Shoreline Development BMP's

Best Management Practices for Shoreline Development Activities Which Encroach In, On, or Over Virginia's Tidal Wetlands, Coastal Primary Sand Dunes and Beaches, and Submerged Lands

Produced by the

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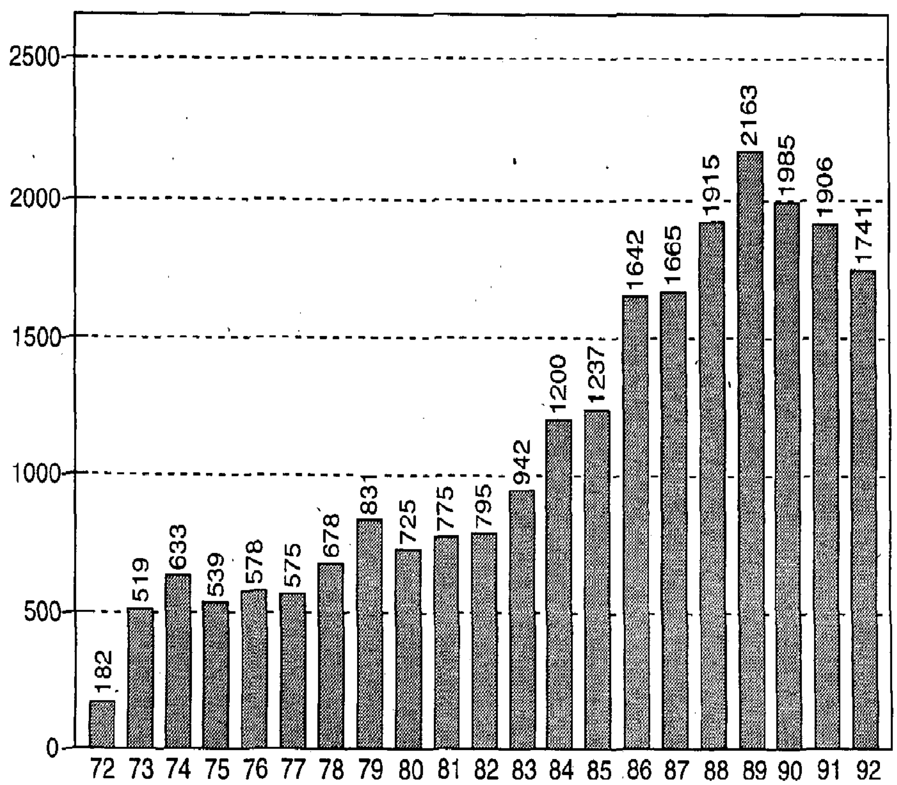
Section I

Introduction

The attractiveness of Virginia's coastal environs for residential, commercial, recreational and industrial uses frequently necessitates their physical alteration. Since the passage of Virginia's Tidal Wetlands Act in 1972, the Virginia Marine Resources Commission has processed over 21,000 applications for proposed shoreline construction. (Table 1) These applications have included projects located within Tidewater involving impacts to Virginia's tidal wetlands, coastal primary sand dunes, and throughout the State involving impacts to State-owned subaqueous lands. The responsibility for regulatory actions taken on these applications is shared among 34 local Wetland Boards and the Commission. Ensuring consistency, with regard to a unified approach to regulatory decision-making, can be

Table 1. Permit Applications.



difficult in this setting. While the basis for regulatory decisions can be found in the enabling Code Sections, the purpose behind a decentralized decision-making process is to provide for local input and site specific considerations that result in decisions that conform with stated policies and standards.

Over the years, the Marine Resources Commission has promulgated and adopted several guideline documents to assist regulators and the regulated community alike in understanding the many issues incorporated into the application review process. As recently as September 1991, the Virginia Institute of Marine Science prepared "The Virginia Wetlands Management Handbook," a compendium of these and other resource materials designed to provide a standardized, ready reference for Virginia Wetland Board members. In this document, we hope to combine some of the existing resource materials and further amplify them with practical and sound approaches to shoreline development activities.

The concept of incorporating cost-effective conservation measures into project design is not a new one. During the permit process, a variety of Best Management Practices (BMPs) are often recommended by the various regulatory and advisory agencies for specific projects. These measures have the combined effect of helping to ensure project integrity for the design life of the structure while minimizing the potential adverse impacts associated with construction. While many BMPs exist for various construction and land use projects, there has not been a concerted effort to compile and consolidate existing shoreline development activities in conjunction with the standard practices and conditions contained in our respective institutional memories. It is therefore the purpose of this document to provide a more comprehensive view of typical BMPs which can be readily applied to shoreline development projects thereby reducing both direct and indirect impacts to wetlands, water quality and marine resources.

Section II

Shoreline Protection

A. General

The coastal shoreline of Virginia, including its bays and tributaries, is experiencing continued erosion. While detrimental to property values and the structures it imperils, such erosion is a natural geologic process. Erosion stems from long term changes in sea level, waves, and local water level fluctuations that occur during storms. Upland soils become unstable when saturated and the interface between land and sea provides both the water and the energy to mobilize destabilized sediments. It is nature's relentless effort to strike an equilibrium in what can be and frequently is a zone of extremely high energy.

Along lower energy shorelines, it may be possible to counteract erosion by non-structual means through the proper planting and maintenance of a vegetated intertidal zone or marsh grass fringe. Such methods of controlling shoreline erosion are generally cost effective when properly applied and tend to preserve the shoreline equilibrium. Vegetated wetlands may erode but their ability to establish dense root systems, trap and accumulate sediments, and baffle wave energy allows them to act as buffers against erosive forces. Also used in combination with structural shoreline protection such as breakwaters, marsh plantings help stabilize these sediments and provide added protection against high energy natural forces.

The installation of structural shoreline protection generally tends to disrupt natural forces and drive shorelines away from the equilibrium state they seek. There are instances, however, where non-structural methods simply cannot mitigate the natural forces and physical characteristics of an eroding shoreline. In these situations, shoreline hardening is often viewed as a necessary alternative to retain upland property. And while the placement of these structures may reduce the sustained nutrient and sediment input into adjacent waters, it is necessary to understand that ground preparation, installation and maintenance of these structures can have equally damaging effects on adjacent living resources.

In reviewing shoreline hardening alternatives, it is helpful to understand the way in which each type of structure interacts with it's surroundings. This insight will help us determine which structure offers the most appropriate solution in a given situation. While it might prove convenient to attempt to identify every situation which might require an erosion control measure, it is not the intent of this document to provide a decision matrix which will yield only one possible solution or recommended structure for a given problem. Rather, with an understanding of structural design considerations and an appreciation of the impacts associated with construction, it may be possible to apply the most appropriate best management practices which minimize primary and secondary impacts associated with construction and maximize the design life of a given structure.

While the proper application of shoreline structures may reduce erosion, not all of the structures identified in this section treat erosive forces in the same manner. The construction of each of these structures involves varying degrees of primary and secondary impacts to the surrounding environment usually in the form of fill or unnecessary sedimentation due to uncontrolled upland runoff. It may be helpful to visualize a complete shoreline hardening project by examining three basic components: site preparation, construction, and post construction stabilization.

Site Preparation

Site preparation typically refers to land disturbing activities which occur prior to construction which facilitate access to a construction site or involve the preparation of proper earthen foundations for the erosion control measure. This can range from the removal of deadwood and debris to extensive grading and sloping of adjacent upland areas. The Shoreline Erosion Advisory Service (SEAS) of the Division of Soil and

Water Conservation is located in Gloucester Point and provides free analysis and planning assistance to private landowners seeking recommendations to address a shoreline erosion problem. Wholesale clearing and grading may not be warranted or necessary. Also it may be advisable to alter upland drainage patterns using berms or drains to help abate the negative effects of upland runoff on shoreline erosion.

Construction

Timing can be a critical factor when preparing for the construction phase of the operation. For large projects, with linear distances greater than 300 feet, it is preferable to gradually work along the shoreline doing the necessary grading, construction and post construction stabilization as you progress. Projects that do not lend themselves to this approach should not be allowed to grade too far in advance of the construction phase without applying the proper erosion control measures to reduce sedimentation in adjacent wetlands and over subaqueous land. Smaller projects, where wholesale clearing is not employed, should take advantage of the reduced disturbances and access points should be limited to only those necessary to import construction materials.

Post Construction

Once construction is complete, the denuded areas need to be stabilized as soon as possible. This can be accomplished through the proper application of silt barriers and the revegetation of denuded areas. The "Virginia Erosion and Sediment Control Manual," (available through your local government or directly from the Department of Conservation and Recreation, Division of Soil and Water Conservation) provides information pertaining to the installation and maintenance of soil conservation measures in accordance with State minimum standards and specifications. Applicants may also want to check with their local government to determine compliance standards under the local sediment and erosion control ordinance.

Chesapeake Bay Regulations

It is appropriate to mention that all proposed shoreline erosion control projects must satisfy the "Chesapeake Bay Preservation Area Designation and Management Regulations." Adopted by the State in September 1989, these regulations contain provisions designed to prevent a net increase in non-point source pollution. Key to achieving the design goals are performance standards intended to minimize erosion and sedimentation potential, reduce land application of nutrients, maximize rainwater infiltration, and ensure long-term performance of the measures employed.

