June 30, 1985

Cecil County Shore Erosion Management Plan

Prepared By: J.M. Hanks Associates &
Environmental Concerns Inc.

JM Hutto Associates

land use planning
site plan design
environmental planning
waterfront development

216 Bay Street, P.O. Box 1067, Easton, Maryland 21601

301/820-8220

July 1, 1985

Mrs. Susan McPheeters
Planner II
Office of Planning & Economic Development
Court House, Room 300
Elkton, Maryland 21921

Dear Susan:

On behalf of J.M. Hutto Associates and Environmental Conern, Inc., I am pleased to transmit herewith the Final Draft of the Cecil County Shore Erosion Management Plan. It is intended primarily for use by Cecil County public agencies, their technical staffs and individual property owners. The text and map overlays presented have been prepared to serve as a basic source of information for use in aggressively pursuing the implementation of effective shore erosion abatement.

Our recommendations have centered on the use of erosion abatement techniques that will produce the least negative environmental impact to the sensitive natural habitats that exist in the shore zone.

We thank you for the opportunity to work with you on this proposal, and hope that this information provides you with the assistance requested in your efforts to foster a better environment for the citizens of Cecil County.

Sincerely,

Jim Hutto

Jim Hutto, AICP

Encls. (as stated)

cc: Edgar Garbisch, Ph.D. President
Environmental Concern, Inc.

CECIL COUNTY SHORE EROSION MANAGEMENT PLAN

June 30, 1985

Prepared for:

Cecil County Office of Planning and
Economic Development

Prepared by:

J.M. Hutto Associates
Easton, Maryland

and:

Environmental Concern, Inc.
St. Michaels, Maryland

Statement of Objective

The material contained in this report and the maps referenced herein have been prepared for the express purpose of facilitating home owner and local government efforts to reduce and/or abate the negative affects of shore erosion that results from the contact of tidal waters with the shoreline. This material has been prepared for planning purposes only. No information contained within this report should be used for a final design recommendation. Competent professional help should be sought prior to initiating any shore erosion construction project.

The primary emphasis in recommending erosion control will be first for the use of landscaping and vegetative stabilization, however when existing conditions do not indicate such approaches the preferred structural approach will be for stone revetment (rip rap) due to the lower environmental impact and longer functional life that properly designed stone revetment has in comparsion to vertical wall structures such as wood and metal bulkheading.

Preparation of this report was funded by a Coastal Zone Management Program Grant from the Office of Coastal Zone Management, NOAA, to the Maryland Department of Natural Resources.

Table of Contents

Section One

Introduction

I. Introduction

The State of Maryland has over 3000 miles of shoreline exposed to estuarine shoreline erosion along the Chesapeake Bay. Cecil County, the most northern county on the eastern shore of Maryland, is subject to considerable shoreline erosion. Throughout the entire county there are reaches along the waterfront where the fastland meets the Bay waters and these reaches of land are often subjected to significant shoreline retreat. As the waterfront real estate market develops along the Chesapeake Bay the trend is for the subdivision of the waterfront areas which in turn bring with it modifications to the adjacent shoreline.

Typically these modifications are designed to stop erosion and improve accessability to the waterfront. The structures used are usually in the form of shoreline stabilization structures such as bulkheading or stone revetments or structures designed to collect beach sand such as groins or groin fields. The dynamic nature of the estuarine shoreline may respond in umpredictable ways to such shoreline modifications such as the possible loss of beach sediments or increased rates of erosion in adjacent shoreline areas.

In presenting this information the procedure used directs the perspective property owner or decision maker through a process that will help to insure that the shoreline treatment installed will be adequate, cost effective and produce the least degree of environmental impact possible. Consequently, recommendations will be made for non-structural shoreline stabilization wherever possible, if non-structural stabilization techniques appear unfeasible the next preferred erosion abatement approach will be for use of stone revetment as opposed to installation of vertical wall structures such as wooden, concrete or metal bulkheading.

If non-structural techniques and stone revetment appear unfeasible then bulkheading may be recommended. This report will include a brief discussion of the process of erosion, planning for shoreline treatment, structural and non-structural design considerations, bid preparation and selection of contractor(s), and a preventative maintenance program for extending the functional life of the shore erosion works.

Section Two

Understanding Shore Erosion

II. Understanding Shore Erosion

A. Shoreline Dynamics and Processes

Before undertaking shore erosion stabilization work, it is often helpful for the property owner to develop a general understanding of the process of shore erosion and how it has worked to shape the landscape of Cecil County. The formation of the landscape in and around the County, as well as the entire Chesapeake Bay region, is the result of a multitued of rapid changes in the height of the sea level during the last two million years. As the sea level rose and fell more than 100 feet above and below its present level, sediments continually gathered along the ancient seashore until the rapid changes in sea level slowed, and the sea level assumed its present position. It is the legacy of this type of landform (coastal deposits) to be highly erodible and thus the shorelines are often subject to rapid "parallel retreat" as the waters of the Chesapeake Bay carry away the soil material from the base of the shoreline bluffs.

