“Living Shorelines”
An Historical Perspective from Chesapeake Bay

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“Living Shorelines”

1970s Referred to as marsh fringe creation

1980s Non-structural approach, MD grant & 1990s program and VA VEC project

1981 to VA Shoreline Erosion Advisory 1987 Service SEAS

Recent moniker: Living Shorelines (2006 by David Burke former head of MD Non-structural program)

Common goal: to apply marsh fringe and/or beach establishment to shore erosion control vs. hardening the coast.
Shoreline Erosion
SCS: Vegetation for Tidal Shoreline Stabilization

Before Vegetative Treatment

Immediately After Vegetation Treatment

Anticipated Results From Vegetative Treatment
## Early Research on Marsh Fringe Creation

<table>
<thead>
<tr>
<th>Decade</th>
<th>Project Details</th>
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| 1970s  | Knutson and Woodhouse, USCOE reports on marsh creation and wave studies  
Broome and Seneca, NC coastal marshes  
Ed Garbisch, MD  
SCS Cape May Plant Materials Center |
| 1980s  | Vegetative Erosion Control Project, VA  
VIMS and DCR (SEAS) |

*Same result: a fetch limited application*
Primary Limiting Parameters

- Fetch
- Shoreline orientation
- Shore geometry
- Nearshore bathymetry
- Boat wakes
- Sunlight (often over looked)
**Ecosystem Services: Marshes**

### Importance and Features

- **Salt marshes** provide important nursery habitat for crabs and fishes.
- **Salt marshes** act as a nutrient filter and are the site of nutrient cycle.
- **Salt marshes** support high primary production.
- **Seagrasses** may or may not occur adjacent to marshes.
- **Kelp and their associated organisms** may occur offshore of salt marshes.

### Icon Key

- **Native marsh grass**
- **Birds and waterfowl**
- **Kelp**
- **Sea otter**
- **Kelp associated fauna**
Six typical shoreline profiles around Chesapeake Bay. The stability of the bank face is dependent upon the width and type of shore zone features. Wide beaches/dunes and marsh zones can offer significant wave protection even during storms.
Stable Bank

Transitional Bank

Erosional Bank
Hard Shore Protection Strategies

Bulkheads
Hard Shore Protection Strategies

Revetments
Vegetative Erosion Control Project
VIMS and SEAS (DCR) 1981-1987

1. Mountjoy
2. Camp Chanco
3. Windmill Point
4. Lee
5. Gill
6. Hickman
7. Tankard
8. Wellford
9. Durham South
10. Durham West
11. Garrett
12. Murphy
13. Poole
14. York River State Park
15. Eley
16. Broad Bay Mano
17. Mariners Museum
18. King
19. Marshall
20. Johnsen
21. Vanderslice
22. Collier
23. Davis
24. Hog Island
Occahannock Creek VEC Site

Marsh planting along Occahannock Creek, Northampton County, Virginia.

Occahannock Creek marsh plantings after 1 year.

Occahannock Creek marsh planting after 10 years of growth.
Minor bank grading and temporary toe protection utilizing straw bales was used to protect the planted marsh fringe.

Since high water impinged upon the base of the bank, only the intertidal species (*Spartina alterniflora*) was utilized.

After one year.

After six years.
Poole VEC Site

24 years after construction
Lee VEC Site

25 years after construction
VEC Project

- 24 sites planted in a variety of shore settings on existing substrate

- Success dependent of 1) fetch 2) shore geomorphology and 3) shore orientation

- Fetch:
  - <1.0 nm, high probability of success;
  - 1-5 nm, low probability, even with maintenance,
  - >5 nm, no probability of success.

- South facing shoreline have better chance.
Management Strategies

This cross-section shows a proposed plan to stabilize a typical eroding shoreline using clean sand to create the appropriate planting area.
Maryland Non-Structural Program

- Over 300 sites installed through grant program
- Program is still active.

RC&D: Dave Wilson and Jerry Walls
Maryland DNR: Lin Casanova, Dave Burke, Jordan Loran, Chris Zabawa, Kevin Smith
Current personnel: Kevin Smith, Tom Brower, Bhaskar Subramanian
Pre-project shoreline on Wye Island, Kent County, Maryland.

Marsh grass plantings with sand fill and short, stone groins

3 months after installation

4 years after construction.
21 years after construction
Loss of fill and shading by previously cut trees caused reduction in marsh fringe.
Wye Island

28 years after construction
Wye Island North-facing Shore

21 years after construction
No marsh; too much shade?
Who’s been gnawing here?
Jefferson Patterson Park & Museum

October 1986
Pre-project

December 1988
Jefferson Patterson Sill

16 years after construction
An integrated water quality model

Positive = diverse habitat opportunities and improved water quality

Negative = few habitat opportunities and reduced water quality

Symbols courtesy of the Integration and Application Network (ian.umces.edu/symbols/), University of Maryland Center for Environmental Studies.
Elevations & planting widths will vary depending on site conditions. Extent of channelward encroachment depends on extent of landward design.
Typical Cross-sections for Living Shorelines

**Low Sill/Low Bank**

Existing Conditions:
- Bank Face is Erosional
- Base of Bank is Erosional
- Existing marsh <5 ft

**Low Sill/High Bank**

Existing Conditions:
- Bank Face is Stable
- Base of Bank is Erosional
- Existing Marsh Width <5 ft
- Fetch <2,000 ft

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Existing Bottom:
- Minimal Fill
- Full Fill
- 2 ft
- +1.0 to +2.0 ft

Existing Marsh:
- <5 ft

M L W:
- +1.0 MHW
- +4.0 (10 yr)
- +5.5 ft (50 yr)
Typical Cross-sections for Living Shorelines

**Medium Sill/High Bank**
- Bank Face is Transitional
- Base of Bank is Erosional
- Existing Marsh Width 5-10 ft, <5 ft or none
- Fetch <4,000 ft

**High Sill/High Bank**
- Bank Face is Erosional
- Base of Bank is Erosional
- Existing Marsh Width 5-10 ft, <5 ft or none
- Fetch <8,