Section 4.3(B)-1(d) of the regulation provides for the alteration of the mandated buffer for erosion control projects provided such alteration is accomplished utilizing the best available technical advice and applicable permit conditions or requirements. This section **does not** provide a categorical exclusion from the Chesapeake Bay Regulations. What it does is allow encroachment into the buffer area only to the extent necessary to establish the erosion control measures given the best available technical advice. This may involve clearing and grading of an entire reach of shoreline but it may also involve clearing only that which is necessary to access the site and install an erosion control structure.

In addition, if the land disturbance involves an area greater than 2,500 square feet, Sections 4.2-4 and 4.2-6 of the regulation state the applicant shall submit an erosion and sediment control plan and shall comply with the requirements of the local erosion and sediment control ordinance. Again, the attainment of a wetlands permit does not obviate the need to comply with this regulation. It is incumbent upon the property owner to find the local representative and ensure compliance with these regulations.

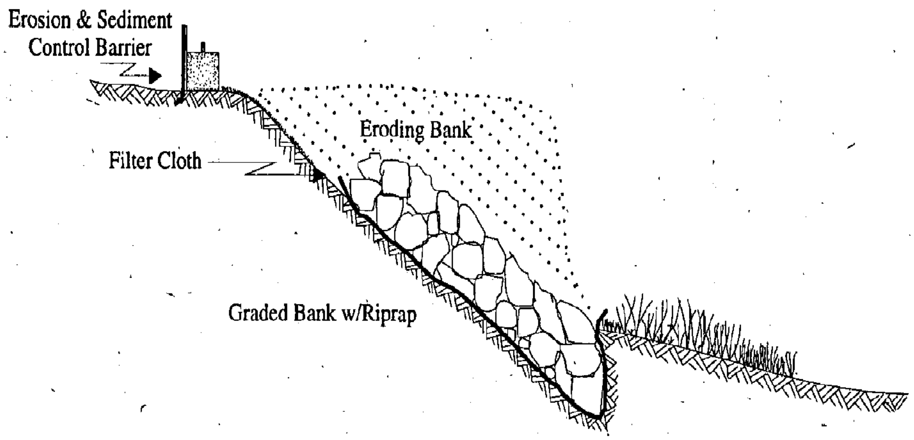
B. Revetments

From an environmental perspective, riprap revetments are generally preferred over bulkheads due in part to their ability to absorb and dissipate wave energy, thereby reducing the transfer of these erosive forces to adjoining properties. The sloped nature of a revetment also provides greater surface area within the intertidal zone than vertical structures. In addition, open spaces between armor units may provide suitable habitat for marine organisms and in some cases trap enough sediment to support wetland vegetation.

A revetment is usually composed of separate layers of stone. The size of the revetment is determined by the energy of the environment which will further dictate the composition of these materials. The construction of larger riprap revetments involves the placement of core material, generally smaller stone with random shapes and sizes, over filter fabric which prevents the loss of earth from behind the structure. The smaller stone acts to fill in gaps between larger armor units, shields the fabric from destabilizing ultraviolet light and also protects the filter fabric from being torn when laying the armor stone. This core layer is then covered with a layer of selected armor units. Armor units may be placed in an orderly manner to obtain good wedging or interlocking action between individual units or they may be randomly placed. The toe of the structure is usually buried below the MLW mark in high energy environs to prevent undercutting. Graded banks which are armored with smaller stone may not require the use of core material. In these instances, the armor stone is mixed with core stone and applied directly over the filter fabric. (Fig. 1, pg. 8) In general, the dumping of material down embankments with little or no attention to placement and the use of filter fabric is not viewed as a practical solution for shoreline erosion.

Designing riprap structures oftentimes requires using known variables to more accurately determine the necessary size of stone, height of structure, and depth of toe. These factors are influenced by the type of material used (unit weight and stability), site specific wave characteristics (wave height,

Figure 1. Riprap Revetment.



period, direction, storm duration and frequency), and design slope.

Recommended Best Management Practices

1. Construction materials employed typically vary in size and composition depending on the type of structure, the physical parameters at the project site and the availability of material. A publication by the U.S. Army Corps of Engineers entitled, "Low Cost Shore Protection... A Property Owner's Guide," recommends that no individual armor unit be longer than three times its minimum dimension. Therefore, if an individual chose to construct a revetment using slab concrete six inches thick, the material should be broken such that the average length of the armor material is no greater than eighteen (18) inches. The State Erosion and Sediment Control Field Manual, STD & SPEC 1.37 describes riprap such that "the stone shall be hard and angular and of such a quality that it will not disintegrate on exposure to water or weathering and it shall be suitable in all other respects for the purpose intended." Most if not all of the material used as riprap in coastal Virginia is either quarrystone granite, or broken concrete.

Riprap can therefore be defined as:

Riprap: *Stone that is hard and angular and of such a quality that it will not disintegrate on exposure to water or weathering and it shall be suitable in all other respects for the purpose intended. No individual armor unit should be longer than three times its minimum dimension.*

a. Rubble concrete may be used as riprap provided it is broken into appropriately sized units and exposed rebar is cut flush with the unit. All asphalt material must be removed prior to installation.

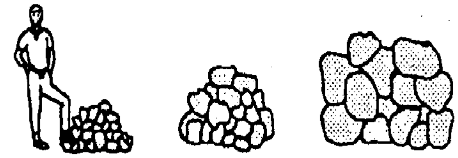
2. Riprap is sized based on its weight. These weights, per VDOT specifications, are divided into the following classes/types (Fig. 2):

   a. Class AI - Stone in this class shall weigh between 25 and 75 pounds with no more than 10 percent of the stones weighing more than 75 pounds. Often referred to as "man-size."

   b. Class I - Stone in this class shall weigh between 50 and 150 pounds with approximately 60 percent of the stones weighing more than 100 pounds.

   c. Class II - Stone in this class shall weigh between 150 and 500 pounds with approximately 50 percent of the stones weighing more than 300 pounds.

Figure 2. Relative Stone Size.



d. Class III - Stone in this class shall weigh between 500 and 1,500 pounds with approximately 50 percent of the stones weighing more than 900 pounds.

e. Type I - Stone in this type shall weigh between 1,500 and 4,000 pounds with an average weight of 2,000 pounds.

f. Type II - Stone in this type shall weigh between 6,000 and 20,000 pounds and have an average weight of 8,000 pounds.

Note: In all classes/types of riprap, a maximum 10% of the stone in the mixture may weigh less than the lower end of the range.

Generally speaking, Classes AI and I stone are utilized in more tranquil creeks and protected shorelines while the remaining stone is typically used on lower tributaries, the Bay, and the ocean.

3. The slope of a revetment may vary somewhat depending on the physical setting and overall size of the proposed structure but, in general, slopes of 2:1 (2 Horizontal on 1 Vertical) or 3:1 are recommended.

4. All riprap revetments should be constructed using the proper application of filter cloth. As structures age and are exposed to erosive forces, filter cloth will tend to preserve the integrity of the structure by retaining underlying base material. Installing filter cloth initially will prolong the life of the structure, reduce maintenance costs, and reduce disturbances to adjacent wetlands caused by construction activities. Filter cloth may also reduce the frequency with which snakes and other undesirable pests utilize the revetment by providing a barrier against burrowing into sediments. Filter cloth should be a woven or nonwoven fabric consisting of continuous chain polymeric filaments or yarns of polyester. The fabric should be inert

to commonly encountered chemicals and be mildew and rot resistant.

5. Proposed alignments for riprap revetments must be staked and flagged indicating the channelward limit of encroachment prior to or concurrent with the submission of Joint Permit Applications. Stakes should be located a maximum of 50 feet apart.

6. As in all shoreline hardening projects, access to a project site has a great influence on the overall impact of construction related activities. Direct and indirect impacts considered during project review generally do not take into account how materials and machinery will access a given reach of shoreline. The total impact of construction generally includes a variety of associated incremental impacts within various ecological zones around a project site. For this reason, care should be taken in transporting materials to a project site. In situations where armor material cannot be readily transported to it's ultimate destination, it is recommended that precautions be taken to minimize overall project impact.

   a. Projects which necessitate the dumping of stone down natural embankments to stock pile material should limit dump points to only those absolutely necessary. Given the core material and site preparation required, dump points should be limited to one every 75 to a 100 feet. The use of shoots to confine loose material may also be useful. Such practices will tend to reduce slope revegetation requirements and minimize erosion onto adjacent wetlands.

   b. Projects requiring the crossing of wetlands or which are in close proximity to wetlands, should make use of mats to minimize construction impacts. While potentially damaging to the standing crop vegetation, the purpose of using mats is to preserve existing elevations and root composition for sustained viability of the wetlands.

7. Following construction, all excess fill material and all disturbed or denuded areas should be graded, seeded and the proper application of temporary erosion and sediment control barriers should be employed to reduce erosion of upland into adjacent wetlands and waters. (Fig. 3)

C. Bulkheads

Bulkheads and seawalls are terms often incorrectly used interchangeably when referring to shoreline protection structures. Generally, bulkheads are smaller and less expensive than massive seawall structures and are designed to retain upland soils while providing protection from minimal wave action. Seawalls on the other hand are designed to withstand the full force of waves and are often concrete structures poured in place.

Figure 3. Erosion and Sediment Control Barrier.