The loss of land to shoreline erosion is basicly a three step process. In order for the process to begin there must be a source of energy in contact with the shoreline. For most cases of severe erosion this source of energy will be the wave action normally found in the Chesapeake Bay and its many tributaries. There is however, a second source of erosive energy and that is groundwater seepage from the face of a shoreline bluff. This condition slowly destroys the bluff's stability thus allowing the process of erosion to continue. In many situations these two erosive forces may work together.

Most often the actual erosion of bluffs occur when either the wave energy carries away the soil from the base of the bluff, called undercutting, or the percolation and seepage of groundwater works to break up the base of the bluff thus allowing

the failure of the bluff face.

As this material collects at the base of the bluff it would serve to protect the rest of the bluff face from futher attack, however this new material will now be susceptible to the full energy of the wave environment. If the toe of the bluff in not directly within the normal tidal range of the adjacent water the material sluffed off may remain at the base of the bluff until it is subjected to higher water levels due to seasonal storms or unusually high astronomical tides. Once these unconsolidated soil materials are introduced to tidal waters they quickly become dispersed as either dissolved (chemical) sediments, suspended (silt and clay) sediments or bed load (sand and gravel) within the Bay watershed system.

The chemical and suspended sediments pose serious environmental impacts to the overall health of the Chesapeake Bay. The role and importance of these suspended sediments are implicated in the poor reproductive success of many of our finfish and shellfish populations and is considered a primary contributor to the declining numbers of once plentiful and vitally important subaquatic vegetation.

Typically, in the Chesapeake Bay, the sand fraction suitable for beach creation will often represent only a small percentage of the sediment produced during the erosion process but may however contribute to the maintenance of beaches found along many of the Bay shorelines. Normally these beaches are in constant motion as the wave action slowly moves this sand along the shoreline. This process is called littoral drift or longshore current. The direction of the longshore currents may change through time, both in terms of the direction of sediment movement and the rate of movement, depending on changes in prevailing wind direction.

B. Cecil County Shoreline Characteristics

Cecil County has a wide diversity of shoreline types. The northern Chesapeake Bay shorelines such as Stump Point below Perryville, Carpenter Point on the Northeast River and Rocky Point and Bull Mountain shoreline along Elk Neck have high bluffs over 30 feet along the waterfront. Much of the rest of Northeast, Elk, Bohemia and Sassafras Rivers have moderate bluffs between 10 and 30 feet, while the headwaters and sheltered coves often have bluffs along the shoreline of less than 10 feet.

Because so much of Cecil County has relatively high topography the "retreat" of the shoreline is less dramatic then the lower shore counties that, in some instances, have erosion rates that claim over 15 feet a year of shoreline along entire reaches. When there are large bluffs the total amount of soil material that must be removed is so great that the comparison between historical and present shorelines show only moderate changes although very large volumes of soil may have been carried away by the Bay waters.

Section Three

Planning Considerations

III. Planning Considerations

With a general understanding of the processes involved in shoreline erosion you are now ready to undertake the next step toward adequate shoreline stabilization, planning your shoreline treatment. Refer to the maps developed during this project for information regarding the most suitable alternative for your particular property.

There are three basic alternatives available for addressing shoreline erosion. These are: (1) Structural (bulkheading, stone revetment, etc.), (2) Non-structural (vegetative planting and landscaping), and (3) removal or relocation of the building being threatened by the loss of land. For the purposes of this report only the first two alternatives will be considered in detail.

A. Non-Structural Considerations

Non-structural shore erosion control techniques involve the creation of an intertidal marsh fringe channelward of the eroding bank either on existing shores or on new shores developed by filling alongshore or by bank sloping.

This technique is generally feasible when some stable marsh exists on site or on neighboring areas having a similar exposure. The approach may also be feasible for barren sandy shores at exposed sites if vegetation is installed above the normal high tide elevation.

The use of non-structural techniques provides an enhancement of the fisheries and wildlife values of the area and a buffer strip which will reduce the amount of pollutants entering tidal waters by filtering upland runoff.

Costs for the non-structural alternatives can vary markedly depending upon existing conditions at the site. However, typical costs of the actual erosion control work can be better defined if additional costs are excluded for (a) clearing the shore of all

fallen trees, stumps, and debris; (b) selected tree and shrub removal and/or pruning to obtain at least six hours of direct sunlight throughout the shore each day during the summer; (c) selected tree and shrub removal for equipment access alongshore; and (d) bringing equipment and materials to the site by water because there are barriers to access by land as a result of high bluffs and/or dense woods.

