19/14: Panel voted to keep protocol 1 prevented sediment in the panel recommendations. Panel report will have a dissenting view document.

Report Content – Overview (Sadie)

- Sadie and the panel reviewed the panel report, the refinements made since Meeting 11, and discussed further edits, such as: 1) add net vegetation surface area increase for protocols 2, 3, and 4, edit reporting units table, add language to the basic qualifying conditions to clarify local TMDLs and Chesapeake Bay TMDL use of BMP
- Sadie to update the panel report based on panel meeting

Updates (Sadie)

- Sadie reviewed the report refinements made since Meeting 11 that were also reviewed in a panel conference call last Friday (3/14/14); these updates included the following:
    - Described how this urban BMP differs from others in Ex. Summary
    - Capped pollutant load reductions allowed per state basin to for BMPs to 1/3 of the pollutant load to that state basin
    - Included the sand Instability Reduction Factor that discounts Protocol 1 prevented sediment and associated nutrients by 50% (See Section 5.2.1.1)
    - Sedimentation Literature Review and Protocol 3 – Sedimentation (Steve)
    - Updated the MD and VA examples
    - Other updates

Urban Stream Restoration vs Shoreline Management (Bill Stack)

Compare the pollutant load reductions

- Bill S provided an example of a urban stream restoration pollutant load reductions for TSS, TN, and TP at the MD example in Baltimore County provided in the report
- The purpose was to compare stream restoration as a proxy for an urban BMP vs shoreline management – protocol 1 prevented sediment
    - The sediment delivery factor is normally applied to urban BMPs. The sediment delivery factor reduces the BMP's sediment effectiveness by ~ 82.5%. However, the sediment delivery factor it is not applied to shoreline practices. This presentation was emailed to panelists on 3/25/14.

      Bill S compared the Baltimore County, MD shoreline management practice in the panel report and a stream

restoration practice with the same site conditions. The results were that the shoreline management practice removed much more sediment. As Bill noted at the meeting, this was because the sediment delivery factor is not applied to shoreline management practices but is applied to stream restoration practices. In this same example, when Bill re-ran the analysis using the stream restoration interim rate today, here are the results:

Shoreline Management (panel report's Table 13) TSS = 450,070 pounds per year TN = 233 pounds per year TP = 168 pounds per year

Equivalent Stream (using the interim rate) TSS = 113,274 pounds per year TN = 195.8 pounds per year TP = 177.5 pounds per year

- *Bill S to send CBWM and the sediment delivery factor explanation to the panel (completed 3/25)*
- The panel discussed local sediment loads from monitoring vs CBWM loading values; local values are higher for Baltimore Co; Lewis suggested this is largely due to long lag times for sediment delivered from the watershed to the Bay
- The state basin cap of 1/3 available for shoreline management sediment pollutant load reductions will help curb unintended consequences; this idea will be further discussed and implemented with the modeling team and in the next stages reporting the panel's recommendations (e.g., WTWG)

Technical Requirements for Entering the Shoreline Management Practice into Scenario Builder, Appendix C progress/update (Lewis)

- Lewis reviewed the technical appendix he authored and explained the state basin concept/geographic extent
- *Steve suggested adding language specifying the local TMDLs vs Chesapeake Bay TMDLs – this was done and the content fit better in the Basic Qualifying Conditions report section (completed)*

Dissenting View Document (Sadie)

- Sadie provided the dissenting view document history, recent panel vote to keep protocol 1 prevented sediment, dissenting view document content, and solicited panel feedback
- Lee, Kevin S., and Jeff were the three dissenting panelists at the meeting and provided the following input:
    - This document was thought through with the dissenters and brought forward to record the dissenting view panelists ideas for: protocol 1 prevented sediment (not all sediment is bad and a high sediment pollutant load reduction could drive management practices, credit for armor, management ramifications, and process comments
- Panelists reviewed the vote to keep protocol 1, the reasons for this, and the panelists concerns for unintended consequences, need for future research, etc.
- Panelists thought that a dissenting view document was a good idea, this has been discussed an previous panel meetings and was agreed to during those meetings that a dissenting view could guide future panel report recommendation interpretations as well as improvements
- Panelists discussed that the panel process and resulting panel report recommendations aimed for consensus, was collegiate, and the dissenting panel views were well vetted through the panel process, as well as captured in the report
- Although consensus could not be reached on all points the recommendations that will be put forth to the work groups is an improvement to current practices and as noted in the report should be updated every two years based on future research
- Multiple panelists suggested that the second paragraph in the process comments dissenting view document should be removed
    - *Dissenting panelists agreed and will vet with the full dissenting view document panelists*
    - Panelists suggested that the HGIT workgroup that has met to discuss and vet these issues could take up the dissenting view document points, especially the management ramifications and process comments captured in the dissenting view document
    - *Dissenting view document panelists to refine the dissenting view document and submit to Sadie and the panel for inclusion in the panel report as an appendix*

Wrap Up (Sadie Drescher)

- Next Steps to Complete Panel Report & Action Items (Sadie)
    - *Dissenters to finalize the draft dissent view document*

- Sadie to edit panel report based on the action items today, send to USWG by 3/7/14, and present the panel recommendations on 3/15

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Appendix B. Panel's Conformity with the BMP Review Protocol Requirements

The BMP review protocol established by the Water Quality Goal Implementation Team (WQGIT, 2010) outlines the expectations for the content of expert panel reports. This appendix references the specific sections within the report where panel addressed the requested protocol criteria.

1. Identity and expertise of panel members*: Table 2 in Section 1.1 Panel M embers*

2. Practice name or title: *Shoreline Management*

3. Detailed definition of the practice: *Section 2 Definitions and Geographic Scope – 2.1.3 Expert Panel Definition*

4. Recommended N, P and TSS loading or effectiveness estimates: *Section 5 Rationale, Methods, and Examples for New Shoreline Management Protocols*

5. Justification of selected effectiveness estimates: *Section 3 Shore Erosion and Management in the Chesapeake Bay and Section 5 Rationale, Methods, and Examples for Shoreline Management Protocols*

6. List of references used: *References, Appendix C Technical Requirements for Entering Shoreline Management Practices into Scenario Builder, Appendix J Marsh Redfield Ratio Data (Table 24), and Appendix L Dissenting View Document*

7. Detailed discussion on how each reference was considered: *Section 5 Rationale, Methods, and Examples for New Shoreline Management Protocols*

8. Land uses to which BMP is applied: *All land uses that meet qualifying conditions*

9. Load sources that the BMP will address and potential interactions with other practices: *Shoreline management practices will prevent tidal shore erosion. The BMP may compliment and/or overlap with wetland and/or coastal wetland practices.*

10. Description of pre-BMP and post-BMP circumstances and individual practice baseline: *See Protocols 1, 2, 3, and 4 in Section 5 Rationale, Methods, and Examples for New Shoreline Management Protocols*

11. Conditions under which the BMP works/not works: *See the Section 4 Basic Qualifying Conditions for Individual Projects and Section 6 Accountability and Unintended Consequences*

12. Temporal performance of BMP including lag times between establishment and full functioning. *NA*

13. Unit of measure: *Mass of TN, TP, or TSS reduced, which depends on project design factors and the applicable protocol(s)*

14. Locations in CB watershed where the practice applies: *Anywhere a project meets the qualifying conditions. See Section 2.2 Geographic Boundary and Section 4.2 Basic Qualifying Conditions for Individual Practices.*

15. Useful life of the BMP: *5 years, but renewable based on visual inspection. See Section 6.1.4.2 Duration of Shoreline Management Credit.*

16. Cumulative or annual practice: *Cumulative pollutant load reductions for Protocols 1, 2, 3 and 4. See Section 5 Rationale, Methods, and Examples for New Shoreline Management Protocols.*

17. Description of how BMP will be tracked and reported: *See Section 6.1 Reporting, Tracking, and Verification*

18. Ancillary benefits, unintended consequences, double counting*: See Section 3.3 Shoreline Management and Habitat Impacts, Section 4.1.3 SAV Habitat, Section 4 Basic Qualifying Conditions for Individual Projects, and Section 7.1 Panel's Confidence in Recommendations.*

19. Timeline for a re-evaluation of the panel recommendations *In two years and every two years after that time. See Section 7.1.1 Proposed Timeframe for Panel Recommendations Review and Update.*

20. Outstanding Issues: *Model pollutant load and the respective protocols that receive the pollutant load reductions will be finalized by the appropriate CBPO Workgroup(s)*

21. Pollutant relocation: *None*

Appendix C. Technical Requirements for Entering the Shoreline Management Practice into Scenario Builder

Tidal shoreline erosion occurs at the interface between the watershed and the tidal Chesapeake. Consistent with this, the CBP models of the watershed (WSM) and the tidal Bay, the Water Quality and Sediment Transport Model (WQSTM), both have model boundary domains consistent with the shoreline. In other words, the Watershed Model (WSM) domain ends at the tidal shoreline and the WQSTM domain begins at the tidal shoreline.

