Lancaster County Shoreline Protection Study and Plan

Lancaster County, VA
July, 1995

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Table of Contents

I. Lancaster County Shoreline Protection Study

A. Erosion Rates 1

B. Erosion Factors 2
1. Fetch and Water Body Energy 2
2. Boat Traffic and Wake 2
3. Existing Shoreline Condition 3
a. Topography and Soil Type 3
b. Natural Protection 4
c. Man-Made Protection 4

C. Shoreline Alteration 4

D. Types of Shoreline Protection
1. Dunes 5
2. Vegetation 6
3. Bulkheads and Seawalls 6
4. Breakwater 7
5. Groins 7
6. Revetments 8

E. Existing Condition of Lancaster County Shoreline
1. Reach 1 8
2. Reach 2 9
3. Reach 3 10
4. Reach 4 11
5. Reach 5 11
6. Reach 6 12
7. Reach 7 13

II. Assessment of Existing Conditions 14

III. Goals and Objectives 16

IV. Lancaster County Shoreline Protection Plan 18

A. Shoreline Protection Means Equal Site Situation 18
B. Incentives for Subdivision Wide Shoreline Protection Efforts in Proposed Subdivisions 18
C. Cooperative Approaches to Shoreline Protection 19
D. Encourage Vegetative Alternatives for Shoreline Protection and Vegetative Enhancement of Resource Protection Areas 19
E. Property Owner Awareness 20

Glossary of Terms 21

Appendix

1. Summary of 1994 Wetlands Board Approvals
2. Summary of 1995 Wetlands Board Approvals (Through 7/95)

Table of Maps and Graphics

1. Slope Map
2. General Locations of Shoreline Alteration
3. Basic Bulkhead Structure
4. Basic Revetment Structure
5. Shoreline Reaches
6. Reach 1
7. Reach 2
8. Reach 3
9. Reach 4
10. Reach 5
11 Reach 6
12. Reach 7
13. Cooperative Approach to Shoreline Protection

Lancaster County Shoreline Protection Study and Plan

Lancaster County is a coastal community which has over 264 miles of tidal shoreline. The environment created by this interaction between the land and water along the County's coasts has helped to form our community's identity. This area of land and water is valued by residents who want live in a scenic setting, by citizens who come to the water for recreation, and by watermen who earn a living off the rich resources found here. The high value that is felt by Lancaster County's citizens for their shoreline is reflected in their desire and actions to protect this area.

However, peoples action to protect the natural shoreline can act to disrupt the delicate natural balance that exists here. Understanding this balance can help decision makers and property owners make the most informed and best possible decisions concerning the protection of the shoreline. This is the goal of the Lancaster County Shoreline Protection Study and Plan.

The Lancaster County Shoreline Protection Study and Plan deals with the issues and policies concerning shoreline erosion protection and control measures in Lancaster County. The study will first investigate the existing shoreline condition and erosion situation in Lancaster County and the plan will then make recommendations based on those findings. The plan will attempt to balance all the factors present when considering shoreline erosion; the natural forces of erosion, the present shoreline condition, the type of water body, and the property owner.

I. Lancaster County Shoreline Protection Study

The first key in understanding Lancaster County's shoreline situation is to determine how much of the shoreline is eroding and where these sections of shoreline are located. After areas of erosion are determined, the reasons for erosion have to be considered. Lastly, property owners responses to erosion problems, such as alteration of their shoreline, have to be investigated as to the effectiveness and impacts of their efforts.

A. Erosion Rates

The Virginia Institute of Marine Science has created 3 different categories to group shoreline erosion. The first group is **Slight/None**, which describes shoreline which is eroding at a rate of less than 1 foot per year. The second group is **Moderate**, which is shoreline which is eroding at the rate of 1 to 3 feet per year. The third group is **Severe**, which is shoreline which is eroding at a rate of 3 or more feet per year. Lastly, to suit the needs of the County's Plan an additional category, **Accretional**, has been added to describe shoreline area which is actually building or increasing over time.

The 1994 Lancaster County Shoreline Inventory completed by the Northern Neck Planning District Commission grouped the County's 3,916 waterfront parcels into categories based on their shoreline situation. The results are detailed below:

Slight/None	3,235 Parcels	82.61%
Moderate	443 Parcels	11.31%
Severe	179 Parcels	4.57%
Accretional	59 Parcels	1.51%

According to the Virginia Institute of Marine Science's Shoreline Situation Report for Lancaster County (1978), the County's average annual erosion rate for the shoreline is 0.7 feet per year. The average rate along the Bay is 1.7 feet per year. Along the rivers the average was 0.6 feet per year.

In the 100 year period before the Shoreline Situation Report was done, 792 acres had eroded from the 43 miles of Bay Shore and 561 acres from the 125 mile of river shore. The greatest average erosion rate is 7.9 feet per year between Windmill and North Points, and 6.6 feet per year between Dymer and Indian Creeks. Along the Corrotoman and Rappahannock Rivers, average erosion rates of individual reaches ranged down from 5.1 feet per year. (Page 10, Shoreline Situation Report for Lancaster County.)

B. Erosion Factors

1. Fetch and Water Body Energy

The distance wind and waves travel across open water before they reach land is called the "fetch". For example the fetch across the Chesapeake Bay is over 20 miles in the parts of Lancaster County along the Bay. The fetch across most tidal creeks in Lancaster County ranges from a few hundred feet in the upper reaches to 1/2 to 1 mile near the creeks' mouths. The fetch is important because it is a factor in how much energy a water body has in influencing erosion.

Low Energy Water Bodies

This category includes the inland part of all the tidal creeks, coves, and upper reaches of rivers in Lancaster County including the following:

Indian Creek
Dymer Creek
Tabbs Creek
Anitpoision Creek
Oyster Creek
Mosquito Creek
Carter Creek
Taylor Creek
Myers Creek
Whitehouse Creek
Greenvale Creek
Deep Creek
Mulberry Creek
Lancaster Creek
Upper Eastern Branch
Upper Western Branch
Moran Creek

Medium Energy Water Bodies

Main Branch Corrotoman River
Mouths of Tidal Creeks along Main Branch of Corrotoman River
Little Bay
Rappahannock River above Towles Point
Mouths of Tidal Creeks along Rappahannock River above Towles Point

High Energy Water Bodies

Mouth of the Corrotoman River
Rappahannock River Below Towles Point
Mouths of Tidal Creeks along Rappahannock River Below Towles Point
Fleets Bay
Chesapeake Bay
Mouths of Tidal Creeks along Chesapeake Bay

2. Boat Traffic and Wake

Wakes caused from boat traffic can act greatly to worsen impacts of erosion on adjacent shoreline. Effects of boat wakes are generally greater in narrow water bodies where the resulting wake has less area to dissipate before it reaches the shoreline, and in areas where there is a large amount of boat traffic. Generally, wakes tend to dissipate over larger distances such as major rivers and bays. However, in narrow stretches of water the shoreline usually absorbs the impact of the boat wake.

Heavy boating areas in Lancaster County include Carters Creek, the Rappahannock River, the main branch of the Corrotoman River, Fleets Bay, and the Chesapeake Bay. Medium areas of boating activity include Myers Creek, Lancaster Creek, Greenvale Creek, Whitehouse Creek, Indian Creek, Dymer Creek, Tabbs Creek, and Antipoision Creek.

3. Existing Shoreline Condition

a. Topography and Soil Type

The topography of the shoreline plays a large role in how the shoreline erodes. Large shoreline bluffs adjacent to the water can be threatened by wave scour at their base, and seepage of groundwater along their faces. The result is that the base of the bluff is weakened and soil which is saturated with groundwater collapses downward and "sloughs off". This trend will continue until the bluff's base is protected and the face is stabilized.

Additionally, steep areas along many upper reaches of Lancaster County's tidal water and shoreline are stable only until they are disturbed by development. These areas can be then difficult to stabilize. These areas tend to be present where there is the existence of steep land and sandy soils. These soil types are found throughout Lancaster County and make up approximately 28% of the county's soil. These soils are generally found along natural drainage courses along upper or inland reaches of tidal creeks and smaller tidal rivers. (See Slope Map)

b. Natural Protection

Existing vegetation along the shoreline can act to stabilize erosion of the shoreline. Additionally, wetlands adjacent to the shoreline can act as a buffer or baffle which can protect the shoreline. Barrier Island beaches and sand spits can also act to absorb wave energy before it reaches the shoreline of the mainland. Lastly, Submerged Aquatic Vegetation can act to slow and dissipate wave energy before it reaches the shore.

c. Man-Made Protection

Altered shoreline can act to prevent erosion at the point where the shoreline is altered. However, the alteration of the shoreline in one location usually acts to increase erosion in areas downdrift of the altered shoreline area. Natural erosion of land results in sediment loss which acts to nourish downdrift shoreline. When a shoreline is altered, this natural supply of nourishment is lost.

C. Shoreline Alteration

Alteration of the shoreline is the constructing of erosion protection structures on, adjacent to, or abutting the shoreline. These artificial stabilization structures include bulkheads, revetments, breakwaters, groins, and jetties.

Alteration of the shore can have positive and negative impacts. Positive impacts are the stabilization of severely eroding land, protection of endangered structures, and the protection of surface water quality. Negative impacts include possible downdrift erosion, loss of wetlands, and a disruption of natural shoreline processes. Negative impacts are often magnified as the amount of altered shoreline rises. Increased alteration can also result in a further loss of natural balance in the shoreline environment.

In 1978, 14 miles or 73,920 feet (5%) of shoreline was artificially stabilized in Lancaster County. The 1994 Lancaster County Shoreline Inventory completed by the Northern Neck Planning District Commission showed that 28.72 miles or 151,620 feet of shoreline had been altered in Lancaster County by 1993. This is a growth of 14.71 miles (77,700 feet) or 105% in 15 years. This amount averages out to .98 miles (5,180 feet) of shoreline alteration a year from 1978-1993. (See "General Locations of Shoreline Alteration" Map)

