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Comprehensive Coastal Resource Management Guidance : Planning Information and Guidance for the Living Shoreline Preference

Center for Coastal Resources Management

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Planning Information and Guidance for the Living Shoreline Preference

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1. INTRODUCTION

A. Purpose and Need for Comprehensive Coastal Resource Management Guidance

Guidance to promote Comprehensive Resource Management is being prepared pursuant to recent amendments to the Code of Virginia. Effective July 1, 2011, The “Living Shorelines Bill” SB 964 (2011) amended §28.2-1100 of the Code of Virginia and added §15.2-2223.2 and §28.2-104.1 to the Code. Beginning in 2013, Section 15.2-2223.2 requires local governments to include a Comprehensive Coastal Resource Management Plan prepared by the Virginia Institute of Marine Science in the next revision of their comprehensive plan. The guidance cultivates long-term sustainability for shoreline resources with consideration of current resource condition, priority planning, and forecasting of projected sea level rise impacts into the future. Under this guidance, the use of living shorelines as a preferred approach for stabilization of tidal shoreline is encouraged. The “guidance” communicates to stakeholders (including local governments) the policy of the Commonwealth with respect to living shorelines, identifies preferred solutions for erosion control, and defines the risks and benefits of shoreline management strategies in an integrated comprehensive manner.

B. Shoreline Planning Area

The shoreline planning area covered by this guidance extends from the coastal riparian upland channelward to include tidal lands that encompass wetlands, beaches, dunes and subaqueous lands. Strategies for managing shoreline and planning for long-term sustainability, however, may extend in-land to a distance in so far that management of these lands affects a change in the shore zone ecosystem and function.

C. The Living Shoreline Preference – What does it mean?

The guidance presented here is consistent with the state’s adoption of a preference for maintaining a living shoreline condition to maintain or enhance coastal ecosystem function and services over time. Section 28.2-104.1 of the Code of Virginia defines a Living shoreline" as “… 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”.

In a nutshell, the living shoreline preference minimizes impacts to the processes and functions that occur naturally in coastal ecosystems.

D. The Coastal Ecosystem

Coastal ecosystems reside at the interface between terrestrial and aquatic ecosystems, and are naturally very complex. Their value far outweighs their relative size in the larger ecosystem. They are exceptionally important habitat for a wide variety of organisms, some living primarily on land, others that live in water and a few that are found only in the intertidal zone between land and water. They perform a vast array of functions that may be grouped into functional categories such as: water quality, habitat, and socio-economic functions. Tidal shoreline systems provide important filtration capacity for materials carried in runoff and groundwater. They serve as the first line of defense against storm generated waves that impact the coast. Humans value these functions and thus derive benefits from the coastal ecosystem services (Barbier 2012) which collectively contribute to improving nursery grounds for organisms, enhancing water quality, and stabilizing the shoreline.

A simplified "function web" shows some of the various functions provided by shoreline components: nearshore shallow areas, tidal wetlands, beaches and dunes and upland riparian areas (Figure 1) (CCRM, 2006). Individual functions may be linked through both beneficial and adverse effects. For example, erosion control has a positive link to both socio-economic function and water quality function but often an adverse effect on habitat. Coastal ecosystem based management (EBM) strives to increase the capacity of the ecosystem to provide services by maintaining and enhancing the natural functions they perform. Figure 2 illustrates the concept of how services are exchanged and maintained across an unaltered coastal profile. Unfortunately, maintaining this condition is not without its tradeoffs and challenges.

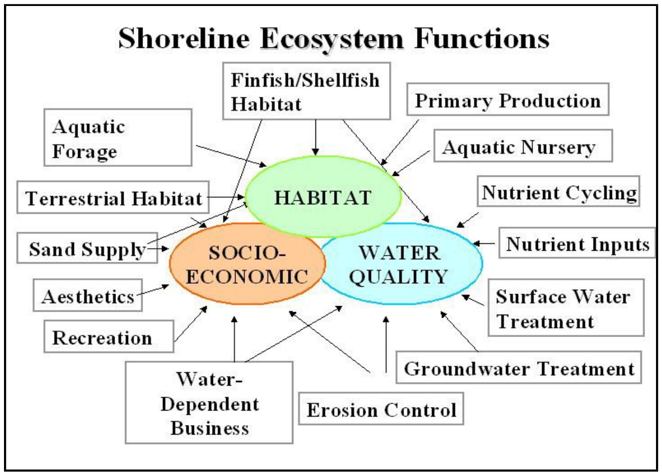

Figure 1. Ecosystem Functions at the Shoreline (from CCRM, 2007)

We understand now that many common shoreline practices disturb this connectivity between the environs along the profile and limit the ability of the system to perform certain functions. The adoption of sound land use practices for coastal communities is necessary to insure that these connections be maintained so benefits derived from coastal ecosystems will also be maintained into the future.