Sediment loads to the WQSTM are from all the sources of sediment that influence the tidal Chesapeake, and include sediment loads from the watershed, shoreline erosion, resuspension of bottom sediment from waves or currents, and sediment loads from the ocean at the Bay mouth. The sediment loads that are input to the WQSTM specifically at the shoreline are loads from shore erosion and the watershed, with the sediment loads of silts and clays of particular interest.

Operationally, the efficient approach to deal with reductions in shore erosion is to track the shoreline management practices with the same approach and methods as is done with all other Chesapeake management practices. The common approach for tracking management actions in the Chesapeake is with the Scenario Builder framework. For shoreline management practices this will be done by the calculation of the mass of sediment fines reduced by shoreline management practices, following the recommendations of the Shoreline Management Expert Panel, and then applying the estimated sediment reductions as a reduction to the watershed sediment loading from the WSM land-river segments that contain the shoreline management practice. In all cases this will be WSM land-river segments that are adjacent to tidal waters. Decrementing the load reductions of sediment fines from the watershed loads adjacent to tidal waters will have exactly the same result as directly decrementing them from the shoreline erosion input loads, but allows a more efficient tracking of the shoreline management practices. In summary, the shoreline management practice will be entered in Scenario Builder in order to credit and track the practice for local jurisdictions; however, the pollutant load reductions will effectively be taken from the WQSTM.

In addition, a pollutant load reduction cap will be implemented for each WSM state-basin. The shoreline management load reductions per state-basin should not exceed one-third of the WQSTM fine sediment shore erosion load to that state-basin. The state-basin fine sediment loads from the WQSTM shore erosion estimates are listed in Table 19. The pollutant load cap ensures that each state-basin segment does not exceed the available pollutant load reductions and reduces the unintended consequences that were discussed in Section 6.2 (e.g., management shift to implement shoreline management practices in high numbers and/or in areas unsuited for the practices). However, it is unlikely that any state-basin will exceed 1/3 the pollutant load using shoreline management practices because 85% of the Chesapeake shoreline is in private ownership (Milligan and Hardaway, 2009) and much of the Bay is already protected/modified. To this point, the Virginia Institute of Marine Science Center for Coastal Resources Management (VIMS CCRM) reported that the Chesapeake Bay is 16% protected; Maryland is 26% protected and Virginia is 10% protected (Berman and Hershner, 1999; VIMS CCRM, accessed 2014). Any state-basin exceeding 1/3 the pollutant load will be assessed on a case by case basis by EPA

CBPO. The shoreline management practice pollutant load reduction cap will be implemented in the suite of EPA CBPO modeling tools.

Table 19. Water Quality Sediment Transport Model tidal shore erosion for each state-basin.

State-Basin	Shoreline Erosion Load (millions of kg/yr)[1,2]				
	Total Inorganic Suspended Sediment (ISS)[3]	Sand	Silt	Clay	Fine Clay
MD West Shore	2.3E+06	1.0E+06	5.2E+05	4.3E+05	4.3E+05
Patuxent	4.0E+05	1.8E+05	9.1E+04	6.5E+04	6.5E+04
Potomac	1.0E+06	4.9E+05	2.3E+05	1.5E+05	1.5E+05
Rappahannock	8.7E+05	6.1E+05	1.2E+05	6.5E+04	6.5E+04
York	7.5E+05	4.8E+05	1.1E+05	6.8E+04	6.8E+04
James	7.9E+05	4.8E+05	1.2E+05	8.6E+04	8.6E+04
MD-DE Upper East Shore	5.2E+05	2.3E+05	1.2E+05	9.5E+04	9.5E+04
MD-DE Middle East Shore	8.4E+05	3.5E+05	1.9E+05	1.3E+05	1.2E+05
MD-DE Lower East Shore	9.5E+05	2.3E+05	2.4E+05	4.4E+05	1.9E+05
Virginia East Shore	3.4E+05	2.6E+05	2.8E+04	2.0E+04	2.0E+04

[1]These values represent 1991 to 2000 average.
[2]These values represent the proportion of tidal erosion allowed for pollutant load reductions and will be refined by the Watershed Technical Workgroup and the Water Quality Goal Implementation Team, as appropriate for the Shoreline Management Best Management Practice.
[3]ISS is the sum of sand, silt, clay and fine clay.

Appendix C References

Berman, M., and C. Hershner. 1999. Development of guidelines for generating shoreline situation reports: establishing protocols for data collection and dissemination. Center for Coastal Resources Management Comprehensive Coastal Inventory Program, Virginia Institute of Marine Sciences, Glocester Point, VA.

Milligan, Donna and C. Scott Hardaway, Jr. 2009. A guide to shoreline management planning for Virginia's coastal localities. Virginia Institute of Marine Science. Gloucester Point, VA.

Virginia Institute of Marine Sciences Center for Coastal Resources Management (VIMS CCRM). Shoreline Inventory data (2006/2007 update), Comprehensive Coastal Inventory. Available online at: http://ccrm.vims.edu/gis_data_maps/data/index.html Accessed 2014.

Appendix D. Shoreline Management in Chesapeake Bay: A Comprehensive Approach

According to Hardaway and Byrne (1999), before any shoreline strategy is planned, the site should be evaluated in the context of the "reach." A "reach" is defined as a segment of shoreline where the erosion processes and responses mutually interact. For example little sand is transported by wave action beyond a major headland creek mouth, tidal inlet or major change in shoreline orientation. One to several properties may be contained along a reach. In highly developed areas there will be several properties in a reach.

It may not be possible for all property owners to have a site assessed, but knowing the basic elements that go into an evaluation should be helpful. Reach assessments involve the following six principal points:

1. Determine the reach limits in which the project site is located.
2. Determine the historical rates and patterns of erosion and accretion for the reach. Identify shore types (upland banks, marsh, etc.) and impacts to shoreline erosion processes and evolution.
3. Determine within the reach which areas supply sand and the volume of that supply for incremental erosion distances. Often, there can be subreaches that interact with each other. These subreaches supply sediment to the other subreaches (erosion), transport sediment from one subreach to the next, or are subreaches where sediment accumulates (accretion). A reach may feature all three types of subreaches.
4. Determine the wave climate and the net direction of littoral sand drift.
5. Identify the factors causing or influencing erosion (other than waves). These may include groundwater seepage, freeze thaw, surface runoff, or other processes.
6. Estimate potential and active sources of nutrient loading (i.e., farmland, commercial, or residential land) and the means by which this occurs, such as surface runoff, eroding sediments, and/or groundwater discharge. Nutrients, particularly nitrogen and phosphorous, do not impact erosion, but they do impact water quality. Installing breakwaters, revetments or other shoreline erosion treatments, inevitably change water discharge and shore change patterns and thus overall water quality. In order to minimize water quality problems, shoreline erosion strategies can and should be designed so that nutrients don't adversely impact water quality or are actually treated by the strategy.

Understanding the size of the reach and those factors which influence the reach provides property owners a sense of the spatial parameters to address shoreline erosion, help frame the problem, and put the problem (e.g., erosion) and solution (e.g., shoreline management practice) into context. These considerations can support sustainable shoreline management.

Appendix E. Policy and Permits

Maryland and Virginia's preferred shoreline management approach is to use living shorelines where appropriate to prevent shoreline erosion and to protect the associated habitat. Maryland is a "high water state" meaning the jurisdictional line is at MHW (mean high water) and Virginia is a "low water state" meaning the jurisdictional line is at the MLW (mean low water). The policy and permit structure differs in the states, but the goals to protect property, prevent erosion, promote nearshore water habitat, and prevent unintended consequences are similar for the states.

Maryland

In Maryland, the Living Shoreline Protection Act of 2008 provides this regulatory authority. The regulations were final in February 2013 and include the following guidance:

- *HB973 – Living Shoreline Protection Act of 2008* "Improvements to protect a person's property against erosion shall consist of non-structural shoreline stabilization measures (i.e., living shorelines) that preserve the natural environment, such as marsh creation" (MDE).
- The regulatory definition of Nonstructural Shoreline Stabilization Measures or "living shoreline" is a suite of stabilization and erosion control measures that preserve the natural shoreline and are designed to minimize shoreline erosion, maintain coastal processes, and provide aquatic habitat.
- Property owners that demonstrate nonstructural practices are not feasible can obtain a waiver.