Slope Map

0 – 6% Slopes

6 – 15% Slopes

15 – 45% Slopes

6 – 45% Slopes

Lancaster Co., VA

July, 1995

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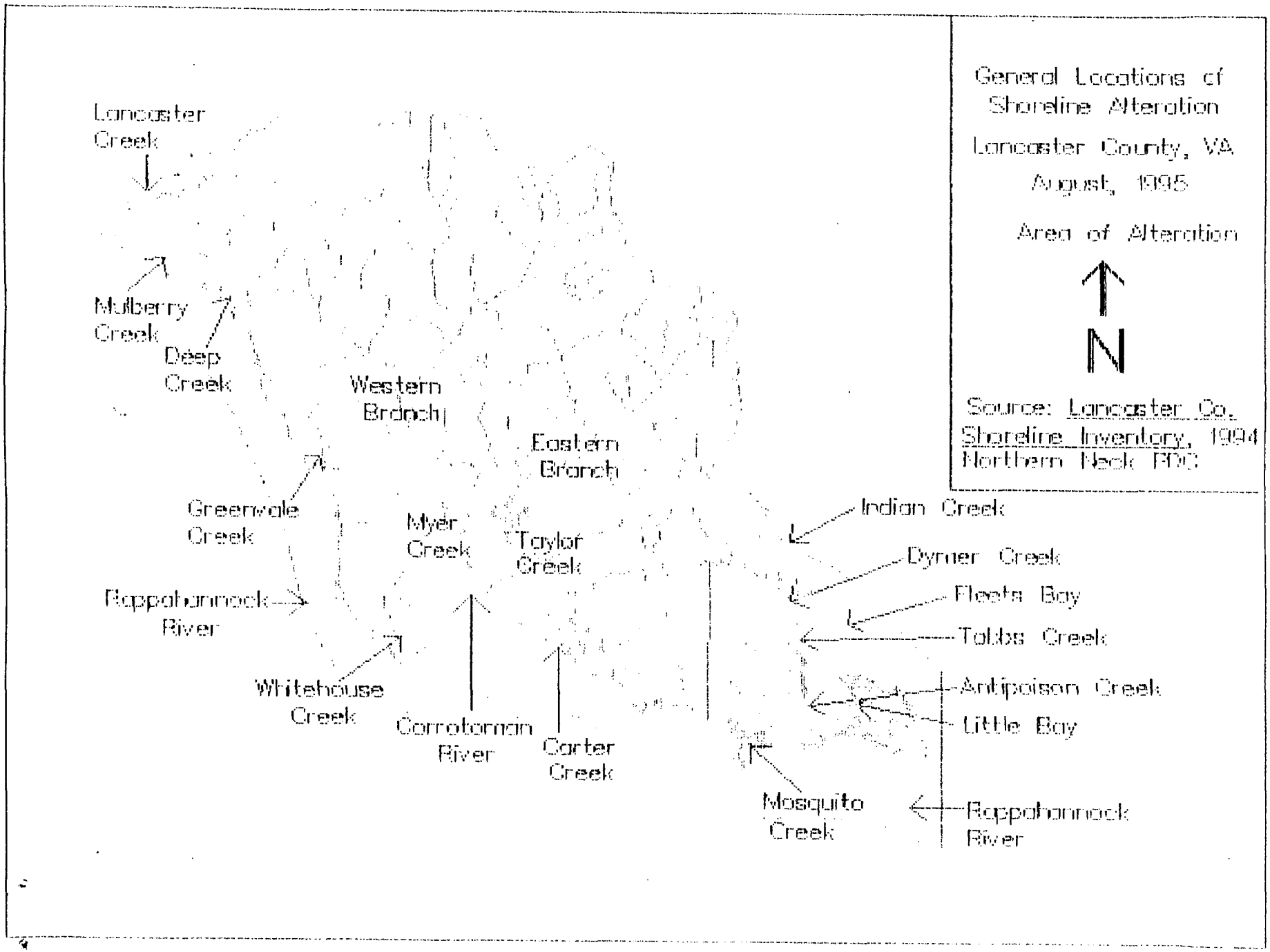
Lancaster County
Planning and Land Use
Office

Sources:
ISSL Lab, VPI&SU
Lancaster County
Soil Survey


General Locations of Shoreline Alteration
Lancaster County, VA
August, 1995
Area of Alteration
N
Source: Lancaster Co. Shoreline Inventory, 1994
Northern Neck PDC
Lancaster Creek
Mulberry Creek
Deep Creek
Western Branch
Eastern Branch
Greenvale Creek
Myer Creek
Taylor Creek
Rappahannock River
Whitehouse Creek
Corrotoman River
Carter Creek
Indian Creek
Dymer Creek
Fleets Bay
Taldos Creek
Antipoison Creek
Little Bay
Mosquito Creek
Rappahannock River

Alteration of the shoreline occurs slowly but has a cumulative impact. Approximately 11% of the County's shoreline was altered by 1993, and this growth continued into 1994 and 1995. Review of Wetland Board Public Hearing Minutes for all of 1994 show that over 2.41 miles of shoreline alteration was approved last year. Additionally, during the first seven months of 1995 another .73 miles of structures had been approved. This is a trend which is expected to build in the next 20 years as new waterfront parcels are developed and homeowners try to protect their homes.

High areas of altered Shoreline in Lancaster County include:

a. Morattico
b. Monaskon
c. Main Branch Corrotoman
d. Mouth of Corrotoman/Weems
e. Carter Creek
f. Palmers/Brightwater
g. Windmill Point and Marina Area
h. Norris Bridge area

Source: Lancaster County Shoreline Inventory. Northern Neck Planning District Commission; Callao, VA: April, 1994.

D. Types of Shoreline Protection

1. Dunes

Dunes are a natural form of shoreline protection. They are basically a ridge or mound of loose, wind-blown material, such as sand. Dunes are very effective when vegetated. However, dunes have to be protected from foot and vehicular traffic. In Lancaster County, there are several isolated areas of sand dunes, all of which are on private property.

The larger areas of dunes in Lancaster County are generally found along the lower Rappahannock River and the Chesapeake Bay, including parts of Fleets Island and Deep Hole Point. Smaller dune areas are found scattered throughout the County and are usually adjacent to higher energy water bodies. Access to dune areas in Lancaster County is through either private property or state owned waters. Therefore, vehicular traffic is very limited, with access available only to property owners with dunes on their land. However, pedestrian access to dune areas is not as limited with existing traffic being generated by both individual property owners and boaters. Realistic methods of minimizing negative impacts of pedestrian traffic in dune areas, which also recognize the Chesapeake Bay Preservation Act's allowances for access to state waters, need to be further explored in Lancaster County. Possible protection methods could include the requiring of raised walk-ways over dunes and other environmentally sensitive features when considering future development.

2. **Vegetation** (Fringe Marsh Establishment)
Vegetative shoreline protection is usually limited to creeks, smaller rivers, coves and partially protected shorelines where there are smaller fetches, and therefore less wave energy (See Low Energy Water Bodies List on Page 2). Fringe marsh establishment is an environmentally sound shoreline protection option which is far less expensive than other commonly used methods for shoreline erosion protection, and often requires no permits.

Many shoreline areas in Lancaster County are ideal for fringe marsh establishment. Often previous fringe marsh in these areas has died off due to boat wakes, the long-term effects of wave action, and the blocking off of light due to large overhanging trees. The result is that a bank starts to erode where vegetative buffer existed before. Establishment of a new marsh fringe can reverse this erosion situation.

Fringe marshes have many desirable impacts. First, an established marsh traps sand moving with the tide and helps maintain a suitable marsh elevation. Additionally, fringe marsh acts as a baffle, which diminishes wave energy in the vegetated area before it reaches and erodes the upland bank. Fringe marshes also act to enhance water quality and wildlife habitat.

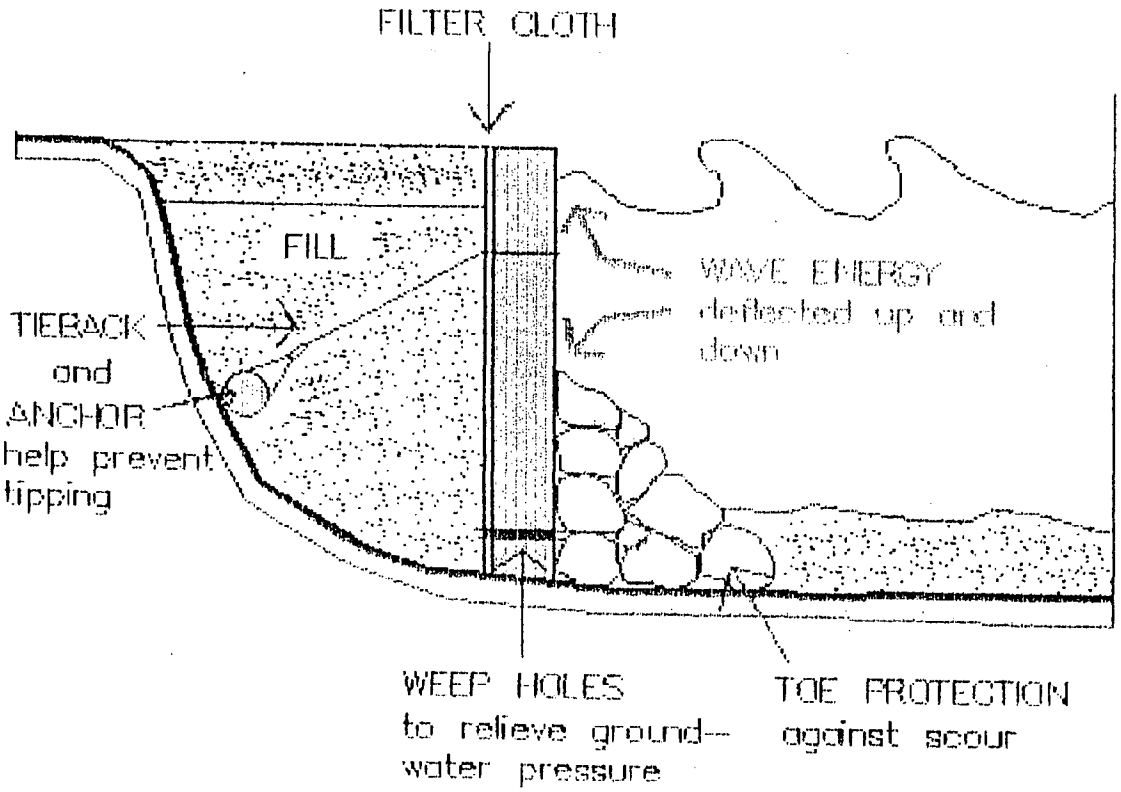
Approximate Cost per Linear Foot for Shoreline Erosion Control

	RELATIVE WAVE ENERGY (Average Fetch*)		
Type of Erosion Control	LOW (< 1 mile)	MEDIUM (1-5 miles)	HIGH (> 5miles)
Marsh w/o Sand 20 ft/fringe	$15	N/A	N/A
Marsh w/ Sand 20 ft/fringe	$30	N/A	N/A
Bulkhead	$45	$150	$300
Riprap	$45	$125	$200

Source: Shoreline Erosion Problems? Think Green.... Barnard, Tom and Hardaway, Scott; Virginia Institute of Marine Science, College of William and Mary; Gloucester Point: VA, 1994.

3. **Bulkheads and Seawalls (See Graphic)**
Bulkheads and seawalls protect banks and bluffs by completely separating the land from the water. Bulkheads act as retaining walls keeping the earth or sand behind them from crumbling or slumping. Seawalls are primarily used to resist wave action. Construction of bulkheads and

BASIC BULKHEAD STRUCTURE



Source: Low Cost Shore Protection. U.S. Army Corps of Engineers. 1981.

seawalls can act to hasten erosion of beach areas immediately in front of the structures. This is because the structures redirect wave energy downward to the toe and beach areas.

Bulkheads and seawalls are most appropriate where fishing and boating are the primary uses of the shore, and gently sloping beach areas for sunbathing and swimming are not desired.

Source: Low Cost Shore Protection. U.S. Army Corps of Engineers; 1981.

4. Breakwater

Breakwaters are structures placed offshore to diminish the energy of incoming waves. Larger breakwaters are suitable for protection of deep harbors. Much smaller breakwaters can be used by individual property owners to protect their shoreline. Breakwaters in this category are usually one to three hundred feet offshore in relatively shallow water and are designed to protect a gently sloping beach. Additionally, after wave energy is dissipated, sandy drift material can then be deposited behind the breakwater and act to build up the beach or protected shoreline.

Breakwaters must be properly designed. If they are too high they can interfere with natural shoreline processes, and if they are too low the shoreline will be inadequately protected. Breakwaters are also prone to scour, so the toe of the structure must be protected. Lastly, breakwaters can have negative impacts on neighboring or downshore properties. Drift material trapped by breakwater can stop downshore shoreline from being renourished.

Source: Low Cost Shore Protection. U.S. Army Corps of Engineers; 1981.