The passage of Senate Bill 964 reflects a commitment on the part of the Commonwealth of Virginia to seek better alternatives to managing shoreline erosion, in particular. The living shoreline approach is an adaptation practice that does not sever the connection between the upland and the intertidal zone. The example in Figure 3 illustrates the strategic placement of stone channelward of the marsh that frequently defines a living shoreline design in an area with higher wave energy.

This document is devoted to providing local governments with guidance for the management of tidal shoreline in a manner that maintains and or enhances the probability that the resources will be sustained in the future.

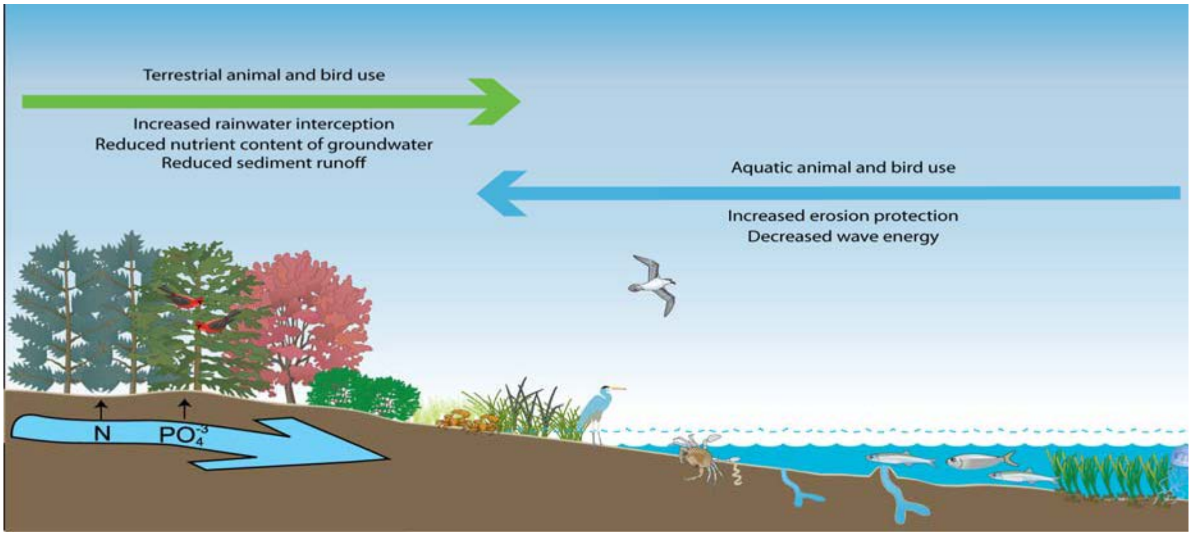

Figure 2. Maintaining integration across the coastal profile (Symbols courtesy of the Integration and Application Network (ian.umces.edu/symbols/), University of Maryland Center for Environmental Science.

Figure 3. Living shoreline example includes a well graded vegetated bank, a planted marsh with a marsh sill to protect the toe of the marsh.

2. THE COASTAL CONDITION

Tidal shorelines are made up of wetlands, upland and riparian lands, nearshore waters, and in some cases beaches and dunes. The morphology of the shoreline is determined by long-term geologic processes that have evolved slowly over geologic time scales as well as physical hydrodynamic forces that work to shape the shoreline daily. Climate change fluctuations have lowered sea level by 300 feet and pushed the shoreline eastward nearly 60 miles. This last low stand in sea level ended approximately 15,000 years ago (Hardaway et al. 2006). The rise in sea level combined with energy generated through storm events has resulted in the shoreline receding inland to its present position. Sea level continues to rise today and the process of shoreline recession remains in motion.

Erosion that typically accompanies shoreline recession can be a positive force since it releases sediment from upland banks which then becomes available to naturally nourish beaches. Erosion, however, has been a naturally occurring force that humans attempt to control in an effort to protect and maintain private property.

Mechanisms for controlling shoreline recession also have impacts on coastal ecosystems. By monitoring traditional erosion control practices over decades we have learned that the practices for stabilizing eroding shoreline also have impacts on coastal ecosystems and threaten sustainability of the coastal landscape; particularly as sea level continues to rise. In some cases, the loss of ecosystem function outweighs the benefits provided.

In general we typically find three types of coastal conditions in Virginia: beach dominated, marsh dominated, and upland or sediment bank dominated shorelines. In any given area more than one of these types may exist, but one typically dominates.

A. Beach Dominated Shorelines

Beach dominated shorelines are typical of higher energy reaches where upland erosion provides a natural sediment supply to nourish beach environments and maintain a subaerial sand flat (Figure 4.). These areas frequently grade seaward to a shallow water, sandy intertidal zone and nearshore. The upland edge can vary from very high bluffs to low lying gently sloping banks comprised of unconsolidated sandy soil. Erosion of the upland edge during storms is critical for the continued replenishment of beach material to the shorezone system. Normal wave conditions and longshore currents filter out fine materials and redistribute the sand sized sediment along the beach and on-offshore. The lengths of these systems are largely dependent on the continuity of the morphology alongshore and the orientation of the shore.