1. Planting an existing shore to a 15 foot wide band of vegetation:

   $8-$10 per linear foot of shore treated

2. Increasing the shore elevation by sloping a non-wooded bank (less than six feet high) to eliminate interaction of tidal water with the eroding bank face; constructing, if necessary, structrues to contain the sloped materials; vegetating the new shore; and seeding all damaged upland areas and sloped upland areas:

   $18-$23 per linear foot of shore treated

3. Increasing the shore elevation by filling and grading alongshore with sandy materials to eliminate interaction of tidal water with the eroding bank face; constructing containment structrues as necessary; vegetating the new shore; and seeding all damaged upland areas:

   $32-$37 per linear foot of shore treated

There will be many instances in Cecil County where the costs for items a-d above will be so high as to exclude from consideration any approach to erosion control. In some instances, where the site is heavily wooded but has no bluff

alongshore, erosion control may become cost effective if access is provided when the site is later developed.

B. Structural Approaches

Most structural techniques will incorporate either of two strategies, a vertical wall of impervious materials (wood, concrete or metal) or a more permeable structure that is designed to reduce wave energy while still allowing the movement of groundwater from the land to the water without the dislocation of soil particles (stone revetment and gabions). A brief description of each type of erosion control is presented below with a discussion of their relative advantages and disadvantages.

1. Bulkheading

Bulkheading is a vertical wall partition designed to retain or prevent sliding of the land. A secondary purpose is to protect the upland against damage from wave action. There are three primary types of bulkheading in use in the Chesapeake Bay area: timber, steel and aluminum material, although other materials are sometimes used. Bulkheads are primarily used to stabilize a shoreline established through the placement of fill or through dredging in front of the bulkhead's location. For activities that require frequent passage between boats and land (marinas, yatch clubs, etc.) the vertical wall structures are usually preferred, however in recent years it has become increasingly evident that bulkheading is much less desirable environmentally. Consequently for the purposes of this report the preferred structural treatment will be stone revetment. However, in some cases, were the impact from the existing erosion problems is severe and shorelines are inaccessible from the land due to dense woodland and/or high bluffs, the shoreline may be

reached by shallow draft barge and pile driver with the wood materials floated to the job site. For such cases it may be more desirable to install bulkheading than continue to allow the erosion problem to go unabated.

2. Stone Revetment

Stone revetments are designed to reduce the energy of the incoming waves as they strike the surface of the structure, while at the same time acting as a filter, with each layer of the structure acting to hold in place the layer(s) beneath it. Reduction of the energy of incoming waves is accomplished by the sloping shape of the structure and by the relatively rough surface that it presents. Filtering qualities result from the use of layers of varying sized stone and other materials.

One of the great advantages of stone revetments lies in their adaptability. They can be designed to fit the existing shape and height of the shoreline. The rough surface of the revetment reduces wave energy. The increased surface area and irregularity of the revetment face produce excellent habitats for marine animals and do not create barriers to the movement between water and land for indigenous animals normally found in the shoreline environment.

Costs associated with construction of stone revetment vary considerably depending on structural design requirements for stone size and weight, etc. as well as distance of site from source of stone and contractors equipment. These figures are only estimates, actual costs may vary considerably, engineering drawings and cost estimates should be acquired prior to any contract agreements with contractors.

C. Getting Professional Help

An important consideration is the need to get good professional help in the selection of proper shore erosion control for your property. This is true for both structural and non-structural treatments. Structural erosion control projects should be designed for your property and the unique site conditions on its shoreline by an engineer or engineering firm experienced in shore erosion control design. A materials spec sheet or drawings should be provided to you for use in getting and evaluating bids by area contractors. If drawings are prepared for your project they can be used to determine if proper materials were used by the contractor during construction. Drawings can be used for inspection purposes during construction as well as for identifing possible sources of error if structural problems develop prematurely. The additional dollars spent for careful design and engineering drawings will pay for themselves many times over if inadequate design or improper construction can be avoided. Very often the engineering firm handling the design of your structure will also organize and manage the construction project for a nominal fee.

In getting the proper design for a non-structural treatment of shore erosion, care should be taken to select a firm that has a proven track record regarding the successful completion of similar projects including the successful planting of marsh grasses.

Another important source of information is the Department of Natural Resources, Shore Erosion Program. This program has trained professionals available, with adequate notice, to make site visits to your property to help you determine the proper approach to protecting your property.

D. Agency Regulations and Permit Requirements

State (Water Resources Administration) and federal (U.S. Army Corps of Engineers) agencies require permits for any alteration of lands below Mean High Water. No permits are required for planting existing shores. However, if a new shore is developed through bank sloping or filling alongshore, permit applications for the work must be filed with these agencies. Additionally, soil erosion control and grading permits must be obtained from the County Soil Conservation District and the Department of Public Works for any proposed bank sloping or shore filling work.

Erosion control structures such as bulkheading and revetments require State (Water Resources Administration) and federal (U.S. Army Corps of Engineers) agency approval. The design firm or contractor involved with your project will often acquire the necessary permits for your project for a small fee.

E. Unified treatment of shoreline under multiple ownership

There are many circumstances along the many miles of Chesapeake Bay shoreline where the cost for treatment of shore erosion is too great to be considered. In some cases the cost of treatment per foot can be greatly reduced by taking advantage of economies of scale. This can be done by organizing and designing one large scale project affecting many properties instead of having each individual property owner pay for their own relatively expensive small project. Organizing property owners into a single large scale project can have other benefits as well, such as applying to the State or County for the creation of a Special Taxing District to take advantage of a limited amount of low or no interest loans.