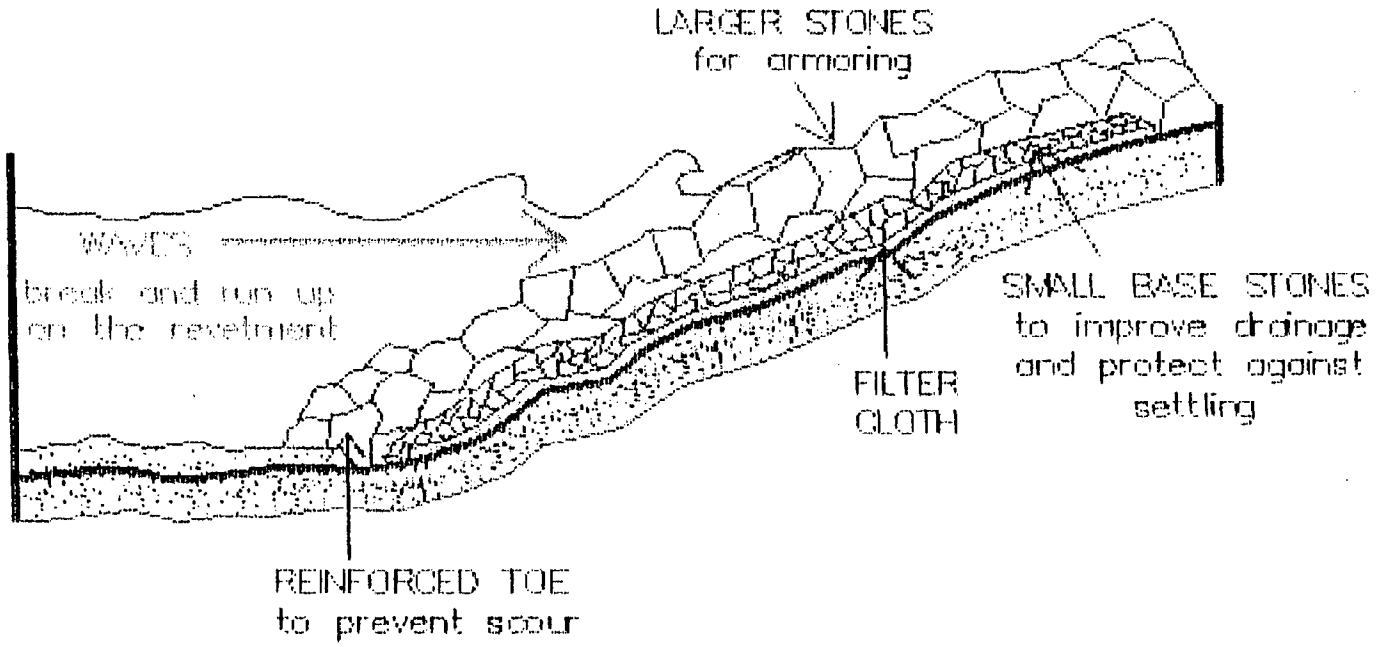
5. Groins

Groins are structures that extend, fingerlike, perpendicularly from the shore. Groins are usually constructed in groups called fields. The primary purpose of a groin is to trap and retain sand, nourishing the beach compartments between them. Groins are designed to interrupt the longshore transport of littoral drift. They are more effective where longshore drift is predominantly in one direction. If not properly placed, groins can decrease nourishment of downdrift shore, resulting in erosion of that shore.

Groins are suitable erosion control measures where a beach is desirable, and they are compatible with most recreational activities. Sand trapped by groins eventually provides a buffer between incoming waves and backshore and inland areas. The waves break on the new beach and expend most of their energy there. Groins are effective protection during normal weather conditions but offer only limited protection against storm-driven waves.

Source: Low Cost Shore Protection. U.S. Army Corps of Engineers; 1981.

BASIC REVETMENT STRUCTURE



Source: Low Cost Shore Protection. U.S. Army Corps of Engineers, 1981.

6. Revetments (See Graphic)

Revetments are structures placed on banks or bluffs in such a way as to absorb the energy of incoming waves. The most common type of revetment used in Lancaster County is the rip-rap. Revetments are usually constructed to preserve the existing use of the shoreline and to protect the slope. Like seawalls, revetments armor and protect the land behind them. Additionally, depending on construction materials, revetments can be either watertight or porous. Porous revetments are most desirable because they can act to further diminish wave energy, while allowing less wave energy to be reflected off of the structure's surface to beach or marsh areas in front of the structure.

Most revetments do not act to interfere with transport of littoral drift. Furthermore, they do not act to redirect wave energy to unprotected areas, except for beaches immediately in front of the structure. However, protecting previously eroding land cuts off the supply of the eroding material which before acted to nourish downshore beaches. This causes downshore beaches to have less nourishment, and can result in their eventual erosion.

Revetments have to be built with armor material sufficient enough to withstand storm conditions. Undersized armor rocks or material will cause the revetment to fail. The toe or base of the revetment should be buried or protected to prevent scouring of the structure. Revetments also should be built on gentle slopes with 2 to 4 feet of run for every foot of rise. Lastly, failure to tie the revetment structure back into the shoreline can result in flank erosion around the structure, because the flank area now receives no upshore nourishment from the now protected shoreline.

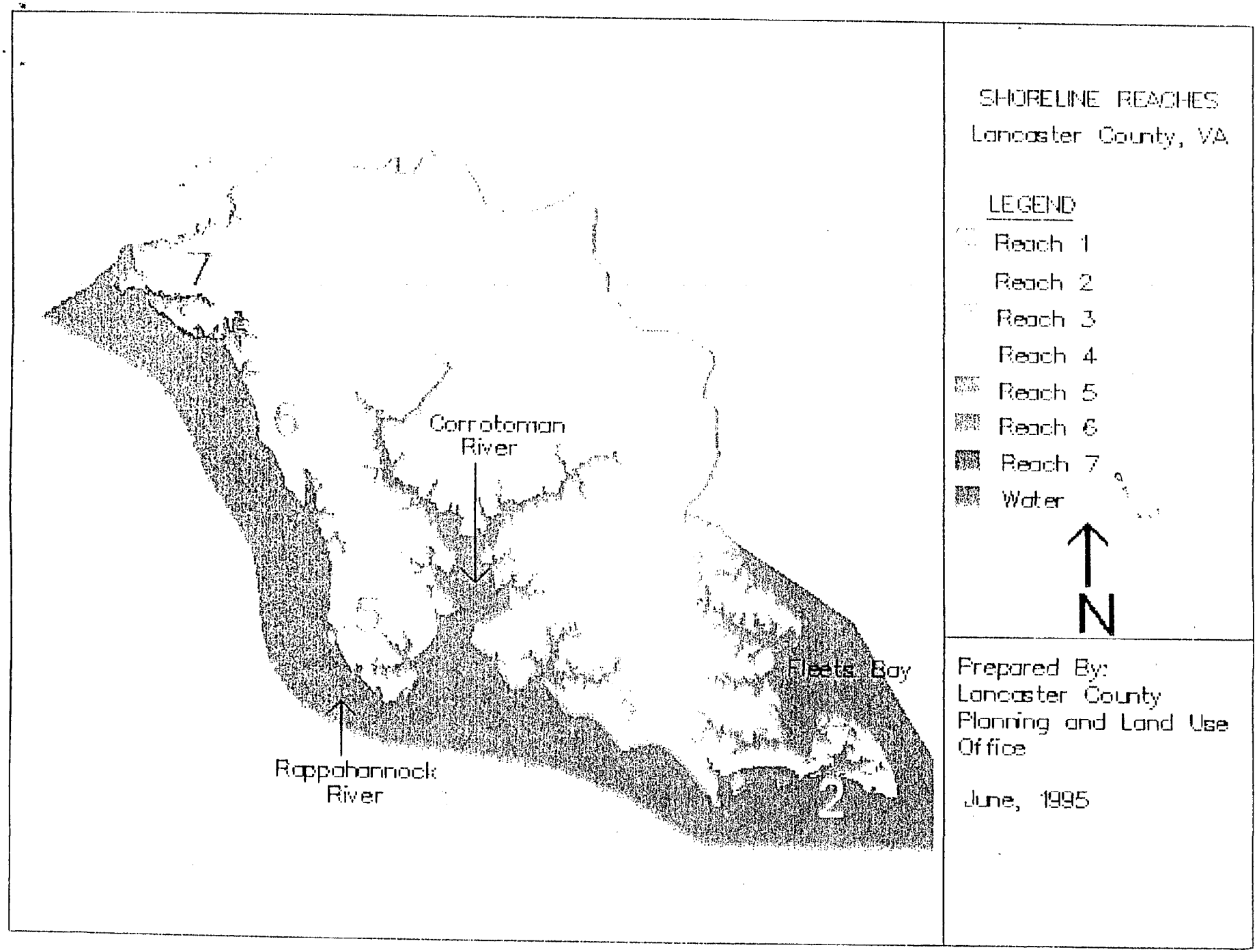
Source: Low Cost Shore Protection. U.S. Army Corps of Engineers; 1981.

E. Existing Condition of Lancaster County Shoreline

For purposes of study, the Virginia Institute of Marine Science (VIMS) has grouped Lancaster County's shoreline into like sections called reaches. Reaches are sections of shoreline which share similar topographic and physical characteristics. There are 7 Reaches in Lancaster County and their locations can be seen on the "Reach Map". Below is a summary of the 7 Reach segments in Lancaster County. The reach summaries have been compiled from information found in VIMS' Shoreline Situation Report for Lancaster County (1978).

1. Reach 1

Reach 1 is approximately 55 shoreline miles in length and extends from Indian Creek to the southern mouth of Antipoison Creek (See Reach 1 Map). Included in this reach is all shoreline along Indian, Dymer, Tabbs, and Antipoison Creeks; as well as the shoreline fronting Fleets Bay. Shoreline topography in this reach is described below:


SHORELINE REACHES
Lancaster County, VA
LEGEND
Reach 1
Reach 2
Reach 3
Reach 4
Reach 5
Reach 6
Reach 7
Water
N
Corrotoman River
Rappahannock River
Fleets Bay
7
6
5
4
3
2
1
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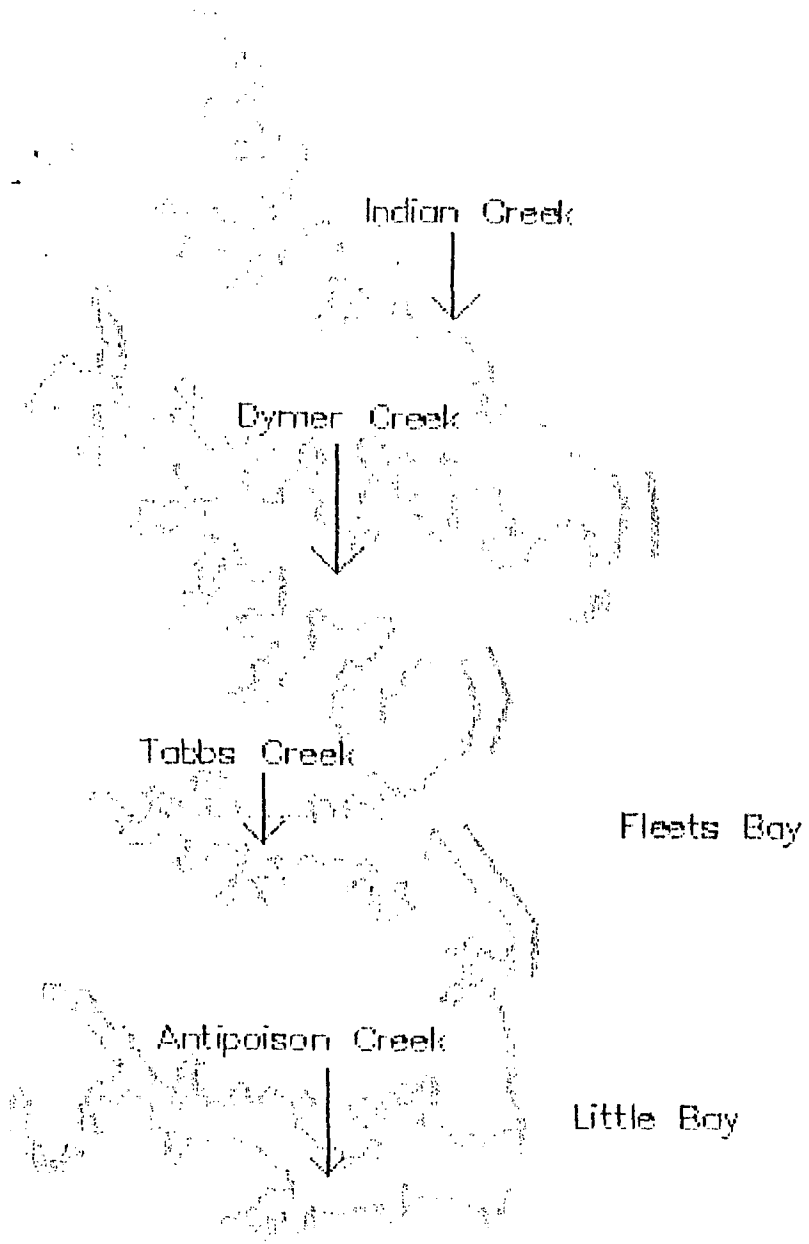
June, 1995



REACH 4
Lancaster Co., VA

Indian, Dymer, Tobbs, & Antipoison Creeks

55 Shoreline Miles

Shoreline

Severe Erosion

Accreting Shoreline

N

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June, 1995

Shore Form

98.18%	Low Shore
1.46%	Low Shore with Bluffs
0.36%	Filled Fastland

Shoreline Type

87.45%	Fringe Marsh
7.82%	Beach
3.27%*	Artificially Stabilized
0.73%	Embayed Marsh
0.73%	Extensive Marsh

* This is a 1978 figure which has probably doubled in the last 15 years.