Guidance documents, checklists, and sample plans are underway for Maryland projects. Permits and application forms in Maryland are obtained through the MDE and require the following (from MDE's website at http://www.mde.state.md.us/programs/Water/WetlandsandWaterways/Pages/TidalRegsLivingShoreline.aspx):

- Joint federal/state application for the alteration of any tidal wetland
- Proposed critical area buffer management plan
- Signed critical area buffer notification form
- If applicable, a living shoreline waiver request form

Virginia

In Virginia, Senate Bill 964 established living shorelines as the preferred approach to shoreline erosion protection in 2011. The legislation mandates the development of a living shorelines general permit and the development of integrated guidance to direct shoreline management. Senate Bill 964 calls for the following:

- Living shorelines definition;

- Requires VMRC to develop a general permit;
- Encourages the use of living shorelines as the preferred practice to stabilize tidal shorelines;
- Requires VMRC to develop guidance for tidal shoreline management;
- Requires Tidewater localities to incorporate the VIMS guidance in their comprehensive plans starting with scheduled reviews in 2013; and
- Requires VIMS to develop comprehensive coastal resource management guidance by 12/30/12. This guidance is locality specific GIS analysis for shoreline management BMPs. The guidance is delivered via map-viewer along with documentation in report form. VIMS creates the shoreline model map viewers over time. Rationale and general information is online at http://ccrm.vims.edu/ccrmp/Guidance_General.pdf

Virginia's shoreline management policy guidance is ongoing. In Maryland and Virginia, living shorelines are the preferred management strategy.

In Virginia, the joint permit is submitted to VMRC who then submits to the appropriate local wetland board, DEQ, and the US Army Corps of Engineers. The applicant usually has to have a permit or waiver from each agency before beginning construction. See Figure 11 for the permit process in Virginia.

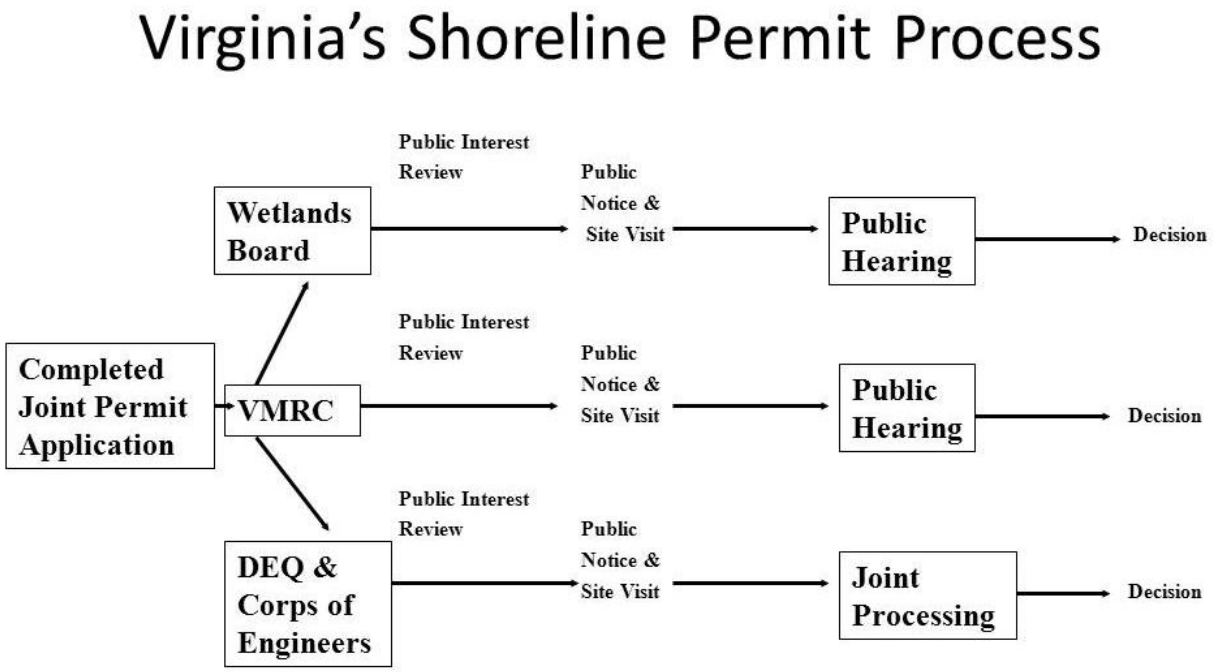

Figure 11. Virginia's shoreline permit process. This figure is courtesy of Tony Watkinson (VMRC) presentation to the panel on 2/25/13.

Delaware

The western part of Delaware is located within the Chesapeake Bay watershed, which includes the coastal plain and the Nanticoke River drainage. The findings in this report can be translated to the coastal shorelines in Delaware.

In Delaware, the 7504 Regulations Governing the Use of Subaqueous Lands, 4.10 Installation and Use of Shoreline Erosion Control Measures outlines the use of nonstructural shoreline practices as the first, preferred shoreline management strategy. The policy states,

> "Efforts shall be made to utilize shoreline erosion control methods that best provide for the conservation of aquatic nearshore habitat, maintain water quality, and avoid other adverse environmental effects. These include, but are not limited to, vegetation, revetments, and gabions. Structural erosion control measures may be allowed where it can be shown, through a review of site conditions and generally accepted engineering standards, that nonstructural measures would be ineffective in controlling erosion."

The state jurisdictional line is the mean low water. This policy is online at:
http://regulations.delaware.gov/AdminCode/title7/7000/7500/7504.shtml#TopOfPage

A USACOE Nationwide 13 permit is needed for bank stabilization projects. These hard structures are the most prevalent practices for shoreline stabilization in the state. The state has a living shoreline Statewide Activity Application (SAA) that includes statewide activity approval for disturbances less than 500 ft^2. The SAA project must have a vegetative component. SAA benefits include no public notice and a cost-share program for vegetated or hybrid shoreline management practices.

District of Columbia

The District of Columbia is a heavily developed, urban community. The US Army Corps of Engineers - Baltimore District issues all District of Columbia permits for work in waters of the United States including jurisdictional wetlands and shoreline management projects. These permits have to be certified by District Department of the Environment (DDOE) Water Quality Division under Section 401 of the Clean Water Act.

The District of Columbia permitting details are available online at:
http://www.nab.usace.army.mil/Missions/Regulatory/PermitTypesandProcess.aspx

Appendix F. Sea Level Rise Considerations for Shoreline Management Practices

The Shoreline management expert panel realizes that future sea level rise (SLR) considerations for shoreline management practices are needed. The design, maintenance, and ultimate effectiveness can be impacted by rising waters and/or more intense storm events. Based on the available information there is a need to consider the future impacts to the shoreline management options provided in this panel report.

The CBPO asked the Science and Technical Advisory Commission (STAC) to review the effects of climate change on the Chesapeake Bay. The STAC produced a report that summarized the available science and recommended the Bay Program and its partners assess the vulnerability of living resource restoration efforts to climate change and require that projects take specific steps to increase the likelihood of success under changing conditions (Pyke et al., 2008). Shoreline erosion control practices can provide pollution reduction benefits and their long term stability and function should be considered in the context of climate change and specifically SLR impacts.

There are several Chesapeake Bay coastal climate change impacts that include storm intensity, precipitation level, wave action, and habitat impact such as SAV, fish, oysters, etc. (Pyke et al., 2008; CBPO, 2005). Sea level rise during the second half of the 20th century was monitored at six sites in the Bay and reported to range from 2.7 to 4.5 mm yr^{-1} with an average of 3.5 mm yr^{-1} (Zervas, 2001). Maryland's "A Sea Level Rise Response Strategy for the State of Maryland" (Johnson, 2000) states, "The average rate of SLR along Maryland's coastline has been 3 to 4 mm/yr, or approximately one foot per century. Such rates are nearly twice those of the global average (1.8 mm yr^{-1}), a result probably due to substantial land subsidence. Furthermore, research has demonstrated that SLR rates will accelerate in response to global warming, resulting in a rise of 2 to 3 feet by the year 2100 (Leatherman et al., 1995). A rise in sea level of this magnitude will undoubtedly have a dramatic impact on Maryland's coastal environment. Norfolk, VA has an estimated 2 feet (± 0.7) feet sea level relative to the land above the mean sea level by 2050. The linear rise rate in Norfolk was 5 mm y^{-1} and is consistent with a high linear subsidence rate in Norfolk (Boon, 2012). Virginia's southern coast will be impacted more from subsidence coupled with SLR (Titus et al., 2010). Current research suggests that wetlands in VA will not accrete fast enough to compensate for increases in water depth due to SLR (Titus et al., 2010). Therefore, SLR is an important to consider in the VA and MD tidal areas.

The latest Status and Trends of Wetlands in The US 2004-2009 (Dahl, 2011) reported the loss of approximately 111,000 acres of emergent estuarine wetlands; this is 2.4% of the total. This report stated the following:

- In salt water systems, the trend is towards an increase in non-vegetated tidal wetlands as vegetated salt marshes decline.
- The increase in tidal non-vegetated area came primarily from former vegetated salt marsh.
- Ninety nine percent of losses of estuarine emergent wetlands were attributed to the effects of coastal storms, land subsidence, sea level rise, or other ocean processes.