In addition to lower costs per foot of structure there are also improvements in the structural integrity because the shoreline will have one singular design along its length as

opposed to a series of individual structures patched together. The points of connection between seperate structures will often be the location of structural failure.

In selecting a length of shoreline under multiple ownership for potential application of a unified shoreline treatment a few criteria should be kept in mind. The first consideration is to find a length of shoreline with a similar recommended treatment. This is not essential but if the project is to benefit from reduced unit costs for stone, wood or grasses then the shoreline treatment should be fairly similar along its length. Another important consideration in attempting unified treatments is to develop support for the project by the property owners. This may be difficult to accomplish and take a long time but the savings will be worth the effort if you are successful.

If the project is deemed suitable by the Shore Erosion Program of the Department of Natural Resources a Special Taxing District can be established to pay for the project through a State sponsored, no interest loan created for your project. A more thorough explanation of that program is presented in Section VII and in Appendix A of this report.

Section Four

A Guide for Selecting Adequate Shore Protection

IV. A Guide for Selecting Adequate Shore Protection

A. How the coded tax map overlays were made.

All shoreline in Cecil County that consists of at least a 10 foot high bank within 20 feet landward of the mean sea level line, based on County topographic maps and U.S.G.S. quad sheets, were identified as having bluffs on working copies of the County tax maps. These shorelines are placed in the high cost category for both structural and non-structural shore erosion control work because of the lack of direct access to the shore of materials and equipment.

All other codes found in the mylar overlay legend were transferred to working copies of the County tax maps after close examination of 1" = 600' 1983 USDA Agricultural Stabilization and Conservation Service (ASCS) aerial photographs of Cecil County. Appropriate NOAA nautical charts were concurrently examined to provide estimates of fetches and seasonal wave climates associated with the shores being considered.

Shores that were considered unsuitable for the vegetative approach to erosion control were coded for a stone revetment structure, except for narrow man-made lagoons, where a bulkhead structure was recommended. Use of bulkheads generally is discouraged because of their adverse impacts to the nearshore marine environment.

All shores having densely wooded uplands 25 feet wide or greater alongshore were coded as being high cost for both the structural and non-structural approaches towards erosion control due to limited access for materials and equipment.

All sandy shores 25 feet wide or greater were identified as being suitable for the low cost non-structural approach to erosion control regardless of exposure. For exposed locations, these shores should be planted at elevations starting approximately one foot above local Mean High Water and extending

to the toe of the bank. For sheltered locations these shores should be planted from the toe of the bank down to the local mid tide elevations. The quality of the ASCS photographs and heavily wooded shorelines limited the clear identification of sandy shores in some instances. Consequently, some potentially suitable shorelines may not have been identified and some shoreliness that have been identified as potentially suitable may have been incorrectly identified.

All shores facing north that have tall trees along the top of the bank and/or have high steeply sloped banks are likely to be sufficiently shaded at all times to render a non-structural approach to erosion control unfeasible. It is not possible to conclusively identify such shores by examining the ASCS photographs. Consequently, the coded mylar overlay will show the non-structural approach as being feasible for some such shores.

Once the shoreline codes were placed on the working copies of the County tax maps they were finally transferred to the mylar overlays.

B. How to use and interpret the maps.

First identify the tax map and parcel number for the property with the erosion proplem. Pull the proper tax map from the map file and lay it out on a flat surface. Then go to the map file containing the mylar overlays and pull out the overlay that has the same identification number as the tax map. Place the mylar over the tax map using the corner positioning guides. Shorelines on the tax map are seen to be divided into coded segments. The legend on the mylar overlay provides an explanation of the code. After locating the shoreline of interest, the associated coded segments will provide the following information regarding existing conditions:

1. No erosion control recommended (e.g., existing marsh, existing groin or groin field, commercial facility)

2. Recommended approach and probable cost using both non-structural and structural erosion control techniques based on available information on site conditions.

C. Qualifier for use of the maps.

No field work was accomplished to verify the codes assigned to the shoreline of Cecil County. Consequently, the assigned codes should be considered a "first cut" for the appropriate approach to shore erosion control. Site inspection by a qualified individual is necessary to verify the appropriate erosion control approach before planning for construction.

D. Non-structural Approach

The three alternatives to the non-structural approach to shore erosion control are (1) vegetating an existing shore, (2) developing a new shore by filling alongshore followed by vegetating the new shore, and (3) developing a new shore by sloping the bank followed by vegetating the new shore. The appropriate choice depends upon the conditions at the site and can only be determined following a site evaluation by a qualified individual.

E. Structural Approach

The three basic alternatives available for structural shore erosion control are (1) stone revetment, (2) bulkhead, and (3)

groin or groin field. Bulkheads and groins have potentially adverse environmental impacts and should be recommended only after careful site evaluation. Consequently, a stone revetment is the only structural approach that is recommended except for a few special circumstances.