Figure 4. Beach dominated shoreline in Gloucester Point, Virginia

Ecologically, beaches provide a number of important ecosystem services. Defeo et al. 2009 enumerated this comprehensive list: (1) sediment storage and transport; (2) wave dissipation and associated buffering against storm events; (3) dynamic response to sea-level rise (within limits); (4) breakdown of organic materials and pollutants; (5) water filtration and purification; (6) nutrient mineralization and recycling; (7) water storage in dune aquifers and groundwater discharge through beaches; (8) maintenance of biodiversity and genetic resources; (9) nursery areas for juvenile fishes; (10) nesting sites for turtles and shorebirds, and rookeries for pinnipeds; (11) prey resources for birds and terrestrial wildlife; (12) scenic vistas and recreational opportunities; (13) bait and food organisms; and (14) functional links between terrestrial and marine environments in the coastal zone. Many of these services are provide direct or indirect benefits to humans.

While they are always in a state of motion, beaches can naturally maintain themselves if there is a sufficient supply of sediment that is allowed to freely shift along the coast line. If human induced changes impede natural processes we may see beaches narrow or the nearshore depth increase. If this occurs the capacity of the beach to perform ecological services will be reduced.

B. Marsh Dominated Shorelines

Marsh dominated shorelines are found everywhere throughout the Chesapeake Bay region and extend from tidal salt marshes to tidal fresh water systems (Figure 5). They establish in areas where sediment input is sufficient to allow tidal flats to accrete vertically at a rate fast enough to remain above mean sea level for a portion of the tidal cycle so vegetation can propagate and colonize. They are maintained by the continuous input and accumulation of sediment and organic matter and the plants that colonize there to hold the sediment in place. Morphologically there are four basic types in Virginia: fringe marshes, embayed or cove marshes, extensive marshes, and marsh islands.

Figure 5. Marsh dominated shoreline in Accomack County

In a coastal ecosystem, marshes are transitional areas between upland and sub-aqueous lands. They provide habitat (food and shelter) for both aquatic and terrestrial animals such as blue crabs, small fish and marsh birds. They are highly productive systems and contribute to aquatic food webs through the growth of algae and the export of detritus. Marshes also improve water quality and help reduce erosion. Grass roots help to improve water quality by filtering groundwater and holding sediment in place. The shoots capture sediment from overland flow and reduce the discharge of sediment directly into the waterway. Like beaches, marshes are also important buffers to wave action and baffle wave energy propagating inshore under normal conditions, boat wake activity, or storms. Therefore, they provide natural erosion control services to the adjacent upland.

Both sea level rise and human activities at the upland edge of marshes contributes to the uncertainty that marsh habitat will continue in perpetuity. With rising sea levels, marshes must have enough sediment input to accrete vertically and maintain their tidal base elevation as sea level rises (Reed 1995). Reduction of sediment input, subsidence, and vegetation loss will diminish the chances for sustainability. In a purely natural setting the ecosystem will migrate landward to occupy higher elevations on the landscape as salt water intrudes. This will become increasingly important for the long-term sustainability of fringe marshes and embayed or cove marshes. Of course this requires that the upland be conducive to accept this transition.

Unfortunately development on the upland is, in most cases a barrier to this migration and traditional erosion control structures are obstacles that physically prevent this from occurring.

The living shoreline approach provides erosion control while still allowing this transgression inland to take place. Section 3 below describes shoreline Best Management Practices (BMPs) that are based on principals that encourage the use of living shorelines.

C. Upland or Sediment Bank Dominated Shorelines

There really is no clear cut description for what is referred to here as a sediment bank or upland dominated shoreline. The characteristics would be a shoreline where the immediate upland bank is in direct contact with the estuary at high tide (figure 6) No transitional zone, characteristically defined by a beach or marsh, is present. The intertidal zone may be virtually non-existent if the nearshore is deep. An intertidal mudflat, on the other hand, may be more characteristic if the nearshore is shallow and unvegetated. In the Chesapeake Bay these areas are commonly found in the smaller tidal tributaries and creeks, but that is not exclusive.

Figure 6. Horsehead Cliffs in Westmoreland County, Virginia

The Chesapeake Bay Preservation Act recognizes the importance of this zone by regulating activities that include the upland immediately adjacent to the shoreline. The riparian zone, as this is frequently referred to, is important for several reasons. It is known to support wildlife in the tree canopy as well as in the herbaceous ground vegetation. It has the capacity to uptake nutrients running off the upland and therefore provides important water quality benefits. Finally a well vegetated riparian zone stabilizes sediment on the upland, and can offer shade to maintain shallow water temperatures suitable for spawning areas.