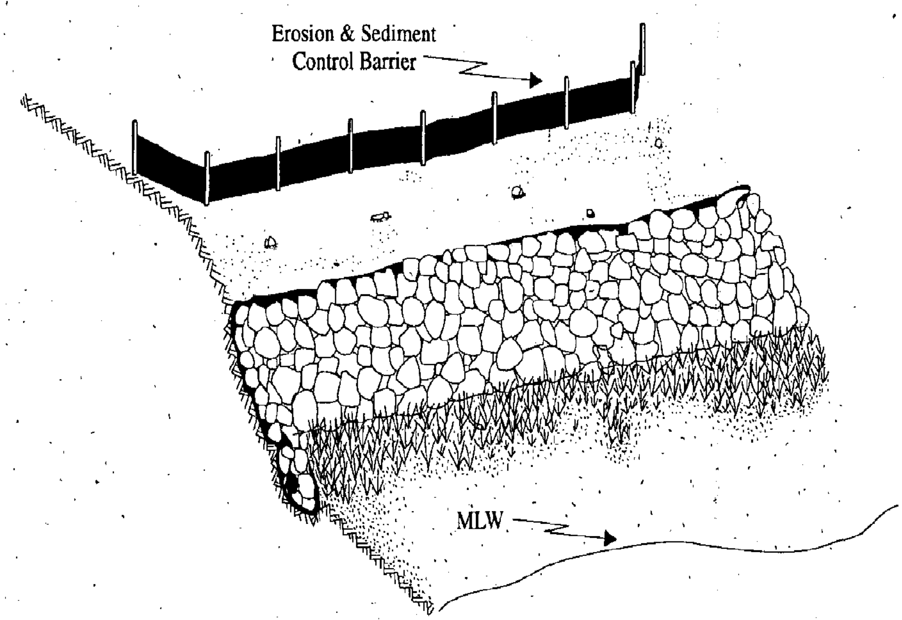
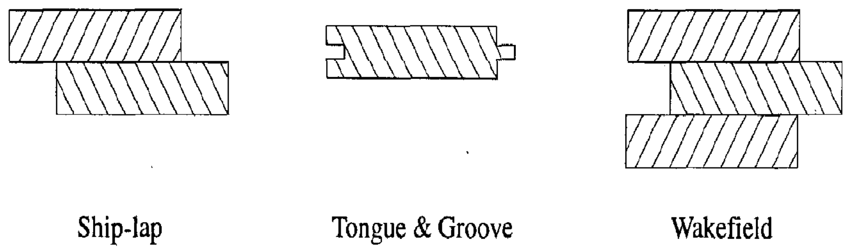
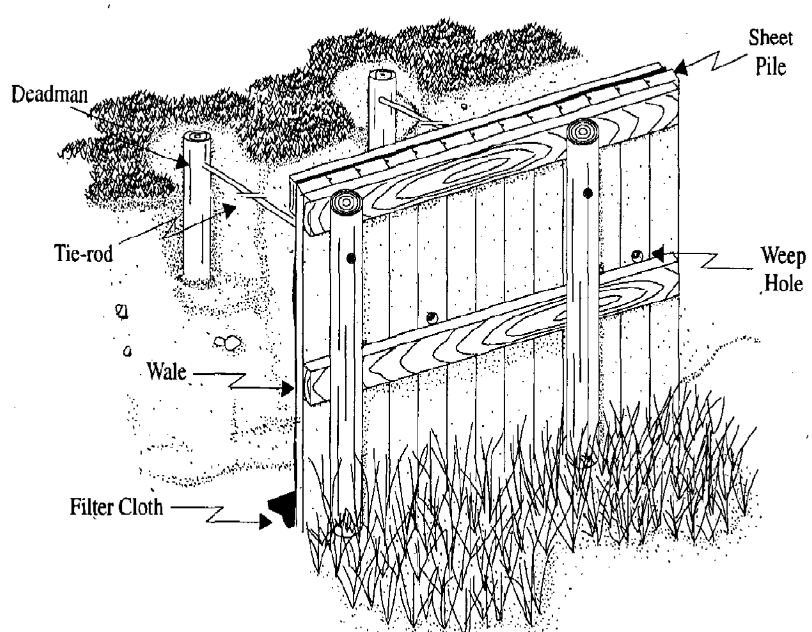


Figure 4a. Sheet Piles (End View).



Proper bulkhead design is a function of both the wave climate in adjoining waters and the physical force placed on the wall by the weight of the backfill material. Sheet piles are usually either ship-lap, tongue and groove, or Wakefield design and are supported in a vertical position by wales. (Fig. 4a & 4b) Typical means for burying sheet piles include: jetting with high pressure water, driving with a pile-driver or sledge, and trenching and backfilling with trenching equipment. Anchors or deadmen are driven into fastland behind the bulkhead and connected to the structure with corrosion resistant tiebacks. These are essential to achieve the design life of the structure by adding the additional strength necessary to withstand back pressure. Premature bulkhead

Figure 4b. Typical Bulkhead Design.



failure is often attributable to failure of the tie-back system through corrosion and/or excessive back pressure. Weep holes may be used along the face of the structure to help reduce the back pressure by providing a means for water to escape from behind the bulkhead.

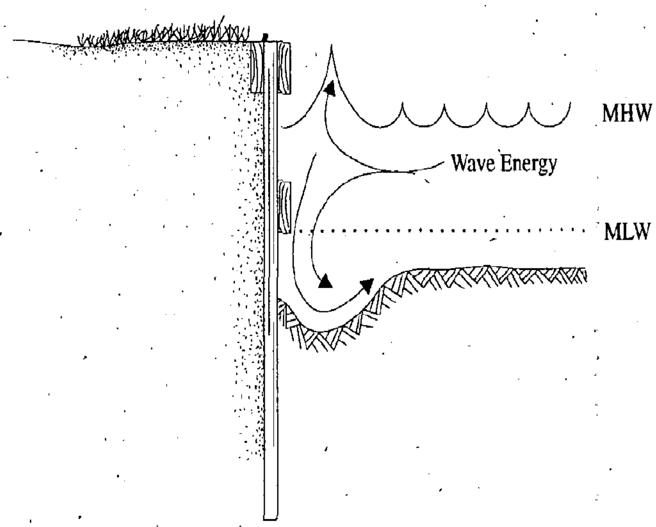
How bulkheads respond to wave energy depends on the structures orientation to the approaching storm waves. Bulkheads are not particularly effective at dampening wave energy. Rather they tend to transfer the wave energy laterally along the face of the structure or vertically up and down. (Fig. 5) In either instance, the cumulative effect is a net loss of sediment in front of the structure and/or along the sides. (Fig. 6) Placing a vertical retaining structure landward of mean high water helps to reduce its exposure to wave action and thereby minimizes erosion.

Recommended Best Management Practices

1. Construction materials/methods should include the following:

    a. All wood should be pressure treated to a minimum of 1.5 lbs/ft^3 of CCA or a minimum creosote level of 12 lbs/ft^3.

Figure 5. Wave Energy Transfer at Bulkhead Face.

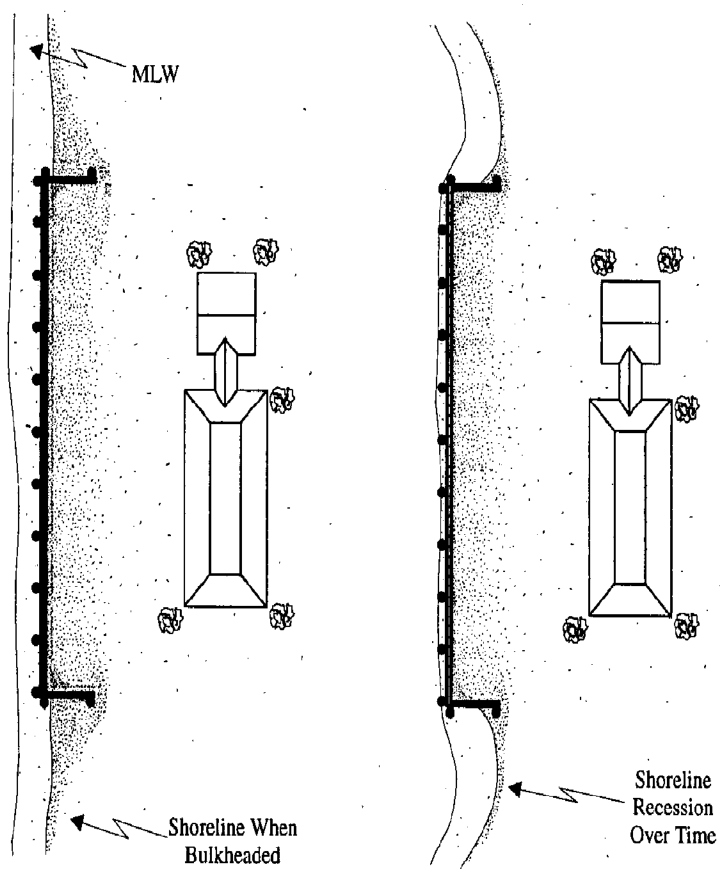


b. All hardware (bolts, nuts, washers, etc.) should be galvanized.

c. Filter Cloth should be a woven or nonwoven fabric consisting of continuous chain polymeric filaments or yarns of polyester. The fabric should be inert to commonly encountered chemicals and be mildew and rot resistant.