Section Five

Design Considerations

V. Design Considerations

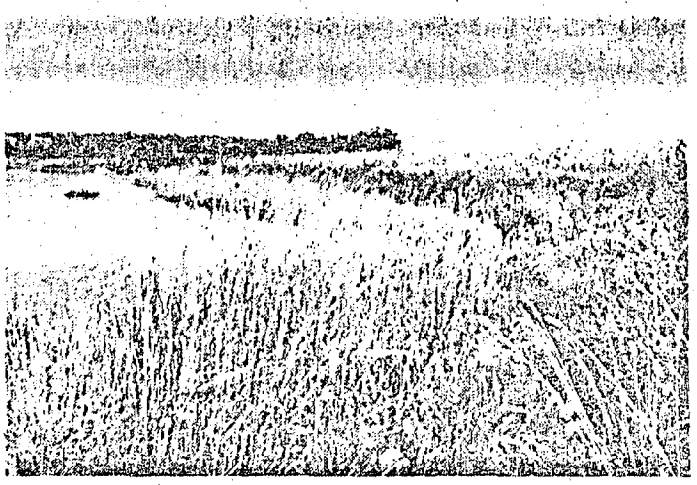
A. Non-structural Approaches

The site should be evaluated by an individual familiar with both design and construction of the non-structural alternatives. If the shore is not suitable to plant directly, an evaluation must be made to determine feasibility for the application of other vegetative and/or landscaping techniques. In many cases the bank can be sloped or a new shore can be developed by adding sandy fill materials along the shoreline. If the latter approach is recommended, elevations relative to Mean High Water along the toe of the existing bank should be estimateed using biological benchmarks on site (e.g., existing marsh plants and water marks on exisiting pilings). The new shore elevation at the bank face and the slope of the new shore must be determined and the volumes of required sandy fill materials computed for shoreline segments. The need for stone containment structures must be determined and if required their locations and sized noted. Any necessary clearing of debris, stumps, and fallen trees must be identified as well as the required clearing of trees and limbs for equipment access for adequate sunlight exposure to shore vegetation. The following discriptions explain how these different techniques are accomplished.

1. Vegetating Existing Shores

Planting existing shores throughout the intertidal zones as well as above the high tide elevation has high potential for erosion control although certain circumstances must naturally exist on the site for this approach to be successful. In instances where the shores are sandy and there is a continual source of sand available for alongshore transport, planting the existing shoreline will provide erosion control benefits.

Typical of many eroding shorelines on the Eastern Shore, this one is shown prior to being landscaped