Maintaining or enhancing a vegetative riparian zone preserves these ecological services. However, development in the coastal upland has replaced the forest and scrub shrubs with manicured backyard lawns. Removal of trees to enhance the view shed on private property has increased erosion of the bank. Armoring the bank in some areas has cutoff the natural supply of sediment down drift.

3. Shoreline Best Management Practices (BMPs)

A. Traditional Practices – What we now know

Following decades of shoreline management within the constraints of Virginia's evolving regulatory program, we have been afforded the opportunity to observe, assess, monitor and ultimately revise our understanding of how the natural system responds to perturbations associated with traditional erosion control practices. By traditional practices we refer here to the construction of bulkheads, concrete seawalls, stone revetments, and the use of miscellaneous materials purposefully placed to simulate the function that revetments or bulkheads perform. The issue is not whether or not they are legal; nor is the issue whether or not they stabilize eroding shoreline. The issue is whether or not the benefits outweigh the cost to the environment, and whether suitable alternatives can perform the same function without the adverse cost to the environment and the ecosystem. Limiting the discussion to bulkheads and revetments and considering their impact to water quality and habitat only, the following has been observed.

Bulkheads: While bulkheads have the potential to impact water quality positively by reducing upland erosion and impounding sediment on the upland side of the structure (Douglass and Pickel 1999, Griggs 2005), the benefits to water quality may be offset by the reduction of sediment available to the natural system to support nourishment of beaches. Bulkheads also alter wave patterns, and the reflective power of waves against the structure in high energy settings can result in erosion of the shallow water substrate and suspension of bottom sediment. This can have significant adverse impacts on the shallow water habitat such as Submerged Aquatic Vegetation (SAV) and intertidal wetlands from both a water quality and a habitat perspective.

The location of a bulkhead in the landscape may affect its impact; subtidal and low intertidal bulkheads promote sediment movement and an increase in sediment grain size at the base of the bulkhead (Bozek and Burdick 2005, Douglass and Pickel 1999, Spalding and Jackson 2001). Bulkheads that are located in the upper intertidal zone and landward appear to have less impact on local sediment movement (Basco et al. 1997, Griggs 2005, Spalding and Jackson 2001) which may translate to low habitat impacts (Jarmillo et al. 2002) on beaches channelward of bulkheads.

Bulkheads can lead to beach or marsh loss through passive erosion (Bozek and Burdick 2005, Griggs 2005) and can reduce marsh plant diversity by occupying the upper marsh elevation (Bozek and Burdick 2005). Impacts to marsh vegetation may indirectly impact water quality but directly effects habitat quality.

Bulkheads closer to the water correlate with sediment loss and high temperatures in the intertidal zone, resulting in impacts to organisms using those areas (Spalding and Jackson 2001, Rice et al. 2004, Rice 2006.) The reduction of natural habitat may result in habitat loss if the bulkhead cannot provide substitute habitat services. On shorelines that tend to be vegetated, bulkheads may lower invertebrate density relative to natural shorelines (Seitz et al. 2006, Toft 2005). In North Carolina, bulkheads were found to increase predation on sea urchins (Zito et al. 2004). In general, bulkheads tend to support lower density and diversity of nekton than natural sites (Bilkovic and Roggero 2008, Bischoff 2002, Hendon et al. 2001, Peterson et al. 2000, Trial et al. 2001). Percentage of hardened shoreline is negatively correlated to the number and diversity of species (Wolter 2001). When compared with riprap, bulkheads tend to support the lowest diversity and abundance of fauna, while riprap may be intermediated or similar to natural sites (Jennings et al. 1999, Schmude et al. 1998, Seitz et al. 2006, Trial et al. 2001). Despite this, along hardened reaches, even altered marsh shorelines can serve as important habitat for some nekton (Hendon et al. 2000).

<u>Revetments:</u> Little work has been done on the impact of riprap revetments on water quality. Like bulkheads, riprap revetments have the potential to impact the sediment dynamics of a system through the entrapment of sediment landward of the revetment (Griggs 2005). This may be a positive impact where clay and fine sediments are prevented from entering the water column and turbidity is reduced, or may be a negative impact where the reduced erosion results in a sediment deficit on downstream properties. Like bulkheads, revetments can lead to beach or marsh loss through passive erosion (Griggs 2005), and may impact down drift properties through the interaction of wave reflection with longshore wave transmission (Camfield and Briggs 1993). They can indirectly reduce water quality through the loss of natural vegetation due to riprap placement (Quigley and Harper 2004), or indirectly improve water quality by providing a substrate for filter feeders (Newell and Ott, 1999).