- Eighty three percent of the estuarine emergent losses were attributed to saltwater intrusion or other forms of inundation.
- Rising sea levels are expected to continue to inundate or fragment low-lying coastal habitats.
- Coastal habitats will likely be increasingly stressed by climate change impacts that have resulted from sea level rise and coastal storms of increasing frequency and intensity

The ability for coastal marshes and wetlands to migrate landward is essential for land protection and to prevent wetlands from "drowning in place." This is especially true where policy research suggests, that developed coastal areas will move to and be allowed to harden shorelines in response to SLR. Marshes and/or wetlands creation channelward of hardened shorelines will not be able to migrate landward in response to SLR in urban areas (Glick et al., 2008). Also, steep slopes, wetland mowing, and other "management" activities prevent existing, created, restored, or enhanced coastal marshes and wetlands from providing their initial and intended pollution reduction. As a result, tracking and verification timeframes should assess the loss of acreage and function of wetlands over time. In addition, structure-induced toe scour may also affect the function and value, therefore the verification inspections should be conducted annually.

For living shoreline management projects, active marsh and/or wetland intervention may be needed to combat the effects of SLR over time. Intervention may be needed most on the developed coastlines where urban development prevents landward migration in response to SLR. This intervention can take many forms that include, but are not limited to the following:

- Raising sill heights and active filling of existing wetland grades to meet zonation elevation requirements for both vegetated and nonvegetated wetlands.
  - One limitation is that the US Army Corps of Engineers and state agencies must comply with a no net loss of wetlands.
  - Therefore living shoreline projects, especially those that are designed to account for SLR may involve permitting issues related to the no net loss of wetland and the conversion of one aquatic habitat to another.
- Filling nonvegetated subtidal lands and converting them to intertidal vegetated and nonvegetated wetlands.

Several policy, research, and implementation options are available to manage in the context of future SLR. Federal, state, and local policies, guidelines, and regulations affirm the ecological values and services that tidal marshes and wetlands provide. However, in order to recognize and sustain the tidal marsh and wetland vital ecosystem services in response to SLR threats, both the existing natural resources and the restoration BMPs need improved inventory strategy and methods. In addition, the shoreline management practice type and placement along the coast should consider the local SLR information. The following coastal restoration and management options were provided by the National Wildlife Federation (Glick et al., 2008):

1. Prioritize project sites based on ecological importance as well as vulnerability to SLR
2. Expand restoration areas and coastal protection strategies to accommodate for habitat migration

3. Restore and protect a diverse array of habitat types to better support ecosystem functions and improve the resiliency of fish and wildlife species.
4. Identify areas that may warrant specific adaptation strategies such as natural and/or artificial replenishment of sediments
5. Expand monitoring and adaptive management practices.

In summary, SLR considerations for shoreline management practice design, implementation, maintenance, tracking, and verification should be updated with the best available information. Future CBPO SLR research can further the Shoreline Management expert panel recommendation implementation phase, can be the focus of CBPO workshops/workgroups, and/or can be considered in the Goal Implementation Team initiatives.

Appendix G. Shoreline Management Site Conditions and Benchmarks

Additional benchmarks the panel recommended for basic qualifying conditions included: 1) shoreline sediment type; 2) nearshore bottom type; 3) shoreline morphology and orientation; 4) back shore area type; 5) bank conditions; 6) boat traffic; and 7) policy considerations. See Table 20 for a summary of these benchmarks. These benchmarks are guidance to support the existing state requirements.

Table 20. Shoreline management site conditions and benchmarks.

Site Condition	Benchmarks
Fetch	• High: 5 to 15 miles • Medium: 1 to 5 miles • Low: < 1 miles
Wave Energy	• High: Bay • Medium: River • Low: Creek
Depth Offshore	• At 10 ft offshore • At 25 ft offshore • At 50 ft offshore
Erosion Rate	• Very High: > 10 ft/yr • High: 5 to10 ft/yr • Moderate: 2 to 5 ft/yr • Slight: < 2 ft/yr
Shoreline Sediment (at MHW)	• Sandy • Clayey • Silty • Mucky • Organic
Nearshore Bottom (at 10 feet, 25 feet and 50 feet)	• Sandy • Clayey • Silty • Mucky • Organic
Shoreline Morphology	• Straight • Irregular • Headland • Pocket (cove)
Backshore Area (Area above and beyond MHW)	• Dunal • Marsh • Forest • Bank

Site Condition	**Benchmarks**
Bank Conditions	• Height • Slope • Composition • Vegetated (% cover) • Type of Vegetation • Stable or Eroding • Undercut
Boat Traffic (From May - September)	• High Traffic Area • Moderate Traffic Area • Low Traffic Area
Tidal range and orientation are also important to determine benchmarks at the local level.	

Appendix H. Tidal marsh denitrification rates in or near the Chesapeake Bay.

The following studies conducted in and near the Chesapeake Bay watershed provide support for the tidal marsh system as a nutrient and sediment load reduction BMP.

- In the Patuxent River, the accreting tidal marsh removed 30% of the total nitrogen and 31% of the total phosphorus from the estuarine/marsh system. This highlights the tidal marsh nutrient reduction capability and the importance for accretion to exceed sea level rise in order to provide these ecosystem services (Boynton et al., 2008).
- The Choptank River tidal marshes retained about 33% total nitrogen and about 94% total phosphorus in the marsh sediments (Malone et al., 2003). The authors state, "In tidal Chesapeake estuaries, tidal marshes represent a large, and previously ignored sink for N and P."
- Five fringe salt marshes in Narragansett Bay, Rhode Island, showed denitrification rates up to 420 µmol N_2 m^2 hr^{-1} to intercept and transform land-derived nitrogen loads (Davis et al., 2004). Denitrification is a major pathway to remove inorganic nitrogen from the estuarine system (Seitzinger, 1988).
- The Dyke Marsh is a tidal freshwater marsh on the Potomac River. The mean denitrification rate was 147 µmol N m^{-2} h^{-1}. Using this rate for the Dyke Marsh area, the potential N removal is 14,600 kg yr^{-1} (Hopfensperger et al., 2009).
- In the Rhode River estuary, tidal marshes transformed particulate nutrients to dissolved nutrients. The marshes retained phosphorus by accumulation on the sediment. Based on the phosphorus retention the high marsh and mudflat are estimated to accrete 3 mm per year (Jordan et al., 1983).
- Another study in the Rhode River estuary found that phytoplankton in the upper estuary led to higher phosphorus than nitrogen removal (Jordan et al., 1991).
- Continuous automated sampling of two tidal marshes in both the high and low marsh over two to three years found that the high marsh exported material and the low marsh imported material and had deposition (Jordan et al., 1991).
- Tidal marshes are effective at trapping sediment both as individual grains and as flocculants. Tidal marsh vegetation plays a role by reducing velocity and breaking up turbulent eddies that might result in resuspension of deposited sediment (Christianson et al., 2000).

The literature review found that denitrification was an important nitrogen removal pathway in vegetative systems. The nitrogen removed in tidal marshes and fringing marshes can represent estimates for shoreline management denitrification.

The studies used for the panel's denitrification protocol are provided in Table 21 and were condensed to represent one value per study as provided in Table 22. See *Section 5.1.2 Tidal Marsh Denitrification* for more information.

Study Area	Denitrification Rate	Nearshore Water Characteristics	Sample Time	Sample Location	Site and Drainage Characteristics	Notes	Method[1]	Source
Dyke Marsh, Potomac River (VA)	147 µmol N m^{-2} h^{-1}	Tidal freshwater	November	Annual, mixed, and perennial plant community type	Dyke Marsh Preserve is a 80 ha marsh on the Potomac River and located south of Alexandria, VA	Mean DNR[2] rates	MIMS	Hopfensperger et al., 2009
Dyke Marsh, Potomac River (VA)	147 µmol N m^{-2} h^{-1}	Tidal freshwater	October	High, mid, and low marsh	Dyke Marsh Preserve is a 80 ha marsh on the Potomac River and located south of Alexandria, VA	DNR listed in Table 4	MIMS	Hopfensperger et al., 2009
Jug Bay NERRS, Maryland	60 µmol N m^{-2} h^{-1}	Tidal freshwater	Spring	High, mid, and low marsh	Patuxent River catchment	NA	MIMS	Merrill and Cornwell, 2000
Jug Bay NERRS, Maryland	28 µmol N m^{-2} h^{-1}	Tidal freshwater	Fall	High, mid, and low marsh	Patuxent River catchment	NA	MIMS	Merrill and Cornwell, 2000
Jug Bay Wetlands Sanctuary, Maryland	120 µmol N m^{-2} h^{-1}	Tidal freshwater	April through October	High, mid, and low marsh		DNR reported was the grand mean of all rates measured	MIMS	Greene, 2005
Patuxent River, Maryland	38 µmol N m^{-2} h^{-1}	Subtidal freshwater	Annual average	High marsh	Patuxent River estuary (Patuxent basin is 2,256 km^2)	DNR rates reported in Table 5 were weighted for	N_2 flux	Boynton et al., 2008