2. All bulkheads should be constructed using the proper application of filter cloth. As a structure ages, even a well constructed bulkhead will settle causing small cracks which can leak backfill. Installing filter cloth initially, therefore, can prolong the life of the structure, lower maintenance costs, and reduce disturbances to adjacent wetlands caused by construction activities.

Figure 6. Shoreline Recession Associated with Bulkheads.



3. If the structure is equipped with drain holes to allow for the movement of water, they should be backed with filter cloth and a small stone filter.

4. Fill material should be free of debris and be a good quality sandy soil. The use of silty dredged material is discouraged since this material drains poorly allowing back pressure buildup behind the bulkhead.

5. In general, the length of the tieback rod should be equal to or greater than the length of the sheet pile used on the face of the structure.

6. The depth of sheet pile penetration below existing grade should be equal to the vertical distance above ground. This helps reduce structural failure as scour occurs along the face.

7. Deadman should be anchored vertically into fastland using either a galvanized rod or cable. (Fig. 7) The placement of deadmen horizontally in associated fill material is discouraged.

8. In areas where the topography does not naturally allow for the proper placement of deadman, the bank should either be graded back or areas for the location of deadmen excavated out of the bank. (Fig. 8) In most cases, it is not

Figure 7. Deadmen.

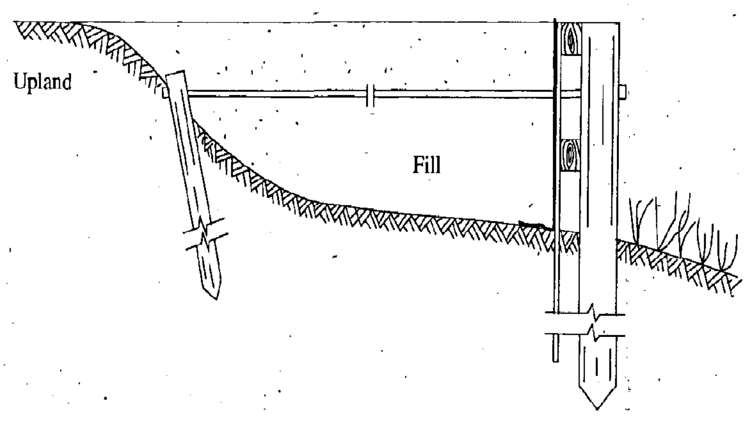
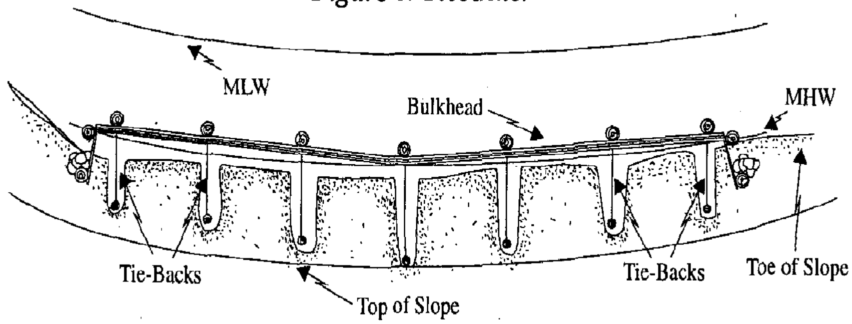


Figure 8. Tiebacks.



desirable to extend the channelward encroachment of a structure simply to accommodate prescribed tieback lengths. Steep high banks may require the use of screw anchors as deadmen to securely support the bulkhead.

9. In situations where bulkheads are located close to exiting structures which will not allow for the proper installation of deadmen, the use or application of knee bracing or buttressing on the seaward side of the bulkhead is recommended. (Fig. 9) (The use of riprap may be appropriate in this setting.)

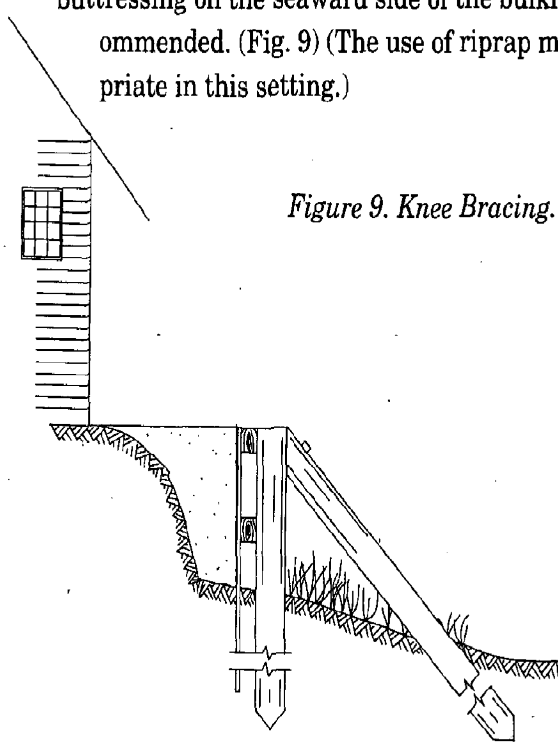


Figure 9. Knee Bracing.

10. Bulkheads should tie into adjacent bulkheads or return walls should extend back into existing fastland. Where practical, the application of riprap along return walls will help prevent flanking of the structure.

11. In situations where bulkheads are located in areas susceptible to wave energy, the proper application of appropriately sized riprap toe scour protection may reduce the likelihood of the structural failure due to undermining at the face. (Fig. 10)

12. Proposed alignments for bulkhead structures should be staked and flagged to indicate the channelward limit of encroachment prior to or concurrent with the submission of a Joint Permit Application. Stakes should be located a maximum of 50 feet apart and at turning points.

13. Structures should ordinarily be located landward of marsh vegetation, or, in areas of non-vegetated wetlands, placed landward of mean high water to minimize exposure to wave action.

Figure 10. Scour Protection.

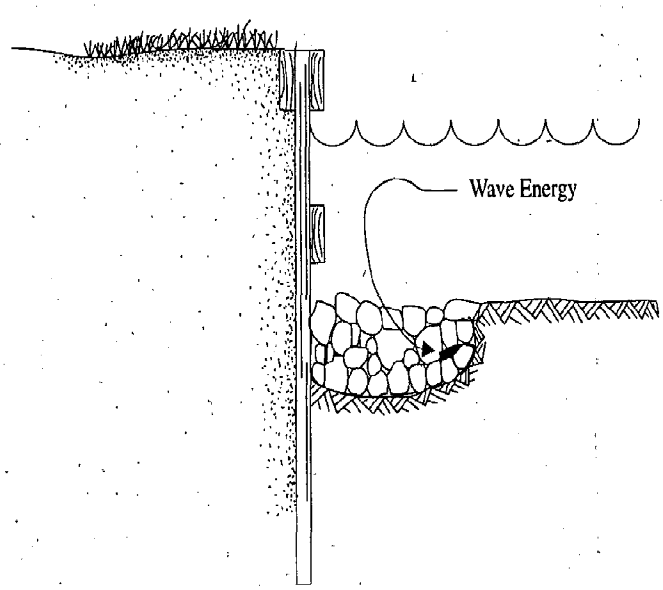
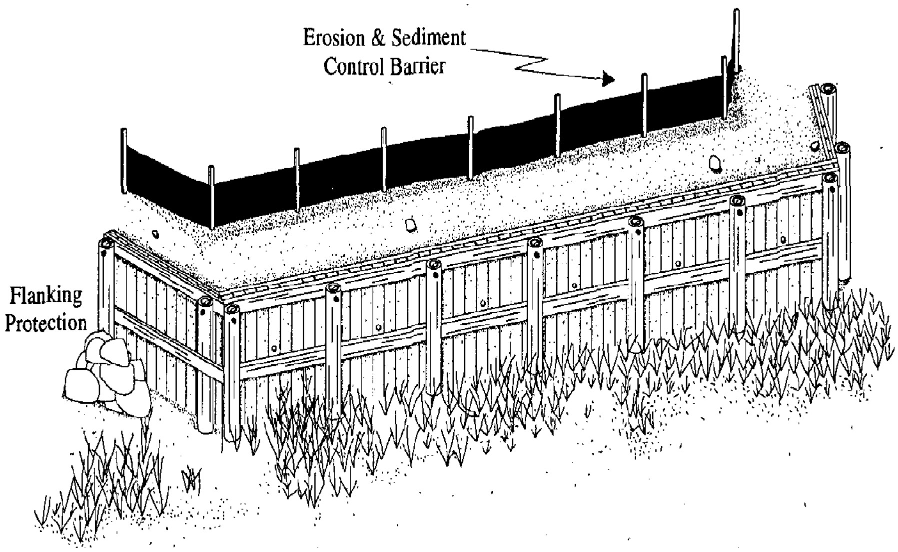


Figure 11. Erosion & Sediment Control Barrier.