Riprap revetments may reduce natural habitat by occupying its space in the landscape (Bozek and Burdick 2005) and through passive erosion (Griggs 2005). Riprapped shorelines are associated with the removal of riparian vegetation, which can lead to a lack of large woody debris, and important habitat, in river systems (Angradi et al, 2004). However, riprap also appears to provide habitat especially along naturally rocky shorelines. Riprap may serve as habitat for filter feeders (Burke et al. 2006, Newell and Ott 1999). Compared with vegetated marshes and natural oyster reefs, riprap tends to support lower diversity and abundance of fauna (Bischoff 2002, Burke 2006, Carroll 2003, Davis et al. 2001, Garland et al. 2002, Hendon et al. 2001, Peterson et al. 2000, Schmetterling et al. 2001, Seitz et al. 2006). Some studies have found exceptions to this, with riprap similar to natural shoreline (Jennings et al. 1999, Trial et al. 2001) and the impact of riprap on community structure may depend on its location along the coastline (Davis et al. 2002) and the structural makeup of adjacent natural sites (i.e. rocky vs. marshy shorelines). Even altered marsh shorelines may serve as important habitat in highly developed reigns (Hendon et al. 2000). In comparison to bare sediment and created oyster reefs, riprap may support similar or higher nekton abundance and oyster settlement (Beauchamp et al. 1994, Burke 2006, Davis et al. 2001).

The literature reviewed suggests that the value of riprap as habitat is highly situational. In areas that are structurally simple or where shorelines are naturally rocky, riprap may provide similar or improved habitat. Riprap appears to provide better habitat than bulkheads in most circumstances. However, it almost always provides reduced habitat compared to a complex marsh shoreline. The situational nature of habitat services provided by riprap has made it a neutral element in the habitat model, neither increasing nor decreasing habitat function.

Research is just beginning to project these impacts, positive and negative, into future scenarios where water levels are higher and the coastal profile responds to climate change. Inclusive in these projected changes are increased salt water intrusion, deepening of the shallow water zone, and temperature shifts in the shallow water zone. We are already seeing shifts in vegetation communities as a result of increased salt water intrusion due to rising water levels (Figure 7).

Figure 7. Upland vegetation dies back in response to salt water intrusion

The response suggests that given the opportunity, the system will migrate landward. This is not a new phenomenon. Transgression has been documented in the geologic record many times. The difference now is that the rate of this transgression is accelerating at a pace that the system responses are easily observed.

As the coastal ecosystem migrates landward in response to sea level rise there is great concern among the science and management communities that traditional erosion control structures are a physical impediment to that inland migration. Bulkheads and revetments create barriers that will prohibit marsh communities from shifting upslope. The continued hardening of shoreline in an effort to counter erosion is reducing uplands available to support this transition. Furthermore, unless zoning at the local level begins to address climate change risk, people could continue to build and develop in low lying areas. Therefore, the need to stabilize shoreline will continue.

B. Preferred Approach – Shoreline Best Management Practices Revised

The concern over the sustainability of ecosystem services with widespread use of traditional structures to counter erosion has fueled the research into living shoreline design and alternative strategies for erosion control. As discussed in earlier sections of this guidance document, a living shoreline treatment is one that does not sever the connection between the upland and the aquatic zone. From an ecological perspective, these are the most desirable shoreline best management practices because they allow energy, food, and organisms to move freely across the zonal boundaries while providing erosion control.

Understanding that a living shoreline design can be quite varied, and that not all settings are suitable for a living shoreline, the guidance associated with Shoreline Best Management Practices (BMPs) points to the practice that minimizes impacts to ecosystem services while still providing adequate erosion control on site.

Integrated management has adapted project designs to local conditions in order to minimize cumulative adverse impacts to ecological services provided by the tidal shoreline system. In general, shoreline management decisions that maximize positive ecological benefits and minimize negative elements are best for a shoreline. Preserving, creating or enhancing natural systems such as marshes, beaches and dunes is always the preferred approach to shoreline erosion protection. However, in areas with very high risk from erosion to permanent, upland structures, shoreline structures (such as breakwaters or revetments) may be appropriate.

As Virginia adopts the living shoreline preference as the overarching shoreline management approach for erosion control, implementation of the new policy at the local government will require guidance, and resources. Under the umbrella program, "Comprehensive Coastal Resource Management Portals" (CCRMPs) for local governments, the Center for Coastal Resources Management (CCRM) is developing a suite of web accessible products and tools (http://ccrm.vims.edu/ccrmp/index.html). Among them, Shoreline Best Management Practices (Shoreline BMPs) which can be applied at local planning scales. Associated tools include Decision Trees and the Shoreline Management Model.

Generally speaking Shoreline BMPs are erosion control strategies that apply the ecosystem based approach to erosion control. They are delivered to the locality in several different formats. Interested stakeholders can access information and data via the CCRMP website for their locality of interest. Data is presented in GIS format and map format from the Shoreline Best Management Practices link and can be displayed and printed from the interactive Map Viewer available in the Toolbox. They have been delineated using a complex set of rules modeled using GIS. This guidance is developed to support decision making within state regulatory, local municipality, and private citizenry of the Commonwealth.