						spatial variation		
Patuxent River, Maryland	32 µmol N m^{-2} h^{-1}	Subtidal freshwater	Annual average	Low marsh	Patuxent River estuary (Patuxent basin is 2,256 km^2)	DNR rates reported from Table 5 were weighted for spatial variation	N_2 flux	Boynton et al., 2008
Patuxent River, Maryland	110 µmol N m^{-2} h^{-1}	Tidal freshwater	Annual average	High marsh	Patuxent River estuary (Patuxent basin is 2,256 km^2)	DNR rates reported from Table 5 were weighted for spatial variation	N_2 flux	Boynton et al., 2008
Patuxent River, Maryland	80 µmol N m^{-2} h^{-1}	Tidal freshwater	Annual average	Low marsh	Patuxent River estuary (Patuxent basin is 2,256 km^2)	DNR rates reported from Table 5 were weighted for spatial variation	N_2 flux	Boynton et al., 2008
Patuxent River, Maryland	60 µmol N m^{-2} h^{-1}	Tidal freshwater	Summer	High, mid, and low marsh	Patuxent River catchment	Annual net DNR in marsh sediments	MIMS	Merrill, 1999
Narragansett Bay, Rhode Island	420 µmol N m^2 hr^{-1}	Tidal saltwater	June to August	High marsh	Watershed to marsh surface area were 3.4, 6.2, 574, 151, and 201	Five fringe marshes sampled; high range DNR reported	MIMS	Davis et al., 2004
West Creek Plum Island, Sound Estuary,	494 µmol N m^2 d^{-1}	Tidal saltwater	August	High marsh (low edge)	Unfertilized West Creek, reference sites	Estimated total daily denitrification rates in tidal	DNRA	Koop-Jakobsen and Gibllin, 2010

Massachusetts						creek and marsh platform sediment		
West Creek Plum Island, Sound Estuary, Massachusetts	428 µmol N m^2 d^{-1}	Tidal saltwater	July	High marsh (low edge)	Unfertilized West Creek, reference sites	Reference and July for marsh platform DNR reported	DNRA	Koop-Jakobsen and Gibllin, 2010
Choptank River, Maryland	123 µmol N m^{-2} h^{-1}	Tidal brackish	July and August	Low marsh	Choptank River catchment	Upstream on the Choptank River	MIMS	Kana et al. (1998)
Choptank River, Maryland	50 µmol N m^{-2} h^{-1}	Tidal brackish	July and August	Low marsh	Choptank River catchment	Downstream on the Choptank River	MIMS	Kana et al. (1998)
Choptank River, Maryland	60 µmol N m^{-2} h^{-1}	Tidal brackish	July and August	Low marsh	Choptank River catchment	Intercept with no nitrate to fuel nitrification	MIMS	Kana et al (1998)
Ringfield Marsh on the King Creek/York River, Virginia	2.75 mmol N m^{-2} h^{-1}	Tidal mesohaline	May and October	High and Low marsh	Colonial National Historical Park on the Ringfield Peninsula near King Creek and the York River	Fringe marsh; average DNR reported from Table 3	DNRA	Tobias et al., 2001
Ringfield Marsh in the York River, Virginia	0.83 mmol N m^{-2} h^{-1}	Tidal mesohaline	May and October	High and Low marsh	Colonial National Historical Park on the Ringfield Peninsula near	Fringe marsh; Average DNR reported from Table 3	DNF	Tobias et al., 2001

Table 21. Denitrification literature summary.

[1]The method acronyms used include:

- MIMS is membrane inlet mass spectrometry.
- DEA is denitrification enzyme activity.
- DNF is the potential denitrification.
- DNRA is the potential dissimilatory nitrate reduction to ammonium.

[2]DNR is denitrification.

ble 22. Denitrification values from literature review and Protocol 2 - Denitrification median value.

Table 22. Denitrification literature summary that was condensed to represent one value per study.

Value	Units	Source
147	µmol N m^{-2} h^{-1}	Hopfensperger et al., 2009
44	µmol N m^{-2} h^{-1}	Merrill and Cornwell, 2000
120	µmol N m^{-2} h^{-1}	Greene, 2005
65	µmol N m^{-2} h^{-1}	Boynton et al., 2008
60	µmol N m^{-2} h^{-1}	Merrill, 1999
420	µmol N m^{-2} h^{-1}	Davis et al., 2004
19.1	µmol N m^{-2} h^{-1}	Koop-Jakobsen and Gibllin, 2010
78	µmol N m^{-2} h^{-1}	Kana et al,1998
3165	µmol N m^{-2} h^{-1}	Tobias et al., 2001
77.67	**µmol N m^{-2} h^{-1}**	**median**
85.02	**pounds N/acre/year**	**median**

Appendix I. Sedimentation Data

The scientific review supports accretion and sedimentation as a sediment and phosphorus removal mechanism. The sediment accretion literature summary is provided in Table 23. Brief summaries of the reviewed studies are presented here:

- Loomis and Craft (2010) in a study of freshwater, brackish, and salt marshes in Georgia found marsh accretion rates of 7.78 mm/yr (tidal fresh), 4.41 mm/yr (brackish marshes), and 1.91 mm/yr (salt marshes). The associated nitrogen accumulation was 8.2 g m^{-2} yr^{-1} (tidal fresh), 6.5 g m^{-2} yr^{-1} (brackish), and 2.4 g m^{-2} yr^{-1} (salt marshes). The phosphorus accumulation was 0.7 g m^{-2} yr^{-1} (tidal fresh), 1.0 g m^{-2} yr^{-1} (brackish), and 0.3 g m^{-2} yr^{-1} (salt marshes). The study utilized ^{137}Cs core analysis to determine accretion rates.
- Smith, et.al. (2013) using cores and ^{210}Pb and ^{137}Cs analysis from interior tidal fresh and brackish marshes in the Mobile Bay developed two models (constant flux-constant supply (CF:CS) and a constant rate of supply model (CRS)) to determine sedimentation rate and mass accumulation rate. The results varied both by the marsh type and the model used. Tidal freshwater sites had a sedimentation rate between 0.657 cm yr^{-1} (CF:CS model) and 0.907 cm yr^{-1} (CRS model), while brackish marshes had a sedimentation rate between 0.498 cm yr^{-1} (CF:CS model) and 0.461 cm yr^{-1} (CRS model). The corresponding mass accumulation rates were: tidal freshwater between 0.834 g cm^{-2} yr^{-1} and 0.587 g cm^{-2} yr^{-1}; brackish 0.529 g cm^{-2} yr^{-1} and 0.335 g cm^{-2} yr^{-1}.
- Currin, et.al. (2008) studied natural and restored fringing salt marshes in North Carolina. A total of 3 paired sites were included in the study, with multiple samples from each site (89 natural site samples, 154 restored site samples). A number of parameters were monitored, including; surface elevation, vegetation, and nekton. The elevation changes were measured at two of the sites for both natural and restored marshes (Site 1: Natural marsh average change = 7.48 cm (n=21), restored = 9.32 cm (N=19); Site 2: Natural marsh average change = 11.78 cm (n=12), restored = 23.96 cm (N=23)). The authors concluded that the accretion rates of restored marshes were 1.2 to 2.0 times greater than natural marshes. Other conclusions of the study include: percentage cover and stem height were significantly lower in restored versus natural marshes; after three years the restored marshes achieved stem densities equivalent to natural fringing marshes. There was no difference in the mean number of fish and crabs or shrimp between natural and restored fringing marshes, but there were some differences when individual species were considered.
- Anisfeld, et.al. (1999) analyzed sedimentation rates in natural, flow-restricted and restored salt marshes in Long Island Sound using ^{137}Cs and ^{210}Pb core dating. The mean vertical accretion rates varied between marsh type and core dating method. The ^{137}Cs dating method resulted in higher accretion rates than the ^{210}Pb. Using the ^{137}Cs method the average accretion rates were: natural = 0.37 cm yr^{-1}, restricted = 0.29 cm yr^{-1}, and restored = 0.66 cm yr^{-1}. The bulk of the accretion was due to inorganic sediment with organic matter equal to 8.4%, 7.2%, and 5.2%, respectively. The equivalent average mass accumulation rate was:

natural = 1020 g m^{-2} yr^{-1}, restricted = 1200 1020 g m^{-2} yr^{-1}, and restored = 1320 1020 g m^{-2} yr^{-1}.