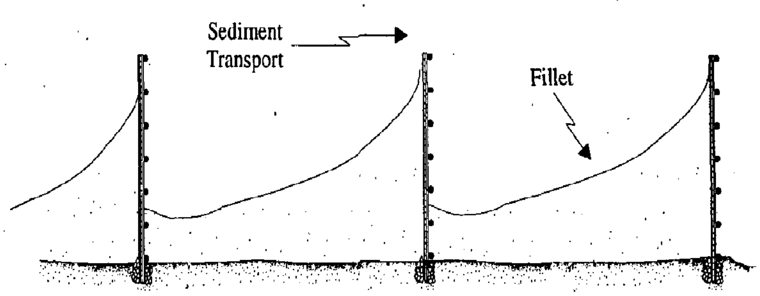


14. Following construction, all excess fill material and all disturbed or denuded areas should be graded, seeded and the proper application of temporary erosion and sediment control barriers should be employed to reduce erosion of upland into adjacent wetlands and waters.(Fig. 11)

D. Groins

Groins are constructed perpendicular to shore and extend out channelward from mean high water. Groins function to trap sand and raise the elevation of the nearshore area to provide better erosion protection. Material moving along the shore in the littoral drift normally accumulates in fillets on the updrift side of the structure. (Fig. 12) Under ideal

Figure 12. Littoral Drift.



circumstances, sand fills the groin cell to a point where it then bypasses the structure and continues movement along the downdrift shoreline. The sand remaining in the fillet is then available to function as a buffer against erosion. Yet even under ideal conditions, material tends to move more slowly through the filled groin cell thereby depriving downdrift shorelines of sand and increasing the rate of erosion on downdrift property.

Groins are generally only effective when adequate quantities of material are moving in the littoral transport system. Because of the potential to damage downdrift properties, it is often recommended to position groins away from property lines and to partially fill groin cells with appropriately sized material. Filling groin cells tends to reduce the time required for littoral material to start bypassing the groin thereby reducing erosion of downdrift property. Groin spurs may also be employed to help reduce downdrift erosion.

Recommended Best Management Practices

1. Construction materials/methods include the following:

    a. All wood should be pressure-treated to a minimum of 1.5 lbs/ft^3 of CCA or a minimum creosote level of 12 lbs/ft^3.

    b. All hardware (bolts, nuts, washers, etc.) should be galvanized.

    c. If the structure is constructed of stone, the stone should be placed on a layer of filter cloth to help stabilize the structure. The size of the stone will be dictated by wave characteristics at the proposed location.

2. Because groins function to trap sediment moving along a shoreline, their effectiveness is somewhat related to the amount of material available in the system. For this reason it is prudent to space these structures such that the distance between groins is greater than, or equal to,

1.5 times the groins length from high water to it's channelward end. Groin length can be determined by examining the sand fillets in existing groins along the same shoreline reach or they can be based on the width of the local beach. Example: A 40-foot groins should be spaced a minimum of 60 feet apart.

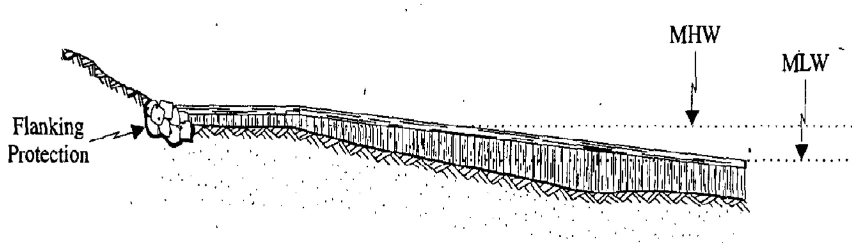
3. All groins should be constructed utilizing a low profile design. (Fig. 13) The low profile groin is designed to resemble the natural beach elevation and allows sand to by-pass and thus nourish downstream properties once the groin cell has filled. Groins which are too long may inhibit the longshore transport of sand to downdrift properties.

Low Profile Groin: *Low profile groins are structures with a terminal elevation at mean low water extending landward to an elevation of 1 foot above mean high water, at mean high water, with the landward terminus extending into upland to reduce flanking.*

4. In situations where groins are located in areas accessible to boaters, it is recommended that the channelward end of the structure be marked to aid navigation. This can be simply accomplished by using a longer pile at the terminus and leaving 12 - 24 inches remaining above mean high water.

5. Proposed alignments for groins should be staked and flagged indicating the channelward limit of encroachment

Figure 13. Low Profile Groin.



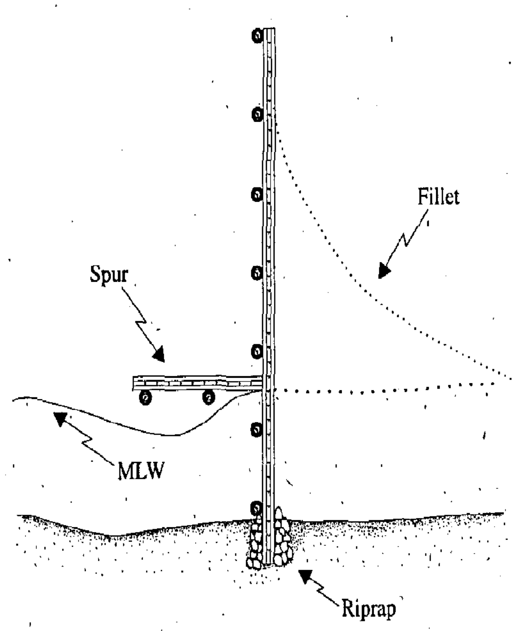
prior to or concurrent with the submission of a Joint Permit Application.

6. Groins should be located a minimum of 25 feet from property lines.

7. The application of groin spurs on the downdrift sides of groins may aid in reducing downdrift scour in the immediate vicinity of the groin. A spur should be located at approximately the mean low water mark. (Fig. 14)

8. At times, it may be desirable to artificially fill or nourish the groin cell to help reduce the amount of time necessary before sand begins bypassing the structure thereby minimizing the disruption in the supply of sand to downdrift properties. Nourishment material should be of a grain size equal to that of native beach sand and should be contoured to approximate the natural sand fillet which forms on the updrift side of the groin.

Figure 14. Groin Spur.

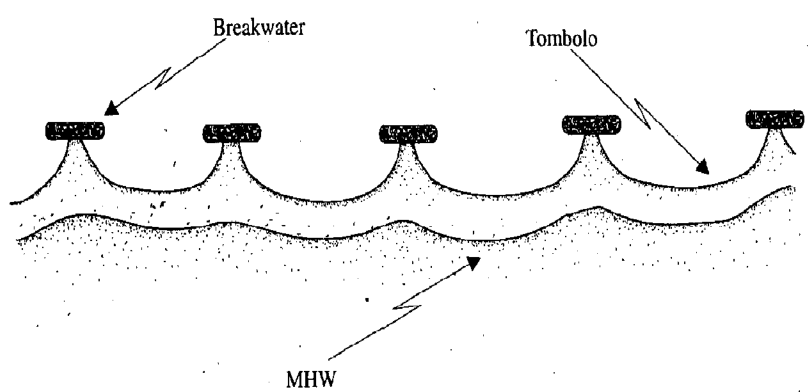


E. Breakwaters

Breakwaters are placed in the water parallel to shore and are designed to dissipate wave energy before it reaches adjoining shorelines.. This decrease in wave energy reduces the ability of waves to transport sediment resulting in an area of sediment deposition behind these structures. A breakwater system usually addresses erosion over a large area and consists of a series of breakwaters along a reach of shoreline. (Fig. 15) Sand moving in the littoral transport system accumulates in the shadow of the breakwater until filled to its natural capacity. Once filled, sand can then move through the breakwater system to downdrift properties. As with groins, breakwaters can be partially nourished to create natural bays or tombolos and insure a minimal disruption in the supply of sand to downdrift properties.

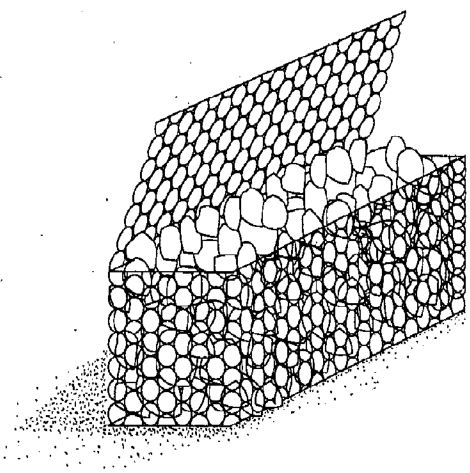
Offshore breakwaters must be constructed of materials capable of withstanding the high energy environment in which they are placed. Since the height of the breakwater determines how much wave energy is dissipated, an important design consideration rests in maintaining the design height for the life of the structure. While a variety of materials have been used in breakwater construction, some degree of success has been achieved in Virginia using quarrystone

Figure 15. Breakwater System.



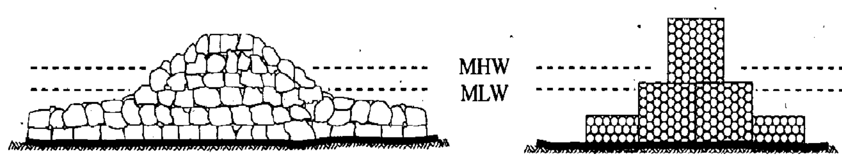
riprap. These structures are typically rubble mound or gabion systems and are able to withstand the differential settlement that may occur after placement. (Fig. 16a and 16b)

Figure 16a. Gabion Basket Filled with Quarrystone.