The shoreline in this reach is prone to flooding during coastal storms due to its low elevation. All structures below 5 feet in elevation would be inundated by high storm waters. Areas of beach in Reach 1 are generally of good quality. Considering erosion, areas of severe erosion exist along the Fleets Bay shoreline between Indian and Dymer Creek (6.6 feet/year) and the Bay front near Tabbs Creek (5.6 to 6.0 feet/year). Additionally, one area north of the Tabbs Creek mouth is accreting at a rate of 1.6 feet per year. All other shoreline areas in this reach, particularly along the creeks, have slight or no change due to erosion.

2. **Reach 2**

Reach 2 is approximately 37 miles in length and extends from the southern mouth of Antipoison Creek, around Windmill Point, and back to Mosquito Point on the Rappahannock River (See Reach 2 Map). Included in this reach are the shoreline areas along Little Bay, Fleets Island, Windmill Point Creek, Oyster Creek, the Rappahannock River and Mosquito Creek. Shoreline topography in this reach is detailed below:

Shore Form

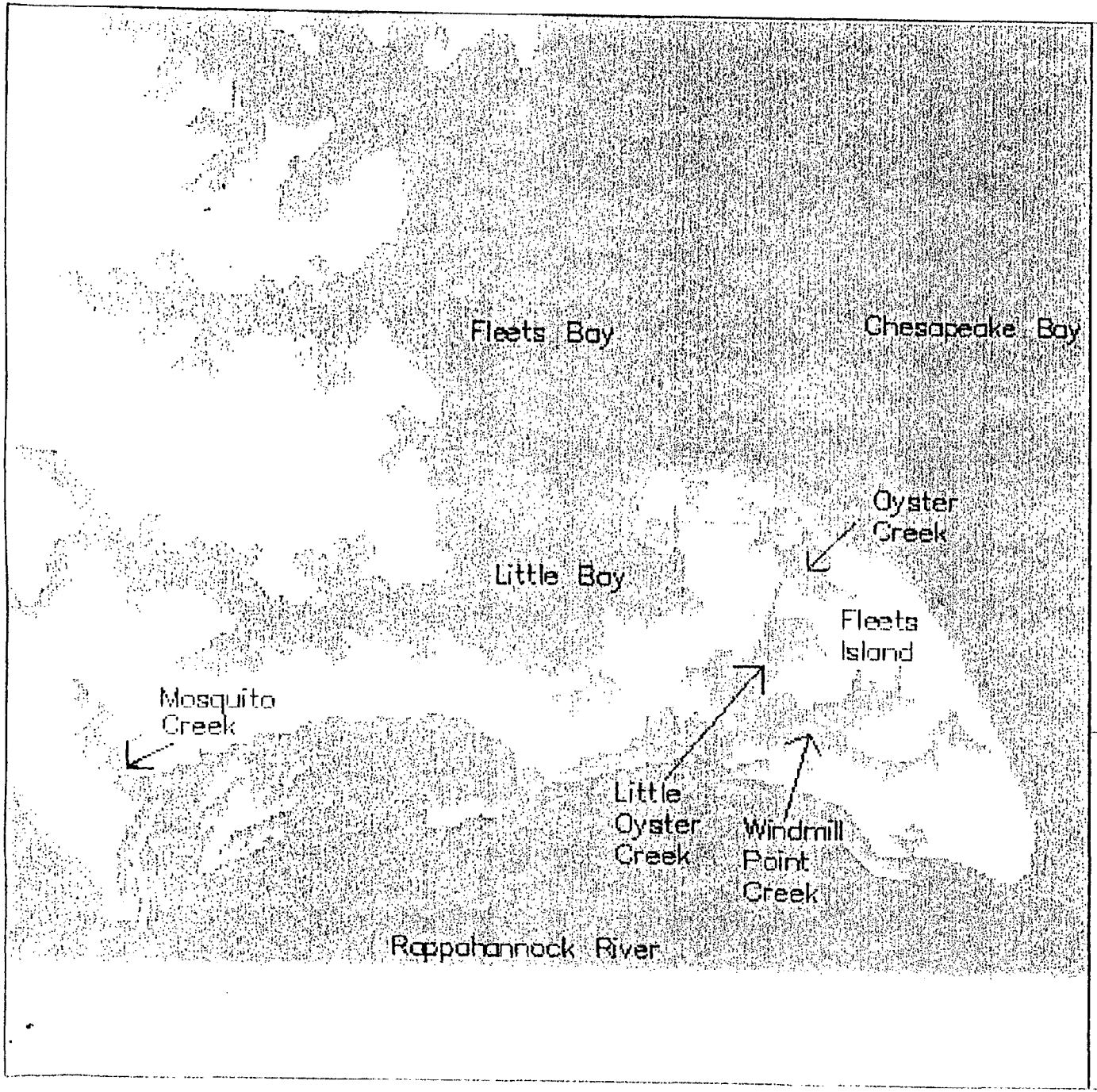
99.25%	Low Shore
0.75%	Low Shore with Bluffs

Shoreline Type

46.61%	Fringe Marsh
24.93%	Extensive Marsh
16.26%	Beach
7.05%*	Artificially Stabilized
5.15%	Embayed Marsh

* This is a 1978 figure which has probably doubled in the last 15 years.

The shoreline in Reach 2 is very low and susceptible to flooding. The majority of the structures in this area are situated 5 feet or less in elevation and would be flooded during periods of high



REACH 2
Lancaster Co., VA

Southern Mouth of Antipoison Creek to Mosquito Point

36.9 Shoreline Miles

Shoreline

Severe Erosion
Moderate Erosion
Accreting Shoreline

N

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Office

June, 1995

storm water. Beach quality in this reach ranges from poor to excellent. Very good beach areas exist along stretches of Fleets Island and between Windmill Point to Windmill Point Creek. Erosion in Reach 2 is severe from North Point to Windmill Point Marina (2.9 to 7.9 feet/year). Moderately eroding shoreline is found from Mosquito Creek to Mosquito Point (2.7 feet/year). Lastly, accreting shoreline is found between the mouths of Windmill Point Creek to Mosquito Creek (1.5 feet/year).

3. Reach 3

Reach 3 is approximately 31.5 miles long and is comprised of all the shoreline from Mosquito Point to the mouth of the Corrotoman River. Include in this reach is all the shoreline along Carter's Creek from Crab Point to Weems. Shoreline topography in this reach is presented below:

Shore Form

33.79%	Moderately Low Shore with Bluffs
22.53%	Low Shore
20.05%	Moderately Low Shore
12.09%	Low Shore with Bluffs
6.87%	Moderately High Shore
3.57%	Moderately High Shore with Bluffs
1.10%	Filled Fastland

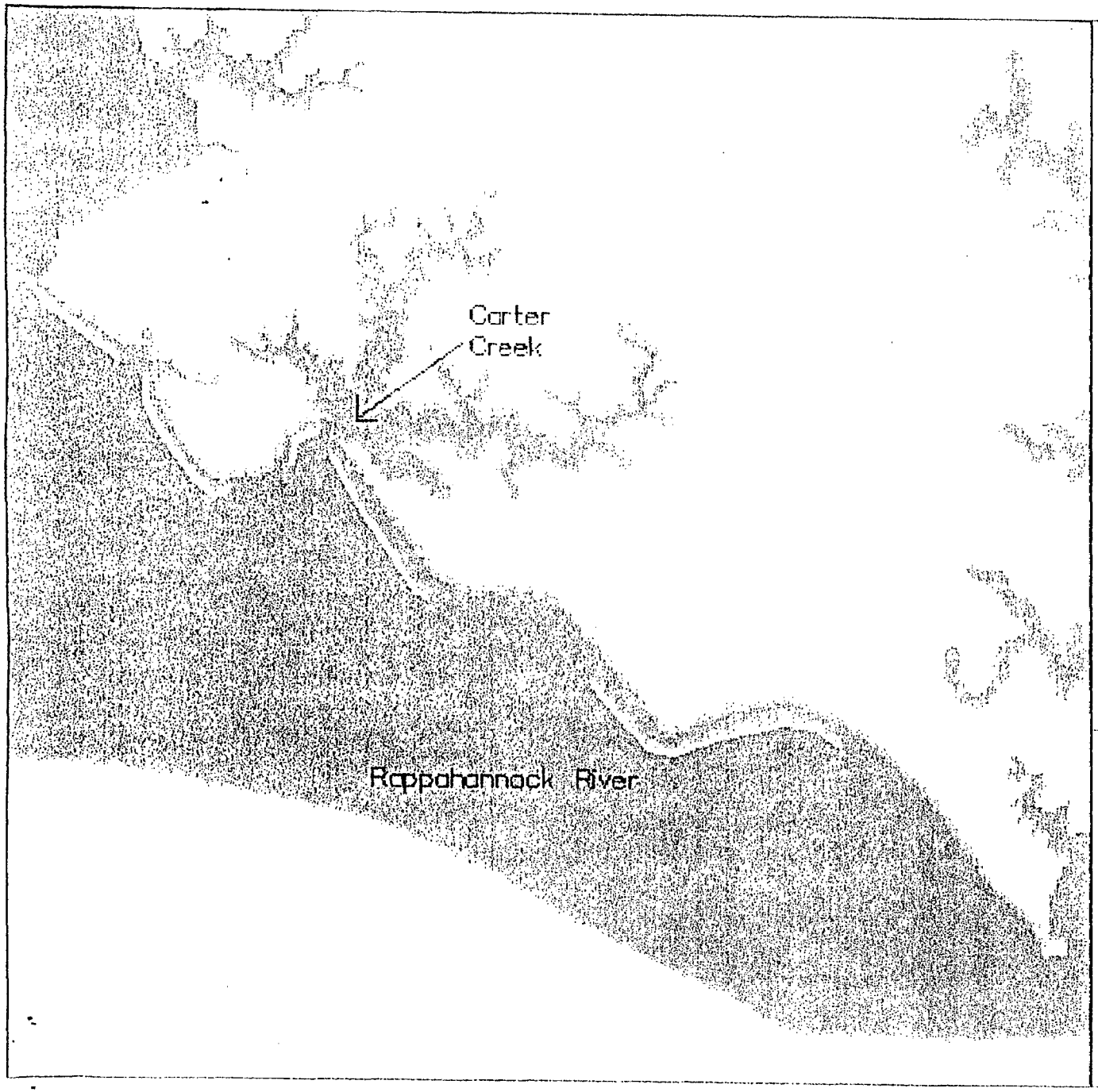
Shoreline Type

65.40%	Fringe Marsh
18.41%	Beach
9.84%*	Artificially Stabilized
6.35%	Embayed Marsh

* This is a 1978 figure which has probably doubled in the last 15 years.