- Chmura, et.al. (2001) studied salt marsh accretion rates in the outer Bay of Fundy using ^{137}Cs and ^{210}Pb core methodology along with pollen stratigraphy to estimate changing accretion rates over time. Average marsh accretion rates ranged from 1.3 to 4.4 mm yr^{-1} over the last two centuries. Recent rates are in-step with local sea level change. Rates were higher in the late 18th and early 19th century than present, which may have been due to local tectonic activity and ice rafting.
- Vogel, et.al. (1996) studied sediment accretion using ^{137}Cs and ^{210}Pb core dating in the North Inlet Marsh in South Carolina. They also used suspended sediment flux analysis and discharge modeling in their study. They the results from three cores indicated the material was 80% inorganic. The three cores had accretion rates of 2.9, 3.5, and 1.6 mm yr^{-1}, which is calculated to be an inorganic accumulation of 0.091, 0.097, and 0.046 g cm^{-2} yr^{-1}.
- Cavatorta, et.al. (2003) studies marshes in the Parker River estuary in northeastern Massachusetts through a combination if aerial photography, TSS sampling, and sediment traps along transects deployed for two tidal cycles. Sediment accumulation ranged from 0.025 to 0.5 g per 9 cm^2 filter. They concluded that due to the lack of TSS in the system that the below ground plant production may be more important than sedimentation in marsh accretion in this system.
- Strange (2008) summarized accretion rate studies from the Virginia eastern shore, with a low of 0.9 mm yr^{-1} to a high of 2.1 mm yr^{-1}.
- White and Howes (1994) studied nitrogen pathways in the Great Sippewissett Marsh, Massachusetts. They determined burial rates of 3.7 – 4.1 g N $m^{-2}yr^{-1}$. They concluded that long-term N retention appears to be controlled primarily by the competition for DIN between plants and bacterial nitrifiers-denitrifiers and secondarily by the relative incorporation of N into aboveground vs. belowground biomass.
- Bragadeeswarean, et.al. (2007) sampled sediment for physical composition and nutrients at three stations over two years in the Arasalar estuary, India. Nitrogen was found to have a mean range of 2.83 – 3.37 mg/g sediment and phosphorus to have a mean range of 0.07 – 0.18 mg/g sediment.
- Morgan, et.al. (2009) studied fringing salt marshes in Casco Bay, Maine for ecological functions and values. They found mean accumulation values from 2.24 g m^2 day^{-1} to 9.82 g m^2 day^{-1}. They found accretion rates of 0 to 6.3 mm/yr.
- Jordan, et.al. (1986) found in a study of the Rhode River estuary in the Chesapeake Bay that influx of particulate matter to marshes is directly related to the amount of time they are submerged during tidal cycles. They found a mineral deposition rate of 2,800 g m^{-2} yr^{-1} for subtidal areas, 400 g m^{-2} yr^{-1} low marsh, and 200 g m^{-2} yr^{-1} for high marsh.
- Calloway, et.al. (2012) studied two marshes in San Francisco Bay using transect coring and marker horizons to determine long-term and short-term.

Table 23. Sediment accretion literature summary.

Study Area	Trapping Rate – Vertical accretion (cm/year)	Trapping Rate (g/cm^2/year)		Pounds Sediment/ Acre/Year	Study Method	Marsh Type	Study Timeframe	Notes	Comments	Source
North Carolina – fringing marsh restoration and natural	7.48 cm 9.32 cm 11.78 cm 23.96 cm			266,943 332,604 420,395 855,064	Elevation Change - Survey	Fringing marsh - polyhaline	Spring (April) Fall (Sept. or Oct)	Natural Restored Natural Restored	These are fringing marshes, restored marshes 1.5 – 2.0 fold greater sediment accretion rates.	Currin, et.al., 2008
North Carolina – North Inlet Salt Marsh	2.9 mm 3.5 mm 1.6 mm	0.1141 0.1213 0.0580		10,180 10,822 5,175	^{210}Pb	Estuarine salt marsh	NA coring	Average bulk density 0.4 g/cm^3	80% inorganic matter, seasonal variation	Vogel, et.al., 1996
Massachusetts – Parker River Estuary		0.05 $g/9cm^2$/21 days 0.025 $g/9cm^2$/21 days		8,615 4,307	Sediment trapping of filters	Estuarine salt marsh	July, 2003; two sets of samples exposed over several spring tide cycles.	Inorganic sediment numbers	This high level, low level interpreted from graph is 0.025.	Cavatorta, et.al., 2003
Connecticut – Long Island Sound	Reference 0.25 cm 0.42 cm 0.42 cm 0.33 cm 0.44 cm 0.34 cm Restricted 0.38 cm 0.19 cm 0.39 cm	IM* 160 750 760 630 1000 780 1200 470 1800	OM* 290 360 400 250 300 430 240 170 390	 1,428 6,691 6,781 5,621 8,922 6,959 10,706 4,193 16,059	^{137}Cs, ^{210}Pb	Salt marshes, both natural and restored		Bulk density varies with depth for restricted sites, but not reference or restored. Ref max = 0.4 g/cm^3 Res max = 0.84 g/cm^3	This study looked at accretion rates in reference marshes, marshes with flow restrictions, and marshes with flow restrictions eliminated. The accretion was partitioned between inorganic (sediment) and organic material. The study also included pore space volume as part of the	Anisfeld, et.al., 1999

Study Area	Trapping Rate – Vertical accretion (cm/year)	Trapping Rate ($g/cm^2/year$)		Pounds Sediment/ Acre/Year	Study Method	Marsh Type	Study Timeframe	Notes	Comments	Source
	0.31 cm 0.25 cm 0.25 cm Restored 0.63 cm 0.69 cm	1000 1100 180 760 1100	210 130 230 380 380	8,922 9,814 1,606 6,781 9,814					accretion (dominated the accretion rate). Also looked at carbon accretion and nitrogen accretion. Burial of nitrogen in marsh sediments is a semi-permanent sink.	
									Review paper of salt marsh fluxes. Insufficient numerical data to be of use for our purposes.	Fagherazz et al., 2013
Maine/Canada (New Brunswick) – Bay of Fundy	1.6 mm 1.4 mm 1.6 mm			5,710 4,996 5,710	^{137}Cs, ^{210}Pb Pollen Strati-graphy	3 Coastal salt marshes	NA cores			Chmura, et.al. 2001
South Carolina									Study looked at sediment and metal mobilization during low tide rainfall events, not applicable, except as another process to consider, but should be covered by looking at long term accretion rates.	Chen et.al., 2012
California – San Francisco Bay	Corte Madera 0.49 cm 0.38 cm 0.49 cm	IM* 2056. 5 1631. 9	OM* 303.9 261.8 372.7 212.3	18,348 14,559 19,194 5,886	Sediment Pads, Marker Horizons, and ^{137}Cs,	Natural salt marsh, and old restored	Pads, 2-week period every 3 months, for 1 year; Markers –	Tran A – Low Tran B – Low Tran A- Mid Tran B – Mid	Study used sediment cores with isotope dating for long term analysis, and sediment pads for short term analysis and fractionation into	Callaway, et al., 2012

Study Area	Trapping Rate – Vertical accretion (cm/year)		Trapping Rate ($g/cm^2/year$)		Pounds Sediment/ Acre/Year	Study Method	Marsh Type	Study Timeframe	Notes	Comments	Source
	0.32 cm 0.36 cm 0.36 cm Based on ^{137}Cs analysis		2151.4 659.8 1109.2 1034.2	242.7 260.7	9,896 9,9227	^{210}Pb	salt marsh	quarterly measurement for 1.5 years.	Tran A –High Tran B - High	inorganic and organic material. Measured bulk density of 10cm segments of cores	
Alabama – Mobile Bay	CF:CS 0.158 0.797 0.290 0.706 1.480 0.085	CRS 0.755 1.058 0.330 0.592 1.153 ND	CF:CS 0.457 1.210 0.086 0.972 0.758 0.08	CRS 0.336 0.838 0.095 0.575 0.370 ND		^{137}Cs, ^{210}Pb	3 different marsh types; freshwater, interior brackish, fringing brackish.	NA cores	 Freshwater Freshwater Interior Interior Fringing Fringing	Six cores representing 3 different marsh types; freshwater, interior brackish, fringing brackish. Used two models to determine rate; constant flux-constant supply (CF:CS) and Constant rate of supply (CRS). No distinct patterns among marsh types.	Smith, et al., 2013
North Carolina – Albemarle Sound						^{137}Cs, ^{210}Pb	Open Water		Not applicable to marsh deposition	Open water deposition, not marsh deposition	Corbett, et al., 2007
California – Mugu Lagoon			Range 0-1.29*							Measured three parameters, TSS, sediment deposition, vertical accretion, short term study February - April	Rosencranz, 2012

Study Area	Trapping Rate – Vertical accretion (cm/year)	Trapping Rate ($g/cm^2/year$)	Pounds Sediment/ Acre/Year	Study Method	Marsh Type	Study Timeframe	Notes	Comments	Source
Tidal freshwater marsh in VA	8.4 to 8.5 cm/yr (84 to 85 mm/yr)		29,977 30,334	Cesium 137	High vegetation and low urbanization in watershed		Are the units reversed or should the cm measurements be .84 and .85?? **Need to Check Units**	Used .84 and .85 cm/year for calculations	Neubauer et al, 2002
Jug Bay NERRS, Maryland	0.2 cm/yr (Harrison and Bloom, 1974) to 1.35 cm/yr (DeLaune et al, 1981) 250 cm/yr (25 mm/yr) to 11 cm/yr (1.1 mm/yr)		7,137 48,178				Ranges of vertical accretion reported in the literature as cited by Merrill and Cornwell	p. 426	Merrill and Cornwell, 2002
Patuxent River, Maryland	0.21 (tidal marsh), 0.27 (subtidal estuary), 0.21 (tidal marsh) and 0.11 (subtidal marsh)			Pb 210				Values from Table 6 converted from g dry sediment/m2-yr (p. 641)	Boyton et al., 2008
New England		0.073 to 1.10	6,513 to		Fringe		- Sediment trapped at		Morgan et