C. Guidance for Shoreline Best Management Practices

The guidance for shoreline BMPs presented here represents the results years of research and development to bring together science and management. As part of that guidance CCRM has generated two interrelated tools to provide guidance for decision makers addressing the policy and regulation of tidal shoreline erosion control. These tools direct the user community to the selection of an ecologically preferred management alternative determined to be appropriate given the specific suite of conditions on site. The applications for these tools vary, but they are consistent in their recommendations. Both derive treatment options from a suite of alternatives that are classified under Shoreline Best Management Practices (Shoreline BMPs).

Decision Trees: Decision trees adhere to the principle of “integrated shoreline management,” and the concept that all elements of the shoreline should be considered simultaneously when making a decision. The approach leads to decisions that optimize the natural functions of the shoreline, while still reducing risk to upland structures from intense or long term erosion. In general, impacts should be placed in the following order: in the upland, in the riparian zone, in the subaqueous zone and in the intertidal zone. The rational for this is the protection of the least abundant and most vulnerable resources over abundant or relatively easily replaced resources. However, the result of following this order would lead to a much larger overall impact (e.g., a large sill structure and fill versus a small revetment); the order of preference may be modified.

Decision trees have incorporated the principles mentioned above by: 1) Recommending that shorelines be left in their natural condition unless shoreline erosion has the potential to result in significant loss of property and upland improvement; 2) Preserving and enhancing natural shoreline elements where possible; and 3) Where impacts are unavoidable, locating erosion control treatments where they will have the least overall impact to ecosystem function.

These decision trees were primarily developed for use by local government staff, citizen board members, and state regulatory and non-regulatory agents involved in shoreline management project review and permitting. However, the tools may also be useful for property owners and other users interested in shoreline management.

Decision trees and more detailed guidance about them are available on line at this site http://ccrm.vims.edu/decisiontree/index.html which can be linked through the CCRMP interface Shoreline Best Management Practices.

Shoreline Management Model: Decision Trees were developed to be used during on-site field visits. The pathways or branches one takes along the tree are determined in part by the observations made onsite. The Shoreline Management Model (SMM) was developed as a tool to advance strategic planning in the coastal zone for local governments by providing tools which develop better linkages between shoreline management and resource sustainability. To the extent that the Decision Trees are used to recommend or respond to a request for an onsite alteration of the shoreline to counter an erosion problem, the SMM is an expression of how the shoreline should be managed comprehensively now and into the future given current conditions.

The SMM was built to reflect and be consistent with the principals that guide the logic in the Decision Trees. The output of the model is robust due to an extensive GIS inventory of shoreline conditions available to characterize the shoreline. The model cannot interpret or predict all conditions possible and is limited to data that represent a snapshot in time. Temporal variations in most of the data occur at time scales slow enough for this not to be a significant issue.

Shoreline BMPs can loosely be divided into two types; actions which will occur on the upland or riparian bank and actions which will occur in the wetland, intertidal and beach zone. Currently 17 different recommendations are offered in this guidance. Depending on the setting and the conditions, more than one option may be recommended at a location. Unlike the Decision Trees, the current version of the SMM does not distinguish between shorelines that are hardened versus those that remain unaltered. Recommendations for areas already defended make the assumptions that the structure has failed or is failing, the shoreline has undergone erosion in the past, and that erosion would persist without the structure.   Appendix 1 lists and defines the various treatment options in a glossary.

Local governments and state agencies are encouraged to utilize the Shoreline BMPs in their planning efforts as a means to balance the needs to protect private property without impacting ecological processes into the future.

4. Integration of Shoreline BMPS for Coastal Zone Managers

A. Management Issues at Hand

In Virginia, tidal shoreline systems are managed in small segments, rather than as a whole unit. Local governments implementing the Chesapeake Bay Preservation Act manage the riparian zone, tidal vegetated and non-vegetated areas fall under the purview of local wetland boards, and the subaqueous environment is the responsibility of the Virginia Marine Resources Commission. Each of these programs tends to seek avoidance of impacts in areas under their jurisdiction. This preference for the status quo can be in conflict with shoreline management that optimizes the tradeoffs in public and private benefits.

Recognition that particular shoreline management options may not be uniformly desirable from different regulatory perspectives means coordination among management agencies will be essential. The basis for coordination is logically the rationale for establishment of the various regulatory programs – sustaining public benefits from environmental services. The desire to maintain the capacity of the natural system to do things that are important and valuable to the general citizenry of the Commonwealth underpins the riparian, intertidal and subaqueous lands management programs operating in Virginia. These programs uniformly seek to accommodate private development interests within the broader goal of sustaining ecological services.