The majority of this shoreline area is considered a low flood hazard area. The exceptions are structures built in low elevation areas at White Stone Beach and at the creek mouths. Those sections area high risks for flood hazards. Over 50% of the shoreline in Reach 3 is comprised of bluffs. Shoreline bluffs can be susceptible to erosion at their base from scour, on their surface from drainage patterns, and in the area in between through groundwater seepage.

Beach quality in Reach 3 ranges from poor to good. Good beaches are present from Mosquito Point to Crab Point. Erosion rates in Reach 3 vary from slight or none, to moderate. Moderately eroding shoreline areas are found along the Rappahannock River (1.5 to 1.7 feet/year, around Weems (1.1 feet/year), and at the mouth of the Corrotoman River (1.2 to 1.6 feet/year). Areas of slight or no erosion is found in Carter's Creek.



REACH 3
Lancaster Co., VA

Mosquito Point to
Carrotoman Point

3.15 Shoreline Miles

Shoreline

Moderate Erosion

N

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Office

June, 1995

4. Reach 4

Reach 4 is approximately 85.8 miles in length and covers the entire length of the Corrotoman River. Included in this reach are the Eastern and Western Branches of the Corrotoman River; and Taylor, Myers, and Moran Creeks. Shoreline topography in this reach is described below:

Shore Form

57.40%	Moderately Low Shore
17.57%	Low Shore
9.69%	Moderately Low Shore with Bluffs
9.37%	Moderately High Shore
3.51%	Low Shore with Bluffs
2.35%	Moderately High Shore with Bluffs
0.11%	Filled Fastland

Shoreline Type

72.73%	Fringe Marsh
18.88%	Embayed Marsh
6.41%	Beach
1.75%*	Artificially Stabilized

* This is a 1978 figure which has probably doubled in the last 15 years.

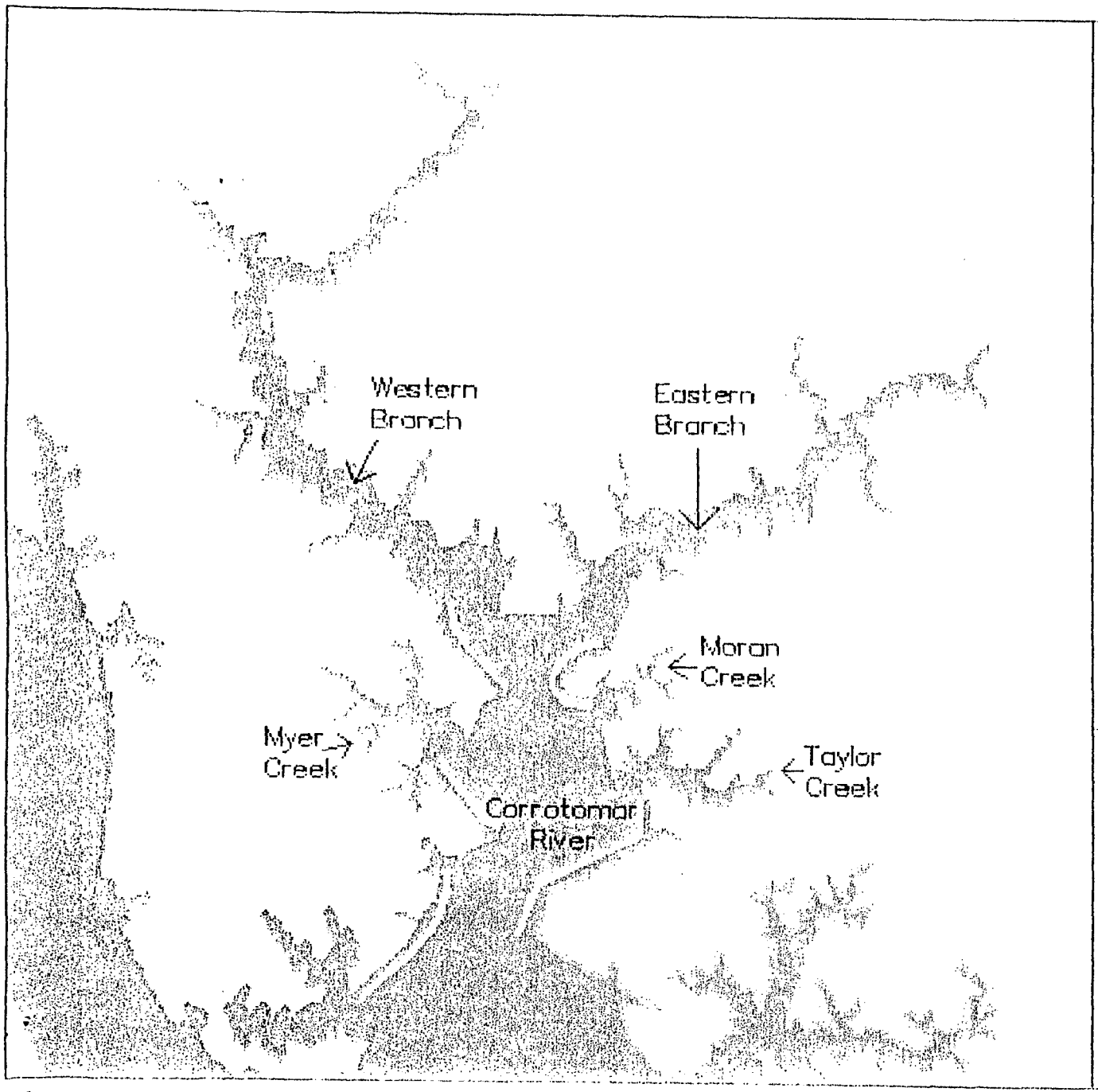
The majority of Reach 4 is a low flood hazard area. The exceptions are the few structures built below 5 feet elevation and the road located on the northern side of the mouth of Taylor's Creek. The quality of the beaches found in this reach is poor. The exception is the beach found at Bar Point which is fair in quality. Almost the entire reach length has erosion rates of slight or none. However, moderate erosion rates can be found from Ottoman Wharf to Bar Point (1.0 feet/year), at Black Stump Point (1.7 feet/year), and on the West Bank of the Main Branch of the Corrotoman River (1.7 to 1.9 feet/year). Additionally, one area with severe erosion rates exists on the Corrotoman River between Taylor and Moran Creeks (5.1 feet/year), but the situation appears to have been stabilized by placement of effective shoreline protection structures.

Reach 5

Reach 5 is approximately 25 miles in length and stretches from the mouth of Whitehouse Creek on the Corrotoman River to the mouth of Belmont Creek on the Rappahannock River. Included in this reach is all the shoreline along Ewells Prong, Whitehouse Creek, Wyatt Creek, Beach Creek, and Paynes Creek. Shoreline topography in this reach is detailed below:

Shore Form

64.20%	Low Shore
28.00%	Moderately Low Shore
5.90%	Moderately Low Shore with Bluffs
2.20%	Low Shore with Bluffs



REACH 4
Lancaster Co., VA

Corrotoman River

85.8 Shoreline Miles

Shoreline

Moderate Erosion

Severe Erosion

N

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Office

June, 1995

Shoreline Type	
72.80%	Fringe Marsh
14.80%	Embayed Marsh
6.40%*	Artificially Stabilized
6.00%	Beach

* This is a 1978 figure which has probably doubled in the last 15 years.

Almost 65% of Reach 5 shoreline is low-lying, making the reach prone to flooding from coastal storms. One area of particular concern is the shoreline around Beach Creek. Most of the beach quality in the reach is considered poor with the exception of some good quality beaches found along Beach Creek. Erosion rates in reach 5 ranges from slight or no change to moderate. The moderately eroding shoreline is found from the southern mouth of Whitehouse Creek to Towles Point, and along the Rappahannock River from Towles Point to Belmont Creek. Lastly, there is slight, or no erosion along the creek shorelines in this reach.

6. Reach 6

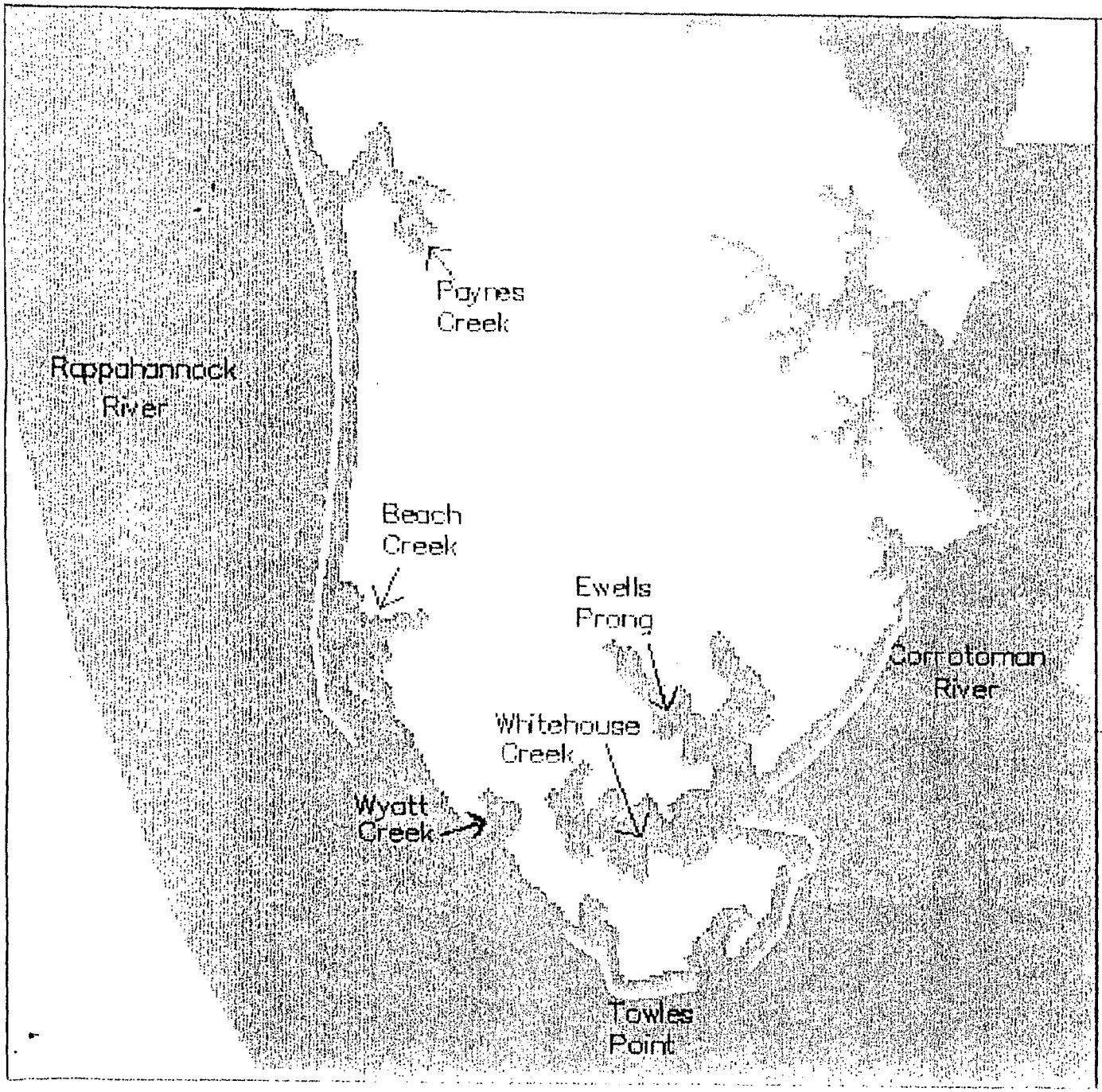
Reach 6 is approximately 14 miles long and runs from Belmont Creek to Deep Creek. This reach includes shoreline along the Rappahannock River, Belmont Creek, Greenvale Creek, and Midway Creek. Shoreline topography in this reach is presented below:

Shore Form	
49.20%	Moderately Low Shore
40.68%	Low Shore
5.08%	Moderately Low Shore with Bluffs
2.82%	Filled Fastland
2.26%	Low Shore with Bluffs

Shoreline Type	
55.00%	Fringe Marsh
16.43%*	Artificially Stabilized
15.00%	Beach
13.57%	Embayed Marsh

* This is a 1978 figure which has probably doubled in the last 15 years.