Study Area	Trapping Rate – Vertical accretion (cm/year)	Trapping Rate ($g/cm^2/year$)	Pounds Sediment/ Acre/Year	Study Method	Marsh Type	Study Timeframe	Notes	Comments	Source
		g/cm2-yr (2 to 30 g/m2-day)	97,694		salt marsh		edge of marsh: 2-30 g/m2/day - Slightly more sediment trapped in fringe marshes than meadow marshes (but not significant		al., 2009
Blackwater		-1.38 g/cm2-yr (-13.8 kg/m2-yr)	-123,121				- Blackwater as a whole is not trapping sediment, unlike what is believed by marsh systems - Blackwater marshes are losing sediment at a rate of 13.8 kg/m2/yr - Any accretion that is occurring is biological, not the accumulation of sediment (but these are not fringe marshes, which is what living shorelines would be, and Morgan et al finds that marshes	- He does find that little sediment is trapped beyond 3m into the marsh (so edge is important, and again, what we're building with LS is edge/fringe marshes) - Different marshes in different areas (e.g., riverine marshes in the turbidity maximum of rivers vs. submerged upland marshes) perform differently for sediment removal. Therefore, sediment removal of LS might depend on where you put the LS project	Stevenson et al., 1985

Study Area	Trapping Rate – Vertical accretion (cm/year)	Trapping Rate ($g/cm^2/year$)	Pounds Sediment/ Acre/Year	Study Method	Marsh Type	Study Timeframe	Notes	Comments	Source
							trap sediment at the edges) -		
Dyke Marsh Wildlife Preserve (Potomac)		0.44±0.29 on elevated banks 0.27±0.24 rest of marsh Data also shows seasonality in deposition	39,256 24,089	Tile-derived sedimentation	Tidal fresh	April 2010 to September 2011	-	-	Palinkas, et al., 2013
Dyke Marsh Wildlife Preserve (Potomac)		0.46±0.18 on elevated banks 0.41±0.29 rest of marsh Data also shows seasonality in deposition	41,040 36,579	Berilium-7	Tidal fresh		-	-	Palinkas, et al., 2013
Corsica River		0.3 to 1.89 in the marsh	26,765 168,622	210Pb verified with 137Cs			-	-	Palinkas and Cornwell 2012
North Carolina		0.021 to 0.036 $g/m^2/yr$ (21 to 36 $kg/m^2/yr$)	0.19 0.32	1) Feldspar marker layers and 2) fine particles in surface soil (p.	Constructed salt marsh	October 1998 to Marsh 1999	Random samples that were from streamside and from marsh interior from eight marsh systems	Constructed S. alterniflora marsh 1 to 3 years old	Craft et al., 2003

Study Area	Trapping Rate – Vertical accretion (cm/year)	Trapping Rate (g/cm^2/year)		Pounds Sediment/ Acre/Year		Study Method	Marsh Type	Study Timeframe	Notes	Comments	Source
						1420)					
North Carolina		0.002 g/m^2/yr (2 kg/m^2/yr)		.02		Feldspar marker layers and 2) fine particles in surface soil (p. 1420)	Constructed salt marsh	October 1998 to Marsh 1999	Random samples that were from streamside and from marsh interior from eight marsh systems	Natural reference marsh	Craft et al., 2003
Louisiana, Mississippi Delta	IM .59 .88 .10 .24 .12	OM 1,928 1,270 374 1,970 724	IM 424 604 538 618 542	OM 17,201 11,331 3,337 17,576 6,459	 3,783 5,389 4,800 5,514 4,836	^{137}Cs	 Saline Brackish Fresh Saline Brackish	NA			Nyman, et al., 2006
*g/m^2/year											

Appendix J. Marsh Redfield Ratio Data

The rationale for a marsh Redfield ratio protocol was based on the vegetation's aboveground and belowground productivity (Table 244). When the shoreline management practice includes the creation of new intertidal vegetated wetlands/plants, with or without any associated structure, the "start-up" of the new marsh will result in a net uptake of nutrients. This is based upon several well-understood natural and construction processes (Davis et al., 2008; Currin et al., 2010). Tidal marshes have high levels of primary productivity. In addition, the new created marshes are generally created using clean sand fill and planted bare root vegetative sprigs. This means that created marshes contain low levels of nutrients. If fertilized, which is a common practice, the slow-release nutrients are used by the new marsh plants to help overcome the lack on in-situ nutrients.

Vegetative biomass in natural marshes is generally split evenly between aboveground and belowground material (Schubauer and Hopkinson, 1984). Assessments of primary production and vegetative cover of newly planted tidal marshes indicate growth and mimic natural marshes at around year five (Craft et al., 2003). Therefore, prior to achieving this level of primary production, the plants in the systems are taking up nutrients and carbon. Much of the biomass of this initial growth is found belowground in the roots and rhizomes as the plants started as bare root springs. The nutrients that support the initial grow-out are removed from the waterway and become a reduction in nutrient load. The following studies were used to determine the Marsh Redfield Ratio.

Table 24. Marsh vegetation aboveground and belowground productivity literature summary.

g dry matter m^{-2} yr^{-1}	Location	Source
2,883	GA	Odum and Fanning (1973)
812.5	NC	Stroud and Cooper (1969)
2,683	GA	Odum and Fanning (1973)
2,658	LA	Hopkinson et al (1978
973	GA	Smalley (1958
2,650	GA	Odum 1959 and Odum (1961
862.5	NC	Stroud and Cooper (1969
650	NC	Williams and Murdoch (1969
1,000	NC	Williams and Murdoch (1969
1,335	VA	Wass and Wright (1969
2,800	NJ	Smith et al. (1979)
1,487	NJ	Roman and Daiber. (1984
5,250	MA	Valiela et al. (1976
6,043	LA	Hopkinson et al. (1978)
1,428	LA	White et al. (1978)

g dry matter m^{-2} yr^{-1}	**Location**	**Source**
1,296	NC	Waits (1967)
1,147	NJ	Roman and Daiber (1984)
993	NY	Harper (1918)
1,335	LA	Hopkinson et al. (1978)
3,237	LA	Hopkinson et al. (1978)
9,162	LA	White et al. (1978)
855	VA	Mason (1989)
1,600	MS	de la Cruz (1974)
2,100	GA	Gallagher and Plumley (1979)
500	NC	Stroud (1976)
350	NC	Cammen (1975)
2,900	NJ	Good (1977)
3,300	NJ	Good and Frasco (1979)
490	NJ	Roman and Daiber (1984)
1,120	NJ	Smith et al. (1979)
3,500	MA	Valiela et al. (1976)
329	VA	Mason (1989)
900	MS	de la Cruz (1974)
310	GA	Gallagher and Plumley (1979)
470	DE	Gallagher and Plumley (1979)
3,270	NJ	Good and Frasco (1979)
2,500	MA	Valiela et al. (1976)
2,200	MS	de la Cruz and Hackney (1977)
3,560	GA	Gallagher and Plumley (1979)
1,070	GA	Gallagher and Plumley (1979)
3,400	DE	Gallagher and Plumley (1979)
2,780	NJ	Good and Frasco (1979)
420	VA	Mason (1989)
2,000	GA	Gallagher and Plumley (1979)
1,458		**Median**

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Appendix K. Sediment Sampling Protocol

Sediment Sampling Protocol

Eroding bank sediments have been identified as a source of nitrogen and phosphorus. Nutrients are contained within and attached to the eroding sediment. Ibison et al. (1990 and 1992), analyzed numerous bank sediments to develop a general sense of nutrient loading to the Bay via eroding bank sediments. The sampling method performed for these studies was to approach the subject eroding bank and acquire fresh samples along the bank face that represent each notable change in strata.

The goal of bank sampling is to acquire sediments along the exposed bank face in order to determine the amount and proportion of gravel, sand, silt and clay that is being eroded into Chesapeake Bay for a particular segment of shoreline. Along with grain size the amount of TN and TP need to be analyzed in the context of the volume and rate of eroded material. Once acquired from the field the grain size and nutrient analyses outlined in the Ibison et al (1990 and 1992) reports should followed.