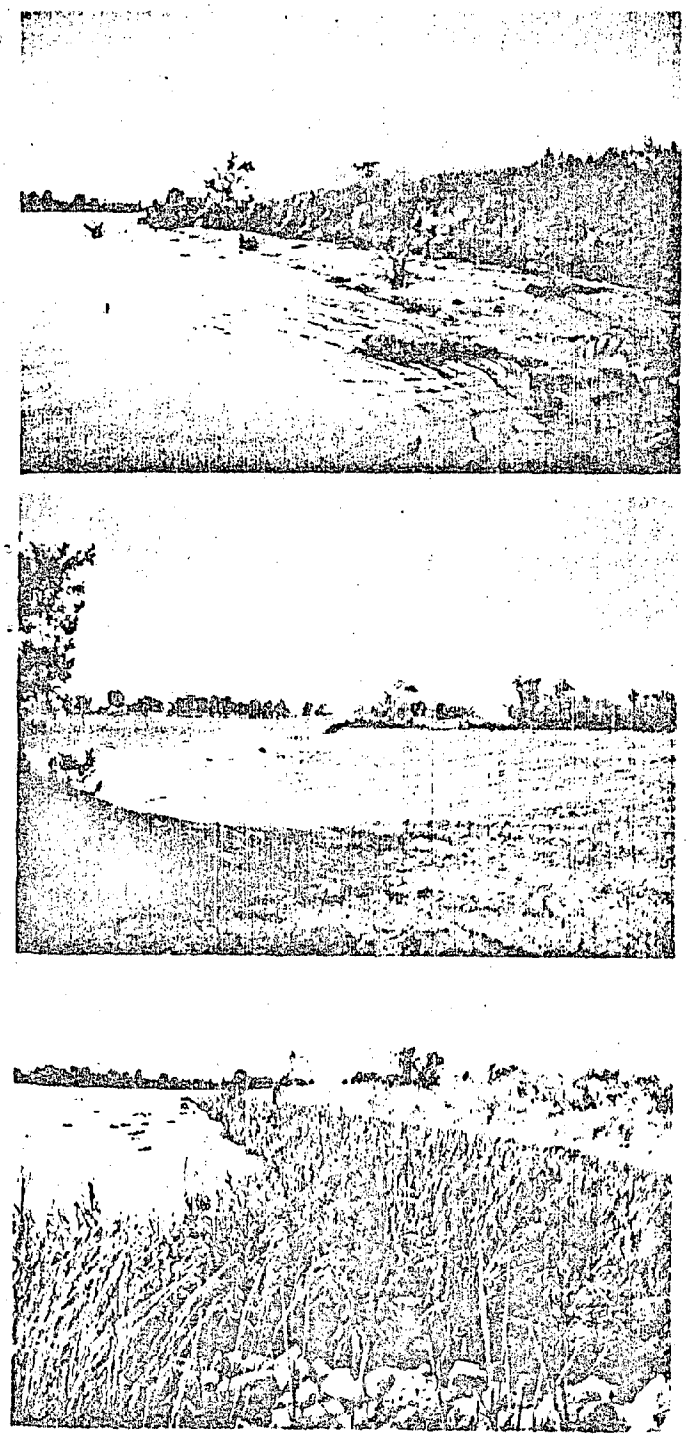


This photograph shows the same shoreline pictured at the left taken two years after stabilization by planting with marsh grasses.

Vegetative entrapment of sand in such a manner can lead to rapid increases in shore elevations along the toe of the eroding bank. Increases in shore elevation is the key to erosion control as it reduces the frequency of tidal interaction with the eroding bank face. Under favorable instances, reduced erosion rates arising from increases in shore elevations will allow time for the eroding bank face to become naturally vegetated with upland plants and thereby provide a stable shore.

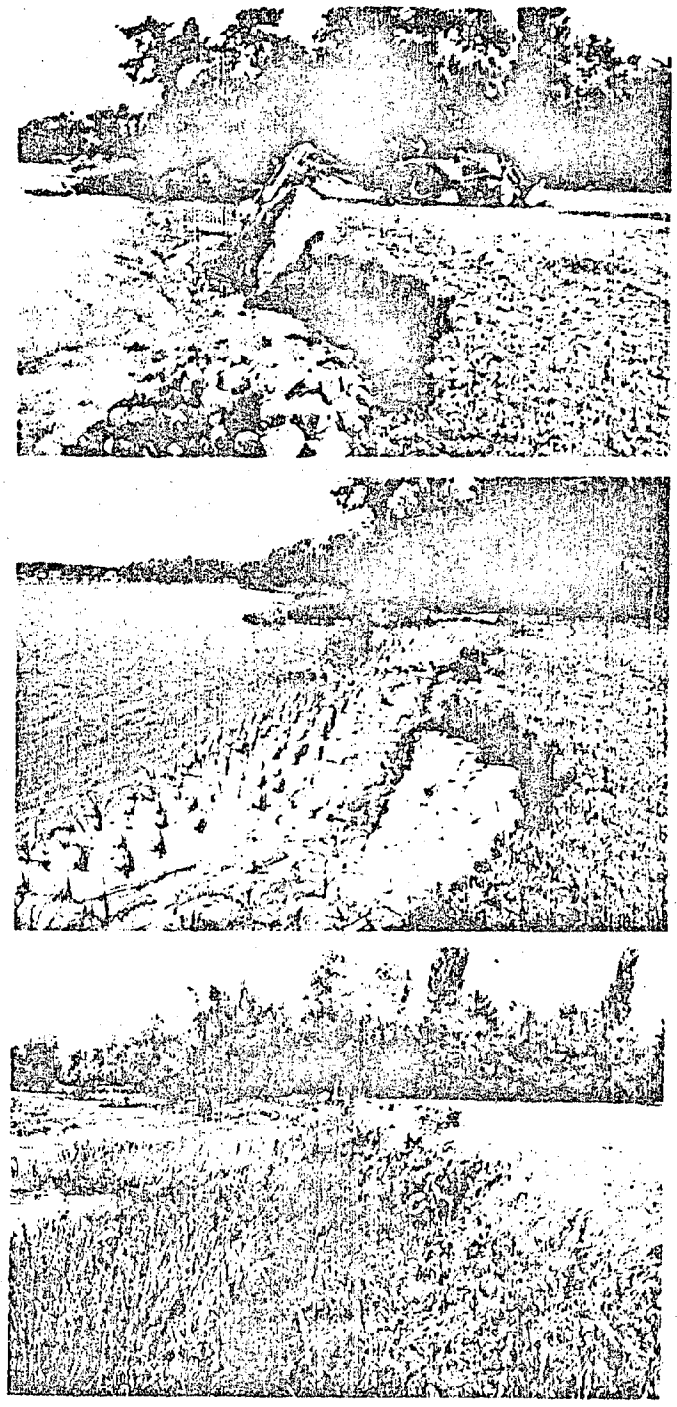
Shores in exposed locations where the wave energy is high should be planted only above the high tide elevation up to the toe of the eroding bank.

2. Vegetating New Shores Developed by Adding Sandy Fill Alongshore



Under favorable conditions, shore erosion can be controlled by developing a new shore. This is done by adding and grading sandy fill materials along the shoreline. Typically, the new shore is elevated to approximately 2.5 feet above local Mean High Water at the face of the bank and sloped on an approximate 10:1 grade down to the existing shore. Only an occasional storm tide would be expected to rise sufficiently above the new shore to interact with the bank face. Stone containment structures are usually placed at points along the shoreline to ensure that longshore currents and storm waves do not relocate the sand fill beyond the limits of the project site. Final stabilization of the new shore is achieved by installing plant materials.