B. Available Guidance

There are currently a variety of guidelines developed by local and state programs managing shoreline development activities. These include the Virginia Marine Resources Commission guidelines for tidal wetlands, subaqueous lands and coastal primary sand dunes. In addition, the Department of Conservation and Recreation's Chesapeake Bay Local Assistance Division and Shoreline Erosion Advisory Service have both issued guidelines for riparian land management. There are, however, no comprehensive guidelines that synthesize the objectives of all these programs.

It has become increasingly apparent that in order to reduce the cumulative and secondary impacts of activities within the multiple jurisdictions and multiple management programs affecting the littoral and riparian zones, better coordination and integration of policies and practices is necessary. It is possible to address the gap of the jurisdictional limitations of the various shoreline management programs by providing enhanced technical guidance to promote integrated management decision-making.

In part, these strategies are designed to close this gap. However, complete closure of this gap cannot occur without a change in how jurisdictional managers interact and coordinate decisions.

C. Strategies for Better Integration

The implementation of recommended shoreline BMPs offered through tidal shorelines management guidance in Virginia is hampered by a segregated management structure that extends from the federal level at the top down to local jurisdictions. There is little that local governments can do to address the lack of coordination or integration of management programs at the state or federal level. The opportunities for better integration of shoreline management range from state and federal legislative and operational changes to changes in local government operations and ordinances.

At the local level, governments could better coordinate the independent regulatory review processes. There are many possibilities for improved coordination, some of which are already in place in some Tidewater localities. These opportunities include:

1. Have the same members of the wetlands board serve on the Chesapeake Bay Board,
2. Have the CBPA and Wetland review occur within the same staff office/ department
3. Establish a coordinated permit review process at the local level where staff meets to discuss/ review projects.
4. Establish a review process check sheet to ensure each appropriate staff and/or Board has reviewed appropriate applications.
5. Offer or attend training to increase awareness/ understanding of staff and Board members of other shoreline management programs.

5. Comprehensive Shoreline Management

Making decisions to support and sustain the ecological and economic values (i.e. ecosystem services) of shoreline resources requires a comprehensive approach to shoreline management. A comprehensive approach requires a basic understanding of the shoreline systems, along with the use of available guidance, to implement effective shoreline management.

This document has provided you with the basic knowledge of the ecosystem and strategies toward implementing integrated management at the local level. The CCRMP Portal (http://ccrm.vims.edu/ccrmp/index.html) extends this advisory service by providing you access to tools and outreach material. Practical ways to incorporate the tools and resources for a comprehensive approach can be accomplished through the following recommendations:

- Utilize VIMS' CCRMP Shoreline Best Management Practices for management recommendation for all tidal shorelines in the jurisdiction.
- Utilize VIMS Decision Trees for onsite review and subsequent selection of appropriate erosion control/shoreline best management practices: http://ccrm.vims.edu/decisiontree/index.html.
- Encourage staff training on decision making tools developed by the Center for Coastal Resources Management at VIMS.
- Consider a policy where Shoreline Best Management Practices become the recommended adaptation strategy for erosion control, and where a departure from these recommendations by an applicant wishing to alter the shoreline must be justified at a hearing of the board(s).
- Follow the development of the state-wide Living shorelines General Permit being developed by VMRC. Ensure that local policies are consistent with the provisions of the permit.
- Follow the development of integrated shoreline guidance under development by VMRC. Ensure that local policies are consistent with the guidance
- Evaluate and consider a locality permit to expedite shoreline applications that request actions consistent with the VIMS recommendation.
- Evaluate and consider a locality-wide regulatory structure that encourages a more integrated approach to shoreline management.Consider preserving available open spaces adjacent to marsh lands to allow for inland retreat of the marshes under rising sea level.
- Evaluate and consider cost share opportunities for construction of living shorelines.
- Seek public outreach opportunities to educate citizens and stakeholders on new shoreline management strategies including Living Shorelines.

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Appendix 1. Glossary of Shoreline Best Management Practices

Upland & Bank Areas

Land Use Management - Reduce risk by modifying upland uses, apply where bank and/or shoreline actions are extremely difficult or limited in effectiveness. May include relocating or elevating buildings, driveway relocation, utility relocation, hook up to public sewer/abandon or relocate sanitary drainfields. All new construction should be located 100 feet or more from the top of the bank. Re-direct stormwater runoff away from top of the bank, re-shape or grade along top of the bank only. May also include zoning variance requests for setbacks, relief from other land use restrictions that increase erosion risk.

Forest Management - Enhance the existing forest condition and erosion stabilization services by selectively removing dead, dying and severely leaning trees, pruning branches with weight bearing load over the water, planting or allow for re-generation of mid-story and ground cover vegetation, control invasive upland species introduced by previous clearing.

Enhance/Maintain Riparian Buffer – Preserve existing vegetation located 100 ft or less from top of bank (minimum); selectively remove and prune dead, dying, and severely leaning trees; allow for natural re-generation of small native trees and shrubs.