Breakwaters do not have universal application. The design of a breakwater system must take into account a variety of site specific considerations including wave characteristics, material composition, height requirements, distance from shore, length, spacing, and existing shoreline configuration. In addition, equipment and material access to the site as well as the potential environmental impact on sensitive submerged habitat must be taken into account. The Shoreline Erosion Advisory Service is available to assist in the design of breakwaters. It is strongly recommended that this type of work be undertaken by professionals experienced in breakwater construction.

Figure 16b. Rubble Mound and Gabion Basket Breakwaters (End View).



Recommended Best Management Practices

1. A plan of access to the proposed breakwater location should be developed. This should include precautions necessary to avoid or minimize impacts to adjoining resources.

2. A construction time table should be developed so that the staging and deployment of stone will not be unduly prolonged. Gabion baskets should be closed and sealed once filled. Partially filled structures should be secured until the remaining work can be completed.

3. At times, it may be desirable to artificially fill or nourish behind a breakwater to help reduce the amount of time necessary before sand begins bypassing the structure. Nourishment material should be of a grain size equal to that of native beach sand and should be contoured to approximate the cuspate shoreline which forms.

Section III

Boating Facilities

A. General

Section 28.2-1203 of the Code of Virginia states that, *it shall be unlawful for any person to build, dump, trespass or encroach upon or over, or take or use any materials from the beds of the bays, ocean, rivers, streams, or creeks which are the property of the Commonwealth, unless such act is performed pursuant to a permit issued by the Marine Resources Commission* ....

In granting or denying any permit for use of State-owned bottomlands and the waters overlying those lands, the Commission considers, among other things, the effect of the proposed project upon:

1. Other reasonable and permissible uses of State waters and State-owned bottomlands;
2. Marine and fisheries resources;
3. Tidal wetlands;
4. Adjacent or nearby properties; and
5. Water quality.

The Commission also considers the water-dependency of the project and any alternatives that are available to reduce any adverse impacts. The Commission is precluded from issuing a permit for a marina or other place where boats are moored without a sewage treatment facilities plan that has been approved by the State Department of Health.

While local Wetland Boards oftentimes have limited direct jurisdiction over marina projects, their consideration of the overall impact of the facility on associated wetland resources is important. Section 28.2-1302(10) of the Code, gives the local Board great latitude to consider a variety of factors when evaluating a project and making their determination. This may involve an assessment of the potential cumulative impacts associated with the marina including: pier shading, shoreline hardening, dredging, slumping and boat wake induced erosion of adjoining wetland resources, and general conformity with the standards prescribed in Code. In the final analysis, approval depends on a majority of the Board concluding that the public and private benefits of a marina outweigh the anticipated detriments expected to result from the construction, operation, and maintenance of the facility.

Private vs. Community Piers

Section 28.2-1203 provides a statutory exemption for certain activities within the jurisdiction of the Commission. One such exemption involves "the placement of private piers for noncommercial purposes by owners of riparian lands in the waters opposite those lands, provided that the piers do not extend beyond the navigation line or private pier lines established by the Commission." The Commission requires the submission of an application on all piers in order that a determination can be made by Commission staff as to the nature of the structure and its status with regard to qualifying for the statutory exemption. In general, staff utilizes the following definitions to make a determination regarding pier status.

A private pier is generally held to be an appurtenance to riparian property constructed in the waters opposite said property whose use is noncommercial by definition and designed to provide navigable access and/or mooring for the riparian owner.

Noncommercial use means a pier which is for individual property owner use only, and does not support the sale of goods or services.

Community piers are generally held to be an appurtenance to riparian property for which ownership interest in the property is divided between two or more property owners in the adjoining subdivision or parcel. Community piers are by definition commercial.

B. Marinas

General Siting Considerations

1. The physical dimensions of the water body should be compatible with the size of the marina and the type of vessels it is designed to accommodate. For example, a shallow cove or basin is not an appropriate site for a deep draft sailboat marina.

2. Marinas must have sufficient upland area to provide all necessary parking, stormwater management BMP's, fuel, and sanitary facilities without filling wetlands or subaqueous bottom.

3. All marinas should be located in areas with good natural flushing to minimize the build-up of organic material and other pollutants on the bottom.

4. Marinas should not be sited close to areas of high natural resource value such as shellfish beds, SAV and areas frequented by endangered species.

5. The transfer or control of shellfish leases for the sole purpose of accommodating marina development is unacceptable.

6. Projects that by their cumulative impact will result in dense concentrations of boats in one area will be critically evaluated as to their impacts on natural resources; however, in densely populated areas, concentration of slips in a single facility may be justified to prevent disturbance of undeveloped shorelines.

7. In order to reduce discharges of non-point source pollution into State waters, the Commission will require the applicant to demonstrate how appropriate best management practices will be incorporated into both the upland development plan associated with the facility as well as the Erosion and Sediment Control Plan required by local government.

8. The Commission may require, as a condition of any permit issued, that BMP structures be completed before any slips can be occupied. An appropriate surety bond or letter of credit may be required to ensure proper installation, stabilization and maintenance of E&S control structures.

Specific Siting Considerations

9. For community piers and marina facilities which are appurtenances to residential developments, the number of slips is **not** predicated on the total number of units on the property.

10. The dredging of access channels should be limited to the minimum dimensions necessary for navigation and should avoid sensitive areas such as wetlands, shellfish grounds and submerged aquatic vegetation.

11. Dredge material disposal areas for initial, as well as future maintenance needs should be clearly defined and designated.

12. Site specific stormwater management BMP's are required to minimize runoff of untreated sheet flow from buildings and impervious surfaces.

13. A solid waste disposal and recovery plan must accompany marina development plans.

14. Sanitary facilities and pumpout facilities convenient to marina users should accompany development plans.

15. Facilities incorporating boat maintenance operations shall include plans for the collection and removal of maintenance by-products (sand blasting material, paint chips, etc.) before effluent enters adjoining waterways. Such plans shall also make provisions for the regular maintenance of these structures.

Recommended Best Management Practices

1. The owner/operator of a marina facility must develop and implement a fuel spill contingency plan prior to slip occupancy. The plan shall incorporate the following provisions:

   a. Gas pumps will be equipped with automatic back pressure cut-off valves.

   b. A deployable containment boom will be stored in an easily accessible container for rapid deployment. This boom will be capable of surrounding the fuel pier and vessels in the immediate vicinity.

   c. Floating absorbents and equipment for retrieving the soaked material.

   d. All marina personnel will be instructed in the proper deployment of the containment boom as well as emergency procedures in the event of a spill.

      (1) Confine and concentrate oil with booms.

      (2) Remove as much as possible by mechanical means.

      (3) Absorb and remove remainder with absorbents.

   e. Emergency numbers shall be prominently displayed next to a public telephone at the marina.

Coast Guard	(804) 441-3314
State Water Control Board	(804) 527-5200

EPA	(215) 597-9898
VMRC	(804) 247-2200

f. In the event of a spill, marina operators are responsible for contacting the appropriate agencies listed above and coordinating the recovery with all available resources including local fire and rescue.

2. Where practical, zonation mooring should be employed to limit the amount of dredging necessary and to reduce the probability of degraded water quality due to poor water circulation.

3. Travel lift washdown areas shall be equipped with settling basins to collect particulate matter before the effluent enters adjacent waterways. Provisions shall be made to clean basins on a regular basis.

4. The use of open-pile piers to gain access are always recommended over the construction of solid fill structures.

5. Where practical, piers constructed over vegetated wetlands should be built at an elevation above the marsh surface equal to the width of the pier plus 1 foot. Height above marsh = (width +1). A three foot minimum height is required.

6. Community Pier permits shall be transferred to the condominium association if and when one is formed in conjunction with the sale or lease of the proposed marina slips. Note: In the event the permit is transferred to a condominium association formed to manage common property, that association will assume responsibility for all future royalties and conditions of the permit.

C. Mooring Buoys

Recommended Best Management Practices

1. Mooring Buoys should not be located:

   a. on private shellfish leases or designated public shellfish grounds.

   b. in submerged cable-crossing areas.

   c. in or near designated navigational channels.

   d. within 200 feet of a public or commercial bathing beach.

   e. so as to interfere with the operation of or access through any bridge.

   f. so as to infringe on the riparian rights of adjacent property owners.

Maintenance/Reporting

2. Mooring buoys will be marked and maintained in accordance with the "Uniform State Waterway Marking System" as approved by the U.S. Coast Guard, which requires buoys to be white with a blue stripe around the middle.

3. Mooring buoys will have their VMRC permit number affixed to the buoy (e.g. 92-1234). Permit numbers (minimum 1 inch) are to be placed above the water line.

4. Mooring buoys will be removed from State-owned subaqueous land within ninety (90) days after receiving written notification from the Commissioner or immediately upon termination of personal use of the mooring device.

Section IV

Dredging

A. General - Mechanical & Hydraulic

Residential development along Virginia's riverine and estuarine shorelines continues to spur an ever increasing demand for waterfront lots with natural, deep water access. As the demand for waterfront construction and riparian access grows, it is becoming increasingly popular for property owners living in headwater areas or along shallow coves, tidal marshes and/or tidal flats, to attempt to modify these shallow water habitats to better accommodate boating access. The result is often a proposal to dredge relatively narrow access channels to these properties thereby adversely impacting a variety of shallow water and intertidal habitats.