Flood hazards along Reach 6 range from low to moderate. The shoreline from Belmont Creek to Midway Creek has elevations above 5 feet and is not in danger of flooding. However, the shoreline from Midway Creek to Deep Creek is moderately at risk to flooding from coastal storms due to the many structures built very close to the shoreline. Beach quality in Reach 6 is generally considered poor. Erosion rates in Reach 6 vary from slight or none to moderate. The



REACH 5
Lancaster Co., VA

Northern Mouth of Whitehouse Creek to Belmont Creek

25 Shoreline Miles

Shoreline

Moderate Erosion

N

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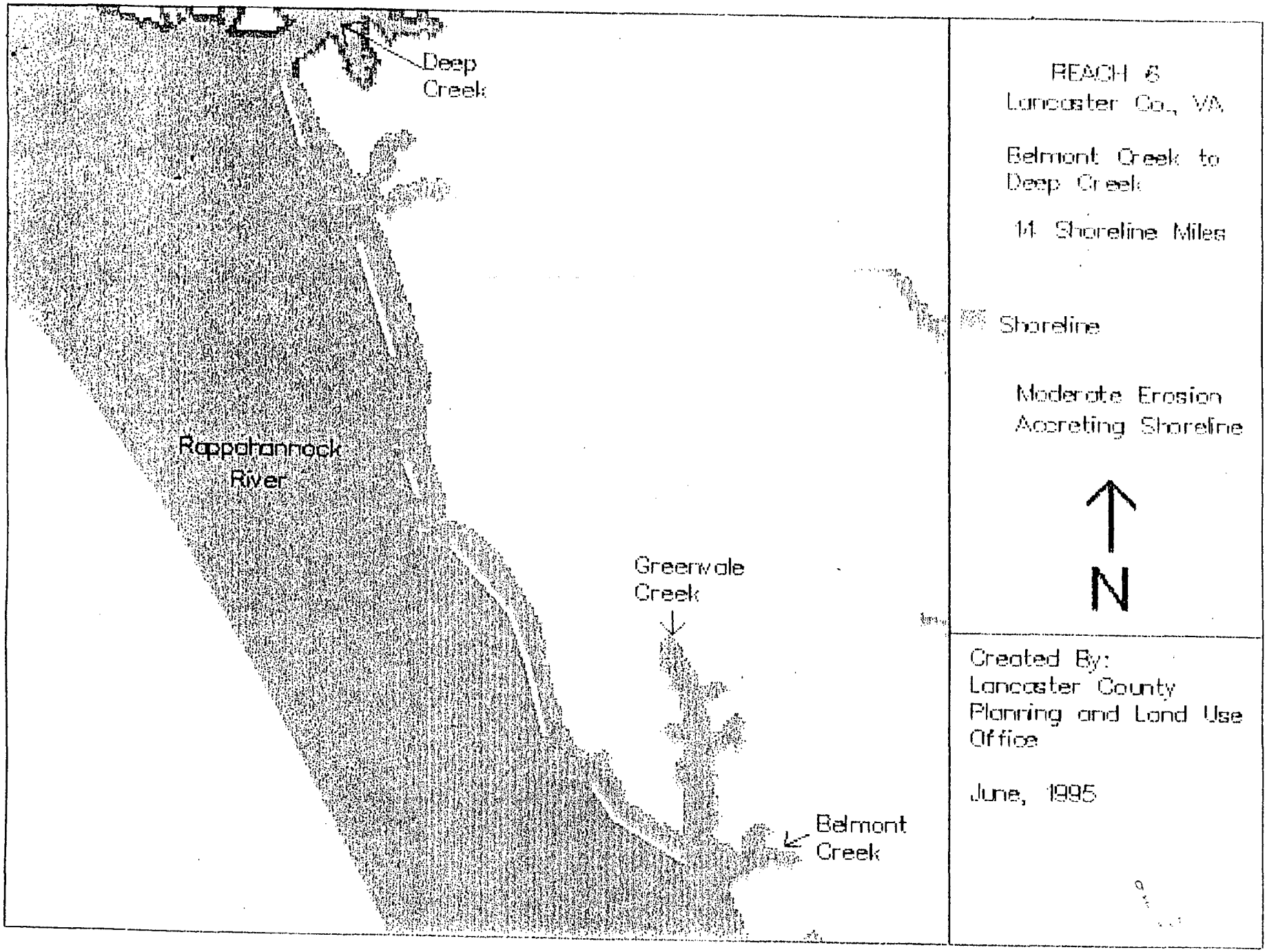
Lancaster County Planning and Land Use Office

June, 1995


Deep Creek
Rappahannock River
Greenvale Creek
Belmont Creek
REACH 8
Lancaster Co., VA
Belmont Creek to Deep Creek
11 Shoreline Miles
Shoreline
Moderate Erosion
Accreting Shoreline
N
Created By:
Lancaster County
Planning and Land Use
Office
June, 1995

Rappahannock River from Greenvale Creek to Midway Creek has an erosion rate of 1.4 feet/year to 1.7 feet/year. However, there are some minor areas of accretion in this same section. Additional erosion occurs along the Rappahannock River from Midway Creek to Deep Creek at a rate of 1.3 to 2.9 feet/year. The exceptions in this section are accreting areas at the mouth of Deep Creek and near Midway Creek.

7. Reach 7

Reach 7 is approximately 28.7 miles long and extends from Deep Creek to the headwaters of Lancaster Creek. Included in this reach is Deep Creek, Belle Isle, Mulberry Creek, Morattico, and the Lancaster County side of Lancaster Creek. The shoreline topography in this reach is detailed below:

Shore Form

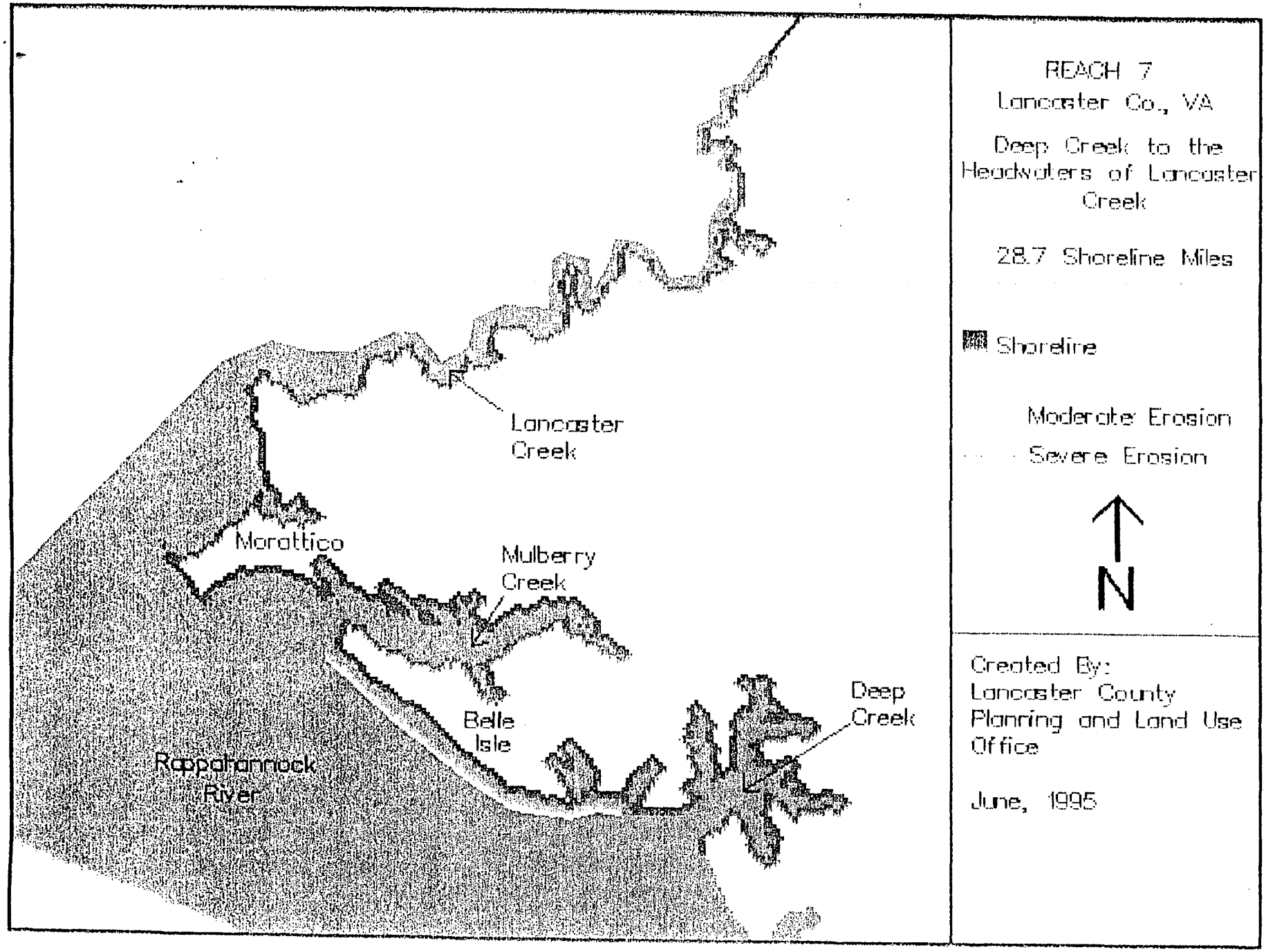
74.22%	Low Shore
25.47%	Moderately Low Shore

Shoreline Type

58.54%	Fringe Marsh
26.13%	Embayed Marsh
9.41%	Extensive Marsh
3.83%*	Artificially Stabilized
1.50%	Beach

* This is a 1978 figure which has probably doubled in the last 15 years.

Flood hazards in this reach are high for areas around Belle Isle and Morattico, but are low for Lancaster Creek. Beach quality in Reach 7 ranges from poor to fair. The fair beaches are located around the mouth of Mulberry Creek. Erosion rates for Reach 7 are slight or none along the creek shorelines, moderate along the Rappahannock River side of Belle Isle (2.5 feet/year), and Severe near Morattico (3.1 to 4.4 feet/year). However, much of the Morattico shoreline has been stabilized with shoreline protection structures.


REACH 7
Lancaster Co., VA
Deep Creek to the Headwaters of Lancaster Creek
28.7 Shoreline Miles
Shoreline
Moderate Erosion
Severe Erosion
N
Lancaster Creek
Morattico
Mulberry Creek
Belle Isle
Deep Creek
Rappahannock River
Created By:
Lancaster County Planning and Land Use Office
June, 1995

II. Assessment of Existing Conditions

Lancaster County is fortunate to have a large amount of tidal shoreline and related natural resources. As this shoreline area becomes more developed, proper management of this resource will be required to preserve its attractive qualities. The first part in the management process comes through recognizing the natural dynamics that shape the County's shoreline. The second part in this process involves understanding how man's actions can positively or negatively impact these resources. Lastly, proper management requires balancing the natural shoreline processes with man's interaction in order to reach the goal of a protected, but enhanced environment.