Enhance Riparian/Marsh Buffer – Vegetation stabilization provided by a blended area of upland riparian and/or tidal marsh vegetation; target area extends from mid-tide to upland area where plants can occupy suitable elevations in dynamic fashion, e.g. seasonal fluctuations, gradual storm recovery; no action may be necessary in some situations; may include existing marsh management; may include planted marsh, sand fill, and/or fiber logs; restore riparian forest buffer where it does not exist; replace waterfront lawns with ornamental grasses, native shrubs and small trees; may include invasive species removal to promote native vegetation growth

Grade Bank - Reduce the steepness of bank slope for wave run-up and to improve growing conditions for vegetation stabilization. Restore riparian-wetland buffer with deep-rooted grasses, perennials, shrubs and small trees, may also include planted tidal marsh. NOTE - The feasibility to grade bank may be limited by upland structures, existing defense structures, adjacent property conditions, and/or dense vegetation providing desirable ecosystem services.

Tidal Wetland – Beach – Shoreline Areas

Enhance/Maintain Marsh – Preserve existing tidal marsh for wave attenuation. Avoid using herbicides near marsh. Encourage both low and high marsh areas, do not mow within 100 ft from top of bank. Remove tidal debris at least annually. Repair storm damaged marsh areas with new planting.

Widen Marsh – Increase width of existing tidal marsh for additional wave attenuation; landward design preferred for sea level rise adjustments; channelward design usually requires sand fill to create suitable elevations.

Widen Marsh/Enhance Buffer – Blended riparian and/or tidal marsh vegetation that includes planted marsh to expand width of existing marsh or create new marsh; may include bank grading, sand fill, and/or fiber logs; replace waterfront lawns with ornamental grasses, native shrubs and small trees.

Plant Marsh with Sill – Existing or planted tidal marsh supported by a low revetment placed offshore from the marsh. The site-specific suitability for stone sill must be determined, including bottom hardness, navigation conflicts, construction access limitations, orientation and available sunlight for marsh plants. If existing marsh is greater than 15 ft wide, consider placing sill just offshore from marsh edge. If existing marsh is less than 15 ft wide or absent, consider bank grading and/or sand fill to increase marsh width and/or elevation.

Enhance/Maintain Beach - Preserve existing wide sand beach if present, allow for dynamic sand movement for protection; tolerate wind-blown sand deposits and dune formation; encourage and plant dune vegetation.

Beach Nourishment - Placement of good quality sand along a beach shoreline to increase the beach width and raise the elevation of the nearshore area; grain size of new sand should be similar to native beach sand.

Enhance Riparian/Marsh Buffer OR Beach Nourishment – Increase vegetation stabilization with a blended area of upland riparian and/or tidal marsh vegetation; restore riparian forest buffer where it does not exist; replace waterfront lawns with ornamental grasses, native shrubs and small trees; may include planted marsh, sand fill, and/or fiber logs.
Consider beach nourishment if existing riparian/marsh buffer does not need enhancement or cannot be improved and if additional sand placed on the beach will increase level of protection. Beach nourishment is the placement of good quality sand along a beach shoreline to increase the beach width and raise the elevation of the nearshore area; grain size of new sand should be similar to native beach sand.

Maintain Beach OR Offshore Breakwaters with Beach Nourishment – Preserve existing wide sand beach if present, allow for dynamic sand movement for protection; nourish the beach by placing good quality sand along the beach shoreline that is similar to the native sand.
Use offshore breakwaters with beach nourishment only where additional protection is necessary. These are a **s**eries of large rock structures placed strategically offshore to maintain stable pocket beaches between the structures. The wide beaches provide most of the protection, so beach nourishment should be included; periodic beach re-nourishment may be needed. The site-specific suitability for offshore breakwaters with beach nourishment must be determined, seek expert advice.

Groin Field with Beach Nourishment - A series of several groins built parallel to each other along a beach shoreline; established groin fields with wide beaches can be maintained with periodic beach nourishment; repair and replace individual groins as needed.

Revetment - A sloped structure constructed with stone or other material (riprap) placed against the upland bank for erosion protection. The size of a revetment should be dictated by the wave height expected to strike the shoreline. The site-specific suitability for a revetment must be determined, including bank condition, tidal marsh presence, and construction access limitations.

Areas Of Special Concern

Marinas - Canals - Industrial or Commercial with bulkhead or wharf – Other Unique Local Features) - The preferred shoreline best management practices within Areas of Special Concern will depend on the need for and limitations posed by navigation access. Vegetation buffers should be included where possible. Revetments are preferred where erosion protection is necessary. Bulkheads should be limited to restricted navigation areas. Bulkhead replacement should be in same alignment or landward from original bulkhead.

No Action Needed – No specific actions are suitable for shoreline protection, e.g. boat ramps, marsh islands.