One of the many concerns discussed in the review process is the maintenance of existing vegetated wetland communities adjacent to proposed channels. The tendency to maximize dredging effort by going as deep and as wide as possible oftentimes has a devastating effect on adjacent wetlands. As largely unconsolidated non-vegetated areas slump into dredge cuts, vegetated wetlands situated too close to the cut will also slump and forever change the character and composition of these wetlands. These impacts, however, can be avoided or at least minimized, through the proper application of buffer requirements.

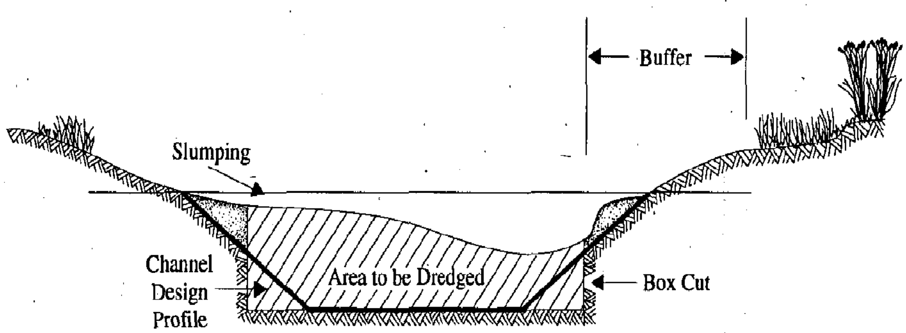
A buffer, in this sense, is generally held to be an undisturbed area adjacent to a sensitive habitat or structure. The buffer's purpose is to reduce, or cushion the direct and indirect effects of dredging by maintaining the integrity of the adjacent areas. The term "undisturbed" is used here to mean "not cut with the dredge cutter head." In the past, considerable confusion has existed over the exact definition and extent of the buffer. Due to the nature of a dredging operation it is more often than not customary for dredge operators to achieve designed side slopes by the box cut method. They simply cut the base width beyond the channel design profile to a point at which slope failure (slumping) of the vertical box cut produces a side slope comparable to the design profile. (Fig. 17) The extent of this encroachment is necessarily limited to one half the distance of the design slope. This becomes the landward extent for intrusion with the cutter head. In general, the buffer starts at the edge of vegetated wetlands and extends channelward to the landward most swing of the dredge cutter head. This distance has typically been a minimum of 15 feet where dredge depths are not greater than 5 feet.

In areas where the width of the waterway far exceeds the proposed channel design width, the maintenance of minimum buffer requirements is generally not restrictive. In narrower waterways, however, it is necessary to **<u>first</u>** consider buffer requirements, since these in turn dictate allowable channel design widths and depths.

1. A minimum of 15 feet should be maintained between the top of the dredge cut and the vegetated wetlands. In those areas where vegetated wetlands are not present, a minimum of 15 feet must be maintained between the top of the dredge cut and the toe of the bank. This landward limit of encroachment should be flagged and inspected prior to construction.

2. In order to lessen the possibility that dredging will have adverse effects on commercially or recreationally important fisheries, certain seasonal dredging limitations may

Figure 17. Dredge Cut Section View with Buffer.



be imposed on a site specific basis. These restrictions will depend in part on the sediment type, proximity of the project to shellfish areas or spawning grounds, dredging method employed, the project's size, and measures taken to reduce turbidity, for instance:

a. No dredging during the period March 1 through May 31. (Anadromous Fish)

b. No dredging during the months of July, August, September, December, January and February. (Oysters)

c. No dredging during the months of December, January, February and March. (Crabs)

3. Individuals wishing to perform dredging should submit a dredge material handling plan incorporating the following components:

a. Plan and section view drawings of the disposal area including dimensions and material composition of the proposed berm and spillway. The disposal area should be properly prepared to receive and contain the fill before the start of dredging.

b. A determination of the capacity of the proposed disposal site incorporating the following sizing requirements. Generally, hydraulic disposal areas should be sized to accommodate three (3) times the volume of material proposed to be dredged. This practice allows for the necessary settling of suspended material without unduly interrupting the pumping process. A minimum two (2) foot freeboard for final design elevations within the basin is recommended. Mechanical dredging operations generally require less storage capacity due to the significant decrease in water volume.

c. Detailed pipeline support and maintenance information needs to be supplied with hydraulic operations proposing to pump over adjacent wetland areas. Such information should include the method of pipeline deployment, location of booster pumps (if necessary), and a plan for restoring impacted areas to preconstruction contours and conditions.

d. Mechanism employed to de-water dredged material. Pipeline outfalls and spillways should be located at opposite ends of the containment area to allow for maximum retention and settling time. Weirs and/or baffles may be utilized to aide settling. Spillboxes, spillways, and risers should be constructed of metal. Wooden outfall structures are generally not suitable.

e. Clamshell and/or dragline operations need to identify the loading/off-loading points for transporting dredge material. Precautions need to be established to prevent further despoliation to surrounding wetlands and subaqueous bottom.

4. All dredging will be done so as to minimize bottom disturbances or turbidity increases which tend to degrade water quality and damage aquatic life.

5. The deposition of dredged material on shore and all earthwork operations on shore will be carried out in such a way as to minimize erosion of the material and prevent its reentry into adjacent wetlands or waters of the Commonwealth.

6. Any vegetated wetland disturbed during construction will be restored to preconstruction contours and conditions.

7. Dredge depths are dictated by the proposed use of the waterway and controlling water depths outside the area to be dredged. Where possible, zonation dredging should be utilized to minimize the amount of dredged material.

8. Over-dredging to reduce the frequency of maintenance dredging should not exceed an additional 1 foot and the need for over-dredging should be based on the expected rate of sedimentation at the dredge site. If authorized, over-dredge allowances will be explicitly stated in permit documents and should not to be assumed.

9. Dredging for proposed small craft channels should be no more than one foot deeper than adjacent natural water bodies and only as wide as necessary to avoid creating circulation and flushing problems. Dredging to depths deeper than the nearest channel can create stagnant conditions which can lead to decreased oxygen levels, unpleasant odors and the death of local marine resources.

10. The dredging of shellfish areas, beds of submerged aquatic vegetation and other highly productive areas is generally prohibited.

11. Overboard disposal of dredged material into tidal waters is generally not permitted.

    a. When overboard disposal is authorized, areas to be used for placement of the material will be located to minimize impacts on commercially important bottom dwelling organisms such as oysters and clams, submerged aquatic vegetation, wetlands and other productive shallow water habitats.

    b. Overboard disposal areas should be properly shaped and positioned to reduce scour and sedimentation.

12. Quality dredge material may be used for beach replenishment at various public beaches in Virginia where natural sources of sand supply are inadequate. See "Criteria for the Placement of Sandy Dredge Material Along Beaches in the Commonwealth."

13. Sand Mining - See Sand Mining Regulations for Additional Information

B. Beach Nourishment

1. In accordance with the *Criteria for the Placement of Sandy Dredged Material along Beaches of the Commonwealth*, the following general criteria should be used to determine candidate projects suitable for detailed evaluation:

   a. Dredge projects with a total volume greater than 7,500 cubic yards and with a reasonable expectation that suitable beach nourishment material is present in the dredge material;

   b. Beaches are located within proximity of the dredge site with a demonstrated need and capacity for accepting all or part of the available material;

   c. The political subdivision within which the potential placement site is located has expressed an interest in obtaining nourishment material;

   d. Applicants will be required to undertake the research necessary to locate private property owners willing to accept the material if no publicly owned shoreline is in reasonable proximity;

   e. When beach nourishment is incorporated into a dredging project, a comprehensive subsurface investigation plan is required including sufficient borings to determine the limits of sand deposits.

2. Every reasonable effort will be made to minimize destruction of submerged aquatic vegetation in the proximity to the beach nourishment sites authorized for placement of suitable material.

Section V

Instream Work

General

In addition to having regulatory authority over activities within tidal waters and along the shorelines within the Commonwealth, the Marine Resources Commission also has jurisdiction over the beds of all non-tidal, perennial rivers, creeks and streams throughout Virginia. In many western areas this is not widely known, but through contact with other State agencies, such as the Department of Environmental Quality, the Department of Conservation and Recreation, and the Department of Game and Inland Fisheries, the regulated public is becoming more informed of the Commission's responsibility over activities in these waterways.

Pipeline, powerline, bridge, and aerial crossings, stream channelization, and dams for creating stormwater management impoundments are examples of the types of activities which the Commission regularly reviews in cooperation with other State and Federal agencies prior to permit issuance. The excavation or mining of sand from jurisdictional river and stream beds also comes under VMRC review and specific regulations are currently being promulgated to address the environmental issues related to these activities.

The main goals in reviewing projects involving instream work are to prevent the loss or deterioration of aquatic habitat, minimize water quality impacts, maintain or improve ambient flow rates, and preserve the natural contours and conditions of the stream bed and adjoining stream banks to the greatest extent possible. Advice and guidance on appropriate construction techniques which achieve these goals are offered through the Department of Conservation and Recreation's Division of Soil and Water Conservation as well as the Department of Environmental Quality and the Department of Game and Inland Fisheries. The Commission also works closely with the field offices of these agencies, which in most cases are geographically closer to western sites and generally contain first-hand information of site-specific concerns regarding proposed work within a particular waterway. The Best Management Practices listed below will give the applicant an idea of some general conditions which may be imposed on a permittee to ensure compliance with stated goals.