3. Vegetating New Shores Developed by Bank Sloping Alongshore



For certain non-wooded sites, new shores can be developed by sloping the existing bank channelward or landward, depending upon the interests of the property owners and conditions at the sites. The grade of the sloped bank will vary with the exposure at the site but generally will range between 15:1 to 30:1. Stone containment structures will have to be constructed at the limits of regrading work and, depending upon the nature of the sloped materials, possibly at other points along the new shore. Final stabilization of the new shore is achieved by installing plant materials.

4. General Design Guidelines

The critical design elements for developed shores are:

a. height and slope of a new shore developed by filling alongshore.
b. slope of a graded bank and direction (landward or channelward) of grading.
c. number, locations, and size of containment structures.
d. clearing for sunlight alongshore.

The design elements are applied on a site specific level considering the existing conditions at the site. General guidelines are as follows:

i. Vegetating Existing Shores

Protected sites: Vegetation can be installed starting at the existing low elevation boundary for marsh plants at the site and extending up to the toe of the bank.

Exposed site: Vegetation can be installed starting at approximately one foot above Mean High Water and extending to the bank toe.

A minimum of six hours of direct sunlight alongshore each day is required for optimum vegetative development.

ii. Sloped Banks

Banks consisting of non-sandy soils should be sloped landward except for sites in very protected locations.

Banks consisting of sandy soils can be sloped either channelward or landward.

iii. New Shore Developed by Filling Alongshore

The height of the new shore at the bank face should be between 2.0 and 2.5 feet above local Mean High Water.

The slope of the new shore should be approximately 10:1.

A minimum of six hours of direct sunlight alongshore each day is required for optimum vegetative development.

iv. Containment Structures

Containment structures should have the same slope as that of the new shore and have a height that is approximately six inches above the finished grade of the new shore.

B. Structural Approaches

1. Stone Revetment

During construction the bank is first graded to achieve the shape required for the structure being installed. A filter cloth is laced and attached on the graded bank. This cloth is similar in weave and texture to tightly woven burlap but is made of a nondeteriorating plastic. The size of perforations should be selected to allow water to seep from the bank while keeping the soil particles in place. Seepage releases pressure from groundwater. Then a six to eight inch layer of quarry stone is added. On top of this is placed the large armor stone, the thickness of which varies according to projected wave energy expected during the "design storm" for the site. Progressively larger blocks and pieces of stone are placed on the face of the revetment. In areas where large waves are expected, an overtopping apron is sometimes constructed. Generally, the overtopping apron is a layer of 10 to 12 inch stone about ten feet wide that extends landward from the tip of the revetment.

2. General Design Guidelines

The design of structural shore erosion works should be done by a competent professional engineering firm using the latest information on shore erosion design. Based on information provided in a 1982, Maryland Department of Natural Resources report called "An Assessment of Shore Erosion in Northern Chesapeake Bay and of the Performance of Erosion Control Structures" the following general guidelines should be followed in the design of shore erosion structures more. A more detailed explanation of theory and practice is provided in the above mentioned report.

a. Determine adequate design heights for structures

All structures should be designed so that the top elevations are greater than the "annual" wave run-up to avoid serious overtopping damage. The use of predictive methods developed in "An Assessment of Shore Erosion in Northern Chesapeake Bay", together with a series of maps prepared as part of the same study provides information for the forecast of future storm tides and wave conditions at sites of new shoreline structures.

b. Proper stone weight

The design median armor stone weight "W_{50}" for a particular structure should be determined in accordance with the equation provided in the U.S. Army Corps of Engineers, "Shore Protection Manual"

c. Proper slope for revetments

Steep slopes for stone revetments should be avoided when possible. The more gradual the slope the more stable the structure will be.

d. Use of filter cloth

The availability of filter cloth is a relatively recent development, consequently the expected functional life is difficult to predict. However, the benefits of filter cloth are well documented and highly recommended by most experts and researchers in this field. Its function in the structure is to

prevent the slow movement of sediments from behind or under the structure. If filter cloth is not used and the sediment is allowed to continue leaching through the structure the larger stones will gradually slump foward and the structure will slowlycollapse.

e. Flank walls

If there is a relatively short section of shoreline to be protected along a rapidly eroding shoreline the untreated sections of the shoreline will often continue to erode until the structure is damaged by waves attacking from the side of the structure. This can be avoided by incorporating return walls or flank walls in the structure design. The length of the flank walls should be at least equal to the average annual retreat of the shoreline times the expected functional life of the erosion abatement structure.