Several areas of Lancaster County have historically experienced severe shoreline erosion including areas along Fleets Island, Fleets Bay, Morattico, and the Main Branch of the Corrotoman River. Also several areas of the County have historically been impacted by moderate shoreline erosion including, much of the shoreline along Rappahannock River and the Main Branch of the Corrotoman River. There are many reasons for this shoreline erosion including the fetch and energy of the particular waterbody, the topography and condition of the existing shoreline, the previous alteration of the shoreline, and wakes caused by boats.

As more of Lancaster County's waterfront has become developed, there has been an increase in the amount of altered shoreline in the County. The 1978 Virginia Institute of Marine Science Shoreline Situation Report for Lancaster County found that 5% or 73,920 linear feet (14 miles) of the County's shoreline had been altered by 1978. The 1994 Northern Neck Planning District Commission Shoreline Inventory provides a contrast by showing that over 10.8% or 151,620 linear feet (28.72 miles) of the County's shoreline had been altered by 1993. Determining the amount of hardened shoreline in Lancaster County is important because altered shoreline can have negative impacts such as the loss of wetlands and beach, the erosion of down-drift properties, the disruption of natural shoreline processes, and the loss of wildlife habitat.

Review of 1994 and 1995 approvals for shoreline protection structures shows that the trend in shoreline alteration is continuing, if not increasing. In 1994, 2.41 miles of rip-rap and bulkhead were approved for construction in Lancaster County. Additionally, through July, 1995 approximately .75 miles of rip-rap and bulkhead had been approved for the year. Evidence supports the conclusion that rip-rap and bulkhead construction is being overwhelmingly used as a shoreline protection measure in Lancaster County, even in cases where vegetative shoreline protection methods would have been more suitable.

Alternative measures for shoreline protection need to be promoted and considered in Lancaster County. For example, vegetative shoreline protection methods, such as fringe marsh establishment, are not being pursued by the large majority of waterfront property owners. This type of shoreline protection provides a natural solution to erosion problems, while also enhancing wildlife habitat and preserving the scenic state of the shoreline. Additionally, when found necessary the use of rip-rap should be encouraged over the construction of bulkheads.

At present, promoting of the use of rip-rap does not seem to be a problem in Lancaster County, where rip-rap is the preferred shoreline protection method. However, in areas of shoreline where there is high energy water the use of porous rip-rap structures should still be promoted. These structures act to absorb wave energy instead of deflecting it back. Rip-rap is possibly a better alternative than bulkhead when considering nearshore sensitive environmental resources such as SAV, and is also better for wetlands and beach areas.

In conclusion, the cumulative impact of shoreline hardening in Lancaster County should be a cause for concern. The result of further alteration of the County's shoreline could be a continued loss of shoreline wildlife habitat, a non-uniform shoreline with spotty and unpredictable patterns of erosion, and an increase in the loss of wetlands and beach areas.

III. Goals and Objectives

Goal 1: **Actively encourage shoreline protection measures which are equal to the erosion potential at a particular site.**

Objective:

Encourage alternative shoreline protection methods such as fringe marsh establishment in shoreline areas with less wave energy, light boat traffic, and small fetches.

Objective:

Discourage use of bulkheads and rip-raps in low energy, lightly traveled water bodies; unless erosion justifies shoreline hardening for protection purposes.

Objective:

Encourage use of revetments instead of bulkheads in high energy shoreline zones, while also assuring that revetment structures are armored adequately enough to provide the intended protection.

Goal 2: **Encourage vegetative enhancement of RPA areas.**

Objective:

Evaluate subdivision proposals as to their existing shoreline condition and upland characteristics in regard to erosion. If necessary, recommend RPA enhancements to offset impacts of proposed development.

Objective:

Encourage individual property owners to maintain and enhance their RPA areas in ways which protect the existing shoreline, improve water quality, and mitigate the impact of their development.

Goal 3: **Encourage coordinated shoreline protection efforts in existing waterfront communities and in new subdivisions.**

Objective:

Propose changes to subdivision ordinances which would encourage submission of a shoreline management plan.

Objective:

Propose changes to the subdivision ordinance which would offer incentives such as density credits to developers who initiate appropriate, coordinated, on-site shoreline protective measures.

Objective:

Encourage waterfront property owners in existing communities to consider multi-parcel shoreline protection strategies before they pursue individual approaches.

Objective:

Utilize the current wetlands workshop series sponsored by the Northern Neck Planning District Commission as a public education tool for Lancaster County. Encourage expansion of workshop audience by actively targeting marketing efforts toward waterfront property owners, and offer a seminar, or series of seminars, about shoreline protection options for Lancaster County property owners.

IV. The Lancaster County Shoreline Protection Plan

A. Shoreline Protection Means Equal Site Situation

It is strongly recommended that Lancaster County actively encourage individual property owners to explore all shoreline protection alternatives and decide upon the protection method most suitable for their shoreline. In Lancaster County there has been a large increase in the utilization of rip-rap, and to a lesser degree bulkheads, for almost all shoreline protection situations. In many cases, alternative protection methods such as fringe marsh establishment would have been more economically and environmentally suitable solutions for shoreline protection, particularly in the many creeks in Lancaster County.

The over-armoring of the shoreline is costly environmentally and economically. First, bulkheads and rip-raps can result in a loss of wetlands and beach areas due to scouring at the base, and wave energy reflected off the body of these structures. Secondly, the hardening of the shoreline can cause downdrift erosion due to the loss of nourishment supplies which have now been cut off through alteration, and because of the possible flanking of these protection structures. Lastly, the property owner loses because they chose an expensive protection means when a alternative, cheaper method would have been sufficient.

Furthermore, it is recommended that in cases where hardening of the shoreline is necessary, that the County encourages methods which have the least impact on the environment. For example, this policy would encourage the use of a properly designed porous revetments such as rip-rap, over impenetrable means such as concrete revetments and bulkheads. Porous revetment structure can act to dissipate the wave's energy as the wave breaks up the structure. Impenetrable structures instead act to deflect wave energy up, down, and back out, which can result in loss of sensitive environmental features in front of the structure.

B. Incentives for Subdivision Wide Shoreline Protection Efforts in Proposed Subdivisions.

It is strongly recommended that Lancaster County proposes changes to the subdivision ordinance which would encourage subdivision wide shoreline protection efforts. One recommended change would be to require submission of a shoreline management plan for new waterfront subdivisions. This requirement would assure that unique on-site characteristics related to shoreline protection would be studied and addressed in a coordinated, subdivision wide manner. This approach would give the County a chance to influence the shoreline protection efforts of a larger area all at one time, before they become the many, separate, individual efforts of property owners in a new subdivision.

The second recommended change to the subdivision ordinance is to offer incentives, such as density credits, to developers who initiate appropriate, coordinated, on-site shoreline protective

measures. The purpose would be to encourage a wide-scale, coordinated approach to shoreline protection while considering the characteristics of a whole site, instead of an individual parcel. This proposed change would benefit both Lancaster County, the developer, and future owners of new subdivision lots.

First, Lancaster County would benefit through more buildable sites in a subdivision, which would add to the residential property tax base. Secondly, the County would further benefit from a more coordinated approach to shoreline protection, which would result in a uniform, attractive shoreline. Third, the developer could profit from additional lot sales gained through density credits. Lastly, new property owners would benefit through the purchasing of a lot in a well planned, desirable neighborhood with protected homesites.

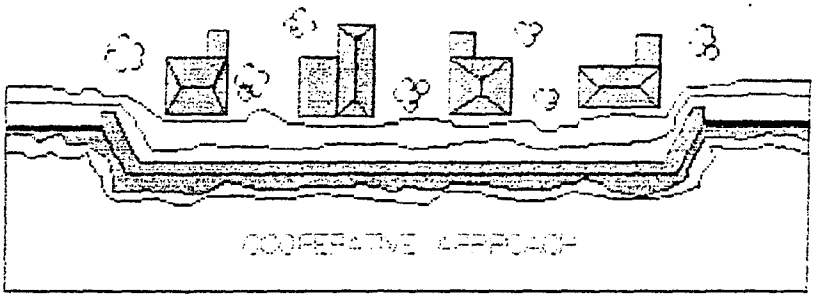
C. Cooperative Approaches to Shoreline Protection (See Graphic)

One of the chief negative impacts of individual shoreline protection efforts is how they can affect neighboring properties. Shoreline alteration at one individual site can result in erosion problems downdrift of the original site. It is strongly recommended that Lancaster County encourage property owners in existing waterfront communities to cooperate in developing neighborhood wide or multi-parcel approaches to shoreline protection.

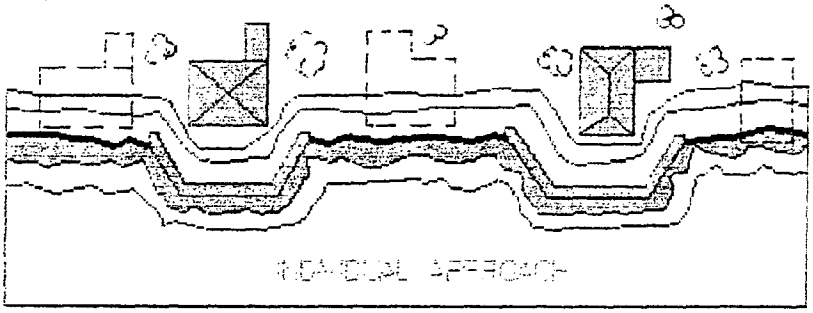
Cooperative protection efforts would benefit both the County and the waterfront property owners. First, the county would gain through the preservation or enhancement of waterfront land values, which in turn support the tax base. Secondly, property owners would benefit by sharing construction costs, while assuring that flanking properties, as well as their own are protected. Often such multi-parcel efforts to thwart localized erosion can be more effective than individualized efforts. The result is that the County is left with a more attractive, uniform shoreline, a constant or increased tax base, and citizens who have saved through shared shoreline protection costs.

D. Encourage Vegetative Alternatives for Shoreline Protection and Vegetative Enhancement of Resource Protection Areas.

Trends in approved permits for shoreline protection structures show a large increase in the actual number of structures and the number of linear feet being altered by property owners. Furthermore, review of shoreline protection structure approvals for 1994 and 1995 show an overwhelmingly large use of rip-rap, and to a lesser degree bulkheads, for shoreline protection (See Wetlands Board Approvals in APPENDIX). In many of these cases vegetative means for shoreline protection would have been viable options, but hardening methods were chosen instead. The cumulative impacts of these approvals are unknown, but include increased loss of wetlands and beach areas, wildlife habitat, and natural shoreline areas. For these reasons Lancaster County should strongly encourage property owners to consider vegetative alternatives for shoreline protection.



Cooperative approach to shoreline protection results in more effective protection against erosion, enhanced safety for personal property, an increased number of desirable building sites, and cost savings due to shared expenses.



Individual approach to shoreline protection results in possible increased erosion risk to neighboring properties due to flanking of the bulkheads, a decrease in the number of desirable building sites, and a disjointed, uneven shoreline.

Source: Low Cost Shore Protection. U.S. Army Corps of Engineers, 1981.

Vegetative methods of shoreline protection could be effectively used in many parts of Lancaster County, including areas along tidal creeks, coves, and other low-energy water bodies with smaller fetches (See Low Energy Water Bodies List on Page 2). Fringe marsh establishment, selective trimming of branches overhanging existing shoreline vegetation, landscaping, and enhancement of existing vegetation are some options available to property owners in applicable shoreline areas. Additionally, vegetative enhancement of Resource Protection Areas could be undertaken by all waterfront property owners. Such efforts could include the planting of vegetative buffer areas or the replenishment and enhancement of existing shoreline vegetation. The benefits are that the property owner can save money through not opting for bulkheads or rip-rap, the shoreline is left in a natural state, and wildlife habitat is enhanced.

E. Support Efforts to Educate Property Owners Concerning Shoreline Protection Issues and Alternatives.

It is recommended that Lancaster County strongly support programs for educating waterfront property owners concerning shoreline protection. The more knowledgeable property owners are of issues and alternatives surrounding shoreline protection, the better prepared they will be to decide upon their shoreline protection methods. Furthermore, the Northern Neck Planning District Commission has a Wetlands Workshop Program already established which offers periodic seminars concerning wetlands topics throughout the Northern Neck. Lancaster County can utilize this existing program as an educational tool for its waterfront property owners. The County can work with the Northern Neck Planning District Commission in designing a workshop specifically for waterfront property owners considering shoreline protection strategies. Supporting this type of educational program in Lancaster County would provide benefit to many.

GLOSSARY OF TERMS

Accretion - The natural building up of sedimentary material along a given segment of shoreline. Areas of accretion are gaining land over time due to natural processes.

Fetch - The unobstructed distance over water in which waves are generated by wind of relatively constant direction and speed.

a. **Narrow**
b. **Moderate**
c. **Wide**
d. **Unlimited**

Littoral Drift - Sedimentary material move along the shoreline under the influence of waves and currents.

Nourishment - The process of replenishing a beach. It may be brought about naturally, by accretion due to the longshore transport, or artificially, by the deposition of dredged materials.

Scour - Removal of underwater material by waves and currents, especially at the base or toe of a shoreline structure.

Shoreforms

a. **Cliffs** - A high, steep face of rock; a precipice.

b. **Bluffs** - A high, steep bank composed of erodible materials.

c. **Marshes** - Areas of soft, wet or periodically submerged land which is generally treeless and usually characterized by grasses and other low vegetation.

d. **Beaches** - The zone of sedimentary material that extends landward from the low water line to the place where there is marked change in material or form, or to the line of permanent vegetation (usually the effective limit of storm waves). The seaward limit of a beach - unless otherwise specified- is the mean low water line. A beach includes the foreshore and backshore.

Source: Low Cost Shore Protection, U.S. Army Corps of Engineers; 1981.

APPENDIX

Summary of 1994
Wetland Board Decisions

Tax Map	Parcel	Description	Length in Feet	Water Body	Date
20	1E	105' of Rip-Rap off of VSH 794	105	Western Branch of the Corrotoman R	12/12/94
31E	1-11	86' of Rip-Rap off of VSH 1051	86	Ewells Prong of Whitehouse Creek	12/12/94
34	94C	108' of Rip-Rap off of VSH 200	108	Currell's Cove of Carter Creek	12/12/94
19C	1-23	145' of Rip-Rap off of VSH 637	145	Jack's Cove of Carter Creek	11/14/94
33	492 "0"	880' of Rip-Rap off of Route 354	880	Rappahannock River	11/14/94
26J	1-28	163' of Rip-Rap off of VSH 730	163	Western Branch of the Corrotoman R	11/14/94
31	37	100' of Rip-Rap off of Route 354	100	Whitehouse Creek	10/13/94
39A	23 & 24	243' of Timber Bulkhead off of VSH 700	243	Rappahannock River	10/13/94
26	18D	90' of Timber Bulkhead off of VSH 610	90	Myer Creek	10/13/94
33	498C	130' of Rip-Rap off of VSH 637	130	Carter Creek	9/12/94
22	44D-1	340' of Rip-Rap off of VSH 699	340	Eastern Branch of the Corrotoman R.	9/12/94
22A	1-16	90' of Rip-Rap off of VSH 785	90	Eastern Branch of the Corrotoman R.	9/12/94
35	72A	205' of Rip-Rap Marsh Toe Protection off of VSH 646		Ashley Cove of Dymer Creek	9/12/94
30	1C	46' of Timber Bulkhead and a 15'x30' B. Ramp off VSH 65	46	Roane's Bay	9/12/94
29	88A	815' of Rip-Rap off of VSH 3	815	Dymer Creek	9/12/94
33	492N	70' of Rip-Rap off of VSH 637	70	Jack's Cove of Carter Creek	9/12/94
22A	1-13	114' of Rip-Rap off of VSH 785	114	Brown's Crk. of E. Branch Corrotomar	9/12/94
5	5B	70' of Rip-Rap off of VSH 718	70	Ivy Creek	8/8/94
22	34	165' of Rip-Rap off of VSH 671	165	Punchies Cove	8/8/94
27C	1-38	343' of Timber Bulkhead off of VSH 768	343	Carter Creek	7/11/94
20B	1-5	100' of Rip-Rap in Heritage Point	100	W. Branch Corrotoman River	7/11/94
31	37	400' of Rip-Rap off of VSH 354	400	Whitehouse Creek	7/11/94
25	117	2-65' Timber Groins off of VSH 765		Rappahannock River	7/11/94
21	35E	220' of Timber Bulkhead off of VSH 604	220	Lowery Creek	7/11/94
19	15C	326' of Rip-Rap off of VSH 737	326	Rappahannock River	7/11/94
21	72B	230' of Rip-Rap off of VSH 611	230	Hills Creek	7/11/94
26	23A	129' of Rip-Rap off of VSH 610	129	Myer Creek	6/13/94
29	53C	95' of Rip-Rap and 1-24' Rip-Rap Groin off of VSH 734	95	Indian Creek	6/13/94
34	14A	110' of Rip-Rap off of VSH 635	110	Sam's Cove of Carter Creek	6/13/94
36	47	160' of Rip-Rap off of VSH 695	160	Big Oyster Creek	6/13/94
27B	2-2	150' of Timber Bulkhead off of VSH 646	150	Dead and Bones Cove of Carter Cree	6/13/94
27	31	500' of Rip-Rap off of VSH 630	500	Moran Creek	6/13/94
29	17D	190' of Rip-Rap off of VSH 651	190	Indian Creek	6/13/94
20G	3-7	200' of Rip-Rap off of VSH 354	200	Greenvale Creek	6/13/94
39	23A	250' of Wooden Bulkhead and 180' of Rip-Rap off of 775	430	Mosquito Creek	5/9/94
25	10A&E	350' of Rip-Rap off of VSH 625 in Paynes Creek Farm	350	Rappahannock River	5/9/94
20D	2-472	77' of Rip-Rap in Corrotoman-By-The-Bay	77	W. Branch Corrotoman River	5/9/94
20	166	2,000 of Rip-Rap off of VSH 611	2000	W. Branch Corrotoman River	5/9/94

26	137	150' of Rip-Rap off of VSH 630	150	Moran Creek	4/11/94
26	16B	161' of Timber Bulkhead with fill and return walls, VSH 610	161	Myer Creek	4/11/94
27	87&87B	1,008' of Rip-Rap off of VSH 630 in Holly Haven Farm	1008	Taylor Creek	3/14/94
25D	1-7	4-24' Low Profile T Groins and Pier off VSH 663, Salt Aire		Rappahannock River	3/14/94
26	34B	550' of Rip-Rap off of VSH 677	550	Myer Creek	2/14/94
33	258	145' of Rip-Rap off of VSH 657	145	Carter Creek	2/14/94
33	249A	3-Finger piers and 4-Mooring Pilings off of VHS 634		Carter Creek	2/14/94
33	197&198	570' of Timber Bulkhead off of VHS 632	570	Carter Creek	2/14/94
32A	2-14	125' of Rip-Rap off of VHS 666	125	Rappahannock River	2/14/94
20B	1-2	65' of Rip-Rap in Heritage Point Subdivision	65	Corrotoman River	2/14/94
34	318	824' of Rip-Rap off of VHS 640 near White Stone	824	Rappahannock River	2/14/94
22	34B	90' of Rip-Rap Marsh Toe Protection off of VHS 671		Punches Cove/E. Branch Corrotoman	1/10/94
27	55D	260' of Rip-Rap off of VHS 694	260	Taylor Creek	1/10/94
			12,748.00	**Feet of Rip-Rap and Bulkhead**	
			or		
			2.41	**Miles of Rip-Rap and Bulkhead**	

Summary of 1995 Year to Date
Wetland Board Decisions

Tax Map	Parcel	Description	Length in Feet	Water Body	Date
31A	1-8	212' of Rip-Rap off VSH 626	212	Rappahannock River	7/10/95
39	44	9x40' Wooden Boat Ramp off VSH 695		Mosquito Creek	7/10/95
36	47A	155' Concrete Revetment, 10x32' B. Rmp off VSH 695	155	Windmill Point Creek	7/10/95
25D	1-2	3-48' Low Profile Timber Groins off VSH 663		Rappahannock River	7/10/95
25D	1-4	3-48' Low Profile Timber Groins off VSH 663		Rappahannock River	7/10/95
33	320	180' of Rip-Rap and 40' of marsh toe pro. off VSH 719	180	Carters Creek	7/10/95
34F	1-3	202' of Rip-Rap off of VSH 636	202	Carters Creek	6/12/95
34	9	225' of Timber Bulkhead offf Old Mill Cove Road	225	E. Branch Carters Creek	6/12/95
31	2	Dredging of Beach Creek Inlet		Beach Creek	6/12/95
22D	1-36	Additional 25' of Rip-Rap off of VSH 613	25	Corrotoman River	6/12/95
11	2L & 2K	402' of Rip-Rap and 152' of Breakwaters off VSH 622	402	Rappahannock River/Lancaster Creek	5/8/95
25D	1-1	48' Timber Groin and 25' of Rip-Rap off of VSH 663	25	Rappahannock River	5/8/95
40C	1-11	135' of Rip-Rap and 120' of Breakwater off of VSH 695	135	Rappahannock River	5/8/95
19	15B	4-48' Timber Groins off of VSH 737		Rappahannock River	5/8/95
26	102P	145' of Rip-Rap, 130' of marsh toe pro. off of VSH 655	145	Town Creek	5/8/95
35	243	75' off Rip-Rap off of VSH 695	75	Harpers Cove/Antipoison Creek	4/10/95
29	74C	320' of Rip-Rap off of VSH 795	320	Dymer Creek	4/10/95
26	5B	168' of Rip-Rap off of VSH 610	168	Corrotoman River	4/10/95
29	74G	202' of Rip-Rap off of VSH 795	202	Simmons Cove/Dymer Creek	4/10/95
35	108K	250' of Rip-Rap off of VSH 643	250	Tabbs Creek	3/13/95
34	211A	52' Timber Groin off of Rt. 3		Rappahannock River	3/13/95
31	36A	69' of Rip-Rap off of VSH 354	69	Whitehouse Creek	3/13/95
26	32G	265' of Rip-Rap off of VSH 609	265	Myer Creek	3/13/95
21	44C	63' of Bulkhead off of VSH 604	63	John Creek/W. Br. Corrotoman River	3/13/95
31E	1-17	200' of Rip-Rap off of 354	200	Ewells Prong of Whitehouse Creek	2/13/95
26	14G	68' of Rip-Rap off of VSH 730	68	Myer Creek	2/13/95
27A	1-1	200' of Timber Bulkhead off of VSH 728	200	N.Eastern Prong of Taylor Creek	2/13/95
27B	1-1	303' of Rip-Rap off of VSH 737	303	Carters Creek	1/19/95
			3889		
			or		
			0.736553	Miles of Rip-Rap and Bulkhead	

Summary of Permits Approved
3,401' or .644 Miles of Rip-Rap
488' or .09 miles of Bulkhead
2 Boat Ramps
12 Groins
272' of Breakwater
170 ' of Marsh Toe Protection

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