Recommended Best Management Practices

1. All interests of the Commonwealth over the original streambed shall be transferred to the new streambed upon completion of a channelization project.

2. Prior to diverting an existing water course into a new channel, all proposed channelization work, including slope stabilization, shall be completed.

3. New channel construction should recreate the pre-existing stream conditions including streambed widths, streambed depths, stream meanders, pools and riffles, and existing streambed cover in the new channel. This includes the construction of a low-flow channel within the confines of the new channel whereby low normal flows shall be more confined than flood stream flow.

4. Instream construction activities shall be accomplished within cofferdams constructed of non-erodible materials in such a manner that no more than half the width of the waterway shall be obstructed at any point in time in order to minimize instream habitat disturbances and water quality degradation.

5. Cofferdams and any excess material will be removed to approved upland areas upon completion of construction, and the streambed and banks shall be restored to pre-existing contours and conditions.

6. To the greatest extent possible, construction shall be performed during low-flow conditions and during the period June 1 through September 30.

7. Virginia's Best Management Practices for silt and erosion control will be followed throughout construction for stabilization of adjacent upland.

8. If blasting is necessary, the Marine Resources Commission shall be notified a week prior to the blasting to permit agency representatives to observe the operation.

9. All areas of State-owned bottom and adjacent lands disturbed by instream work shall be restored to their original contours and natural conditions within ten (10) days from the date of completion of instream work. All excess material shall be removed to an upland site and contained in such a manner as to prevent it's reentry into State waters.

10. Where practical, new overhead crossings should be located at or near existing crossings.

11. Where practical, overhead structures should be designed in such a manner that instream activity is minimized or eliminated.

12. Directional drilling is a preferred alternative to trenching and backfilling. Where directional drilling is deemed to be a possible alternative but is not being utilized, sufficient documentation will need to be provided to explain why directional drilling is not being employed.

13. The pouring of wet concrete within State waters is discouraged because of the documented adverse impact on aquatic resources.

14. In order to lessen the possibility of dredging having adverse effects on commercially or recreationally important fisheries, certain seasonal dredging limitations may be

imposed on a site specific basis. These restriction will depend in part on the sediment type, proximity of the project to shellfish areas or spawning grounds, dredging method employed, the project's size, and measures taken to reduce turbidity.

a. No dredging during the period March through May 31. (Anadromous Fish)

Section VI

Glossary

BEACH - The shoreline zone comprised of unconsolidated sandy material upon which there is a mutual interaction of the forces of erosion, sediment transport and deposition that extends from the low water line landward to where there is a marked change in either material composition or physiographic form such as a dune, bluff, or marsh, or where no such change can be identified, to the line of woody vegetation, or the nearest impermeable manmade structure.

BMP - Best Management Practice. In general, BMP's are measures that have the combined effect of helping to ensure project integrity for the design life of the project while minimizing the potential adverse impacts associated with construction and maintenance.

BOX CUT - The physical profile of a dredge cut. Typically, areas are box cut with a hydraulic cutter head or mechanical clam shell and adjoining undisturbed sediments will slump into the box cut area in an attempt to reach a more stable slope. Generally, the finer the gain size of the sediments, the flatter the slope.

BULKHEAD - A vertical structure or partition, usually running parallel to the shoreline, for the purpose of retaining upland soils while providing protection from wave action.

CHANNEL DESIGN PROFILE - The proposed section view of a dredged area after slumping. Usually including side slopes of 2:1 or 3:1.

COASTAL PRIMARY SAND DUNE - A mound of unconsolidated sandy soil which is contiguous to mean high water, whose landward and lateral limits are marked by a change in grade from ten percent or greater to less than ten percent and upon which is growing as of July one, nineteen hundred eighty, or grows thereon subsequent thereto, any one or more of the following plant species: American beach grass; beach heather; dune bean; dusty miller; saltmeadow hay; seabeach sandwort; sea oats; sea rocket; seaside goldenrod; and short dune grass. The following localities are currently authorized to adopt the coastal primary sand dune ordinance: the counties of Accomack, Lancaster, Mathews, Northampton, and Northumberland, and the Cities of Hampton, Norfolk, and Virginia Beach.

COMMISSION - Virginia Marine Resources Commission: A nine member citizen board appointed by the governor and chaired by a Commissioner who serves a dual role as agency head.

DREDGE BUFFER - An undisturbed area adjacent to a sensitive habitat or structure. Generally, the buffer starts at the edge of a vegetated wetland and extends channelward to the landward most swing of the dredge cutter head. This distance has typically been a minimum of 15 feet. The term "undisturbed" is used here to mean "not cut with the dredge cutter head."

DREDGED MATERIAL - The material removed from a channel bottom or other water body during a dredging operation.

FRESH WATER - Water containing no appreciable salt, usually less than 0.5 parts per thousand.

GABION - A container filled with stone, brick or other material to give it a weight suitable for use in revetments or breakwaters. In the marine environment, usually made of galvanized steel wire mesh with a PVC coating.

GROIN - A shore protection structure built perpendicular to shore to trap sand moving along the shoreline in order to accrete sand and thus retard erosion of the shore.

JETTY - A structure extending into a body of water designed to prevent shoaling of a channel.

KNEE BRACING - Piles secured to the bulkhead extending channelward from the face to provide increased stability in situations where the proper application of deadmen is not possible.

LITTORAL PROCESS - Those physical features and characteristics of the intertidal area which determine the type of shoreline present.

LOW PROFILE GROIN - Low profile groins are structures with a terminal elevation at mean low water extending landward to an elevation of 1 foot above mean high water, with the landward terminus extending into upland to reduce flanking.

MEAN HIGH WATER (MHW) - The average height of high waters over a nineteen year period.

MEAN LOW WATER (MLW) - The average height of low waters over a nineteen year period.

MEAN TIDE RANGE - The vertical distance between mean high water and mean low water.

OVERBOARD DISPOSAL - The practice of placing dredged material on subaqueous bottom in lieu of upland disposal.

PIERS -

A PRIVATE PIER is generally held to be an appurtenance to riparian property constructed in the waters opposite said property whose use is noncommercial by definition and designed to provide navigable access and/or mooring for the riparian owner.

NONCOMMERCIAL use means a pier which is for individual property owner use only, and does not support the sale of goods or services.

COMMUNITY PIERS are generally held to be an appurtenance to riparian property for which ownership interest in the property is divided between two or more property owners in the adjoining subdivision or parcel. Community piers are by definition commercial.

PRESSURE TREATED - The process whereby wood in impregnated with certain chemicals to reduce or retard invasion by wood destroying organisms.

REACH - A discrete portion of a river, stream or creek somewhat homogeneous in its physical characteristics and upon which there is mutual interaction of the forces of erosion, sediment transport, and accretion.

RIPRAP - Stone that is hard and angular and of such a quality that it will not disintegrate on exposure to water or weathering and it shall be suitable in all other respects for the purpose intended. No individual armor unit should be longer than three times its minimum dimension.

SEDIMENT BARRIERS - Structures placed at the toe of a slope or in a drainageway to intercept and detain sediment and decrease flow velocities from drainage areas of limited size. Barriers may be constructed using posts and filter fabric properly anchored at the base and/or straw bales staked in place end to end or any combination of the two.

SHEET PILE - Typically, a wooden plank or steel sheet used in the construction of bulkheads and groins.

SLOPE - Degree of deviation of a surface from the horizontal; measured as a numeric ratio, percent, or in degrees. Expressed as a ratio, the first number is the horizontal distance (run) and the second is the vertical distance (rise), as 2:1. A 2:1 slope is a 50 percent slope. (Slope is actually defined as rise/run (1:2 or 1:3), but is generally referred to as run/rise.)

SUBMERGED LANDS - Those ungranted lands beneath the tidal waters of the Commonwealth extending seaward from the mean low water mark to the 3 mile limit (Territorial Sea) and including nontidal freshwater subaqueous bottomlands; or lands beneath freshwaters extending channelward from the ordinary high water mark. The upper limit of VMRC jurisdiction, at the present time, is considered to be where waterways reach a minimum average annual flow rate of five (5) cubic feet per second.

TIME OF YEAR RESTRICTIONS - Restrictions which limit bottom disturbing activity during periods of heightened sensitivity for certain aquatic organisms.

WALER - A wooden plank used in bulkhead construction to help support sheet piles.

WEEP HOLES - Holes placed in the face of a bulkhead at regular intervals to allow water to seep from behind the structure and reduce excessive back pressure caused by the weight of the water.

WETLANDS - Tidal wetlands, as defined in Section 28.2-1300 of the Code of Virginia, means both vegetated and nonvegetated wetlands.

VEGETATED WETLANDS - Lands lying between and contiguous to mean low water and an elevation above mean low water equal to one and one-half times the mean tide range at the site of the proposed project....... upon which is growing any one of the 37 plant species identified in Code.

NONVEGETATED WETLANDS - Unvegetated land lying contiguous to mean low water and between mean low water and mean high water, including those unvegetated areas of Back Bay and the North Landing River subject to flooding by normal and wind tides.

FEDERAL DEFINITION: Areas that are inundated or saturated by surface or ground water at a frequency and duration, sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

WETLANDS BOARD - A board created pursuant to Section 28.2-1303.

ZONATION - The practice of terracing depth requirements such that shallow draft vessels are moored closer to shore while deeper draft vessels are located progressively more channelward.