Section Six

Preventative Maintenance Guidelines

VI. Preventative Maintenance Guidelines

Due to the destruction of seasonal storms and constant pushing and pulling action of the water waves, it is recommended that property owners who have shore erosion works in place take time at least once a year to inspect and repair their erosion propection. Once a revetment begins to loose stones or a rip develops in the filter cloth behind the stone, the eventual complete destruction of the revetment may soon follow if the problems aren't repaired immediately. The same is true for non-structural shore erosion treatments, excessive losses of vegetation due to high wave action of animal damage should be replaced immediately if loss of the sand beach is to be avoided. For both structural and non-structural erosion control works the cost of repairing weakened erosion works will increase rapidly the longer the problem goes unaddressed.

A. Preventative Maintenance for Non-structural Alternatives

1. Early each spring or as required remove all washed in litter and debris that has been deposited alongshore.

2. Install and maintain a goose exclosure fence just channelward of the vegetation during the months of October through April.

3. Replant as necessary any areas where plants have been washed out or eaten out by animals.

4. Remove shading shrubs and tree branches to maintain six hours of direct sunlight alongshore each day.

B. Preventative Maintenance for Structures

1. Inspect the face of the revetment for voids that may appear due to the settling of the entire structure as it adjusts to the site. Voids should be filled with stone of proper size and they should be filled so that the filter cloth beneath is not ripped in the process.

2. Inspect the face of the revetment for any signs of displacement of stones. In many cases after a heavy storm one or more stones may become disloged and role down the face of the revetment. If this should happen the stone should be carried back to its proper location if it is not too heavy to safely lift and carry or a backhoe used to move the stone if it is too heavy to carry (Note: The stones in a revetment are often slippery and too unstable to walk on safely, so do not attempt to replace heavy stones alone).

3. Because stone revetments are typically associated with areas of high wave energy they often suffer damange after a major storm. If there has been damage to a structure it is most important that the damage be properly repaired as quickly as possible. Should the structure go unrepaired until the next major storm there could be a collapse of the structure and very expensive replacement cost.

Section Seven

Special Taxing Districts

VII. Special Taxing Districts

Within the State of Maryland, provisions have been made in the Annotated Code for establishing Special Taxing Districts for the construction of shore erosion control structures by adjacent property owners. These districts are called Shore Erosion Control Districts and may be formed with County consent.

The Department of Natural Resources, Shore Erosion Control Program currently manages a program offering 25 year, interest free loans for a limited number of projects each year. A group of property owners representing one entire length of shoreline may qualify for an interest free State loan if a Special Taxing District is formed with the help of the County government.

Additional help for erosion abatement may be provided by the County government by assisting in creating a County Special Taxing District for the construction of an erosion control structure. This type of special taxing district will involve the use of special tax bonds to be sold by the County government in order to generate capital at a favorable interest rate. These bonds would not require a pledge of the issuer's (Cecil County) full faith and credit. Instead, the loan places a lien on benefitting protected properties as a guarantee for repayment, thus reducing the County's exposure and potential impact on existing County fiscal status.

Another alternative available to the County government is the establishment of a revolving loan or a sinking fund for the construction of shore erosion abatement projects deemed to have high priority. Those sections of waterfront identified as having a critical erosion problem may be considered as high priority. Monies used for their protection can be repaid at a rate of interest sufficiently low to encourage construction and as the loan is repaid additional projects can be undertaken. One of the major problems associated with this type of financial assistance is the relatively large sums of money that will be removed from

liquidity, this may represent a substantial opportunity cost in terms of forteited investment options. These losses will need to be weighed against the benefit of abating erosion for a particular reach.

A. Procedure for establishing a State Shore Erosion Taxing District.

1. Preliminary Phase

a. Initial inquiry received from property owner by letter, telephone or personal contact.

*b. Field Inspector visits site with property owner.

1. Erosion problem examined.
2. Technical assistance offered.
3. Explanation of program and information on SEC Districts provided.
4. Application for financial assistance if warranted by the severity of the erosion problem.

2. Application Review Phase

a. Application and supporting documents received from property owners.

b. Application reviewed by the Department and priority assigned based on the extent and severity of the erosion problem.

c. Applications reviewed quarterly for inclusion in the numerical priority list of potential projects, based on the availability of funds.

3. Establishment Of SEC District Phase

a. The County receives a copy of the application and a written petition signed by 75 percent of the property owners requesting the establishment of a Shore Erosion Control District and an SEC project.

b. The petition includes the boundaries of the District, tax map delineations, reasons for the request, names and address of property owners, etc.

c. If the petition is accepted, the County forwards it to the Department for consideration.

d. The Department prepares a Feasibility Report pursuant to Article 25, Section 167B. The report includes the need for a District, the type of construction recommended, and the estimated costs for the project.

e. The Feasibility Report is submitted to the County with a copy to the property owners.

f. When the property owners indicate approval of the project concept at a public hearing, the County establishes a Shore Erosion Control District. The County notifies the Department in writing that a District has been established and countersigns the application for State Financial Assistance.

4. Project Set-Up Phase

a. Property owners and County representatives notified of impending project initiation.

*b. Pre-project meeting held to discuss proposed work.

c. Letter of confirmation sent to County with copy to property owners' representative.

d. County representative signs and returns confirmation letter along with any requested documents, and deposit if required.