Methods

One may start at the top or bottom of an exposed and eroding bank face but it is important to keep track of elevation above some reference point. Establishing approximate MHW is a good start. One needs to perform a rudimentary site assessment in order to determine if only on bank sampling transect is needed. Long sites with varying alongshore lithology and stratigraphic faces may require more than one sample transect. Higher banks become more difficult not only because it takes more time and gets dangerous but slumping may cover part of the outcrop along the bank face and base and digging for the *in situ* strata becomes important. Taking a continuous vertical transect may also be difficult so moving up or down river along the bank face may be required to reach a "fresh" outcrop. This is fine as long as the alongshore strata does not change significantly. The important thing is to keep track of the elevation of the samples.

Sampling from the bottom up may require digging steps into the bank as you sample up. Using repelling gear going top to bottom will also help especially on the higher banks. Ladders can work on intermediate banks (20 to 30 feet) if they are very steep approaching vertical but there should be two people for this work. Other gear should include a stadia rod (or equivalent), a hand level, sample bags (Whirl Paks TM) and sampling tools. These could include trenching tools, metal scoops, or other digging and scraping devices.

The exposed bank face needs to be "cleared" to expose a fresh swath of strata. Using the side of a trenching tool works great for this and the point shovel can be used to take samples. One can take spot samples or channel samples or some combination as long as the samples best represent the exposed strata. The channel sample method takes samples along the bank face as one tries to take a consistent amount of material along the vertical extent of the channel. This is much easier in sands and silty sands than hard silts or fat clays. The goal is to sample each different strata

somewhat equally so the results can be applied appropriately to the overall eroded volume of the bank. Do not sample across significant stratigraphic boundaries like the one between sands and clays. At this point, it is still important to relate grain size to nutrients even though the whole section is eroded away over time.

It is important to keep track of the sampling exercise by taking copious field notes. After the samples are taken they should be placed in a cooler and sent to the lab for analyses.

Analysis

Refer to Ibison et al. (1992 and 1990).

This sampling method was developed by Scott Hardaway (2013).

Appendix L. Dissenting View Document

This dissenting view document was compiled and vetted by the following Shoreline Management panelists:

- Kevin Smith, MD DNR
- Jana Davis, CBT
- Pam Mason, VIMS
- Jeff Halka, MGS retired
- Eva Koch, UMCES
- Lee Karrh, MD DNR

Chesapeake Bay Program
Shoreline Management
Expert Panel
Dissenting View

April 3, 2014

The Shoreline Management Expert Panel met from January 2013 to March 2014, charged with quantifying the nitrogen, phosphorus, and sediment load reductions resulting from shoreline erosion control practices. The resulting panel report represents the majority view; however, significant dissent (40 % of the panel) characterized several of the main findings. The purpose of this dissenting view is to summarize the areas of dissent and describe its logic such that those reviewing the report, including various Bay Program committees and boards as well as the general public, can be aware of the issues. This dissenting document focuses on the science and the outcomes; however, some comments on the panel process are offered that may help inform adaptive management of the panel process by the Bay Program in the future.

Summary of the Report and the Dissent
The panel report describes four types of credit that can be earned by shoreline erosion control practices:

1) sediment and nutrients eroding from the bank immediately upland of the practice, termed "prevented sediment;"
2) sediment and nutrients captured through trapping sediment from the water column through contact with water through tidal action,
3) denitrification occurring in the wetlands created through living shorelines; and
4) nutrients bound through uptake by the plants used in a living shoreline.

The dissent focused entirely on the first type of credit: prevented sediment, which provides the bulk of the credit a typical shoreline management project would be awarded.

The two underlying principles serving as the basis for most of the dissent were:

a) the treatment of sediment in the Chesapeake Bay Watershed Model (CBWM), in which sediment reduction credit is given across sediment grain sizes; for example, from fine-grained sediments emanating from upland construction sites (known to have adverse impacts on factors such as water quality) as well as naturally eroding large-grained sand particles from a bay-front cliff, (known to create wetland and SAV habitat),
b) the narrow focus of the panel's charge on nutrients and sediment rather than an ecosystem approach, resulting in potential unintended consequences to other natural resources.

Sediment types: Not all sediment is "bad"

Shoreline erosion is a natural geologic process, experienced by shorelines of all estuaries worldwide, balancing such global forces as tectonic uplift (mountain ranges constantly erode, and sediments are carried down rivers) and sea level rise due to glaciation. Sediments, especially large-grained sediments, eroding from shorelines serve many important geologic and ecological functions, including supplying sediment that supports submerged aquatic vegetation (SAV) beds; wetlands; unvegetated beach habitat important for species like horseshoe crabs and terrapin; and dynamic sand spits and other similar features that protect low energy coves, which, in turn can be important habitat for seabirds and other wildlife (e.g., Kirwan and Megonigal, 2013). In fact, previous workshops and committees convened by the Chesapeake Bay Program have recognized the ecosystem value of eroding shorelines (Chesapeake Bay Program, 2005; Chesapeake Bay Program, 2006). Turning off that sediment supply with shoreline erosion control practices, whether "green practices" (e.g., living shorelines) or traditional hard armor, can interrupt the sediment budget for a region, negatively affecting SAV (Palinkas and Koch, 2012), wetland, and other habitat. Additionally, Patrick et al (in press) demonstrated negative impacts to SAV distribution when more than 5.4% of the shoreline has stone structures in a watershed, as identified by the 2006 VIMS Shoreline Inventory (which did not differentiate between revetment and sill). Solving one problem, as was the focus of this panel's charge, can cause an even greater problem in other natural resources.

This report attempted to manage this issue by only giving credit for the portion of prevented sediment that is fine -grained. To accomplish this, the total volume of sediment that was prevented from entering the system through the installed practice was multiplied by the percentage of the fine-grained sediments estimated to be present in the bank. However, while this approach does not give credit to prevention of the coarse-grained sediment, it still encourages its loss into the system by not providing a negative incentive. Preventing the fine-grained sediment from eroding, which may be a positive, should be balanced by prevention of the coarse-grained sediment from eroding, which is a negative. In the formula used, the positive outcomes are provided credit but the negative ramification is ignored.

Solution: The dissenting group on the expert panel therefore are of the opinion that protocol 1 in the report, which provides credit for prevented sediment, should be removed.

Focus on nutrients and sediment rather than ecosystem approach: Credit for armor

In the expert panel report, qualifying conditions are articulated in which nutrient and sediment credit can be earned for hard shoreline armor (conventional erosion control), such as bulkheads

and on-shore stone revetments, particularly in cases in which living shorelines are not possible. Some on the panel felt that given what we know about impacts of such conventional armor on fish habitat, SAV habitat, and other resources, there should never be a credit offered to armor. Armor in estuaries generally removes the shallowest areas of habitat available, often removing the entire range considered to be refuge habitat (Jennings et al. 1999, Peterson et al. 2000, Bilkovic et al 2006, Davis et al 2008, Palinkas and Koch 2012, Patrick et al. in press). Armor may exhibit chemical differences or leach toxic chemicals (Weis et al. 1998). Armor can disrupt both chemically and biologically the land-water interface (Jennings et al. 1999). As a result of all of these factors, armored sites generally have lower species diversity of motile macrofauna and infauna, lower densities, and differences in body size (e.g., Peterson et al. 2000; Bilkovic and Roggero 2008, Davis et al. 2008; Long et al. 2011)

Armor in certain cases may be unavoidable or the only management solution, such as in highly developed port facilities or in areas in which toxic sediments are prevented from entering a waterway. This dissenting statement acknowledges that such armor should be used as a management option in some cases. However, the question is whether such practices should be allowed to receive sediment reduction credit in the bay model.

Solution: Given the negative impacts on other natural resources also managed by the Bay program, such as SAV, wetlands, fishes, and more, the dissenting group on the expert panel hold the opinion that while armor may be permitted by regulatory agencies in some cases, it should not be provided sediment or nutrient credit.

Management ramifications

The outcome of the expert panel report is such that shoreline erosion control projects in some cases will be calculated to provide as much if not more than the reduction credit for nitrogen, phosphorus, and sediment per linear foot than stream restoration or stormwater practices like bioretention cells. As a result, the costs may be less expensive per pound of pollutant relative to stream restoration or stormwater management practices. Such differences are likely to drive management choices by local jurisdictions charged with meeting total maximum daily load targets (TMDLs), even though these sources of nutrients and sediment are not a direct result of human activity but are instead a natural process. Ecologically and from a larger systems perspective, the practices are not as valuable and may actually be a net detriment.

Local jurisdictions and other landowners may choose to or need to install erosion control practices for their erosion protection value, independent of any nutrient or sediment credit to be earned. This dissenting document does not address when such practices should be pursued or permitted, instead only focusing on whether or not those shoreline erosion control practices should be awarded TMDL credit. Qualifying conditions have been and should continue to be quantified as part of federal, state, and local permitting processes to include explicit criteria for when erosion control practices of any kind are allowed.

Process comments

This panel, as those that came before and will come afterwards, was charged with attributing numerical values to water quality services associated with various management practices. While intentionally singular in water quality focus, this process makes consideration of other issues,

such as habitat or public access, difficult if not impossible. From an integrated ecosystem perspective, this is not a sustainable approach to "valuing" management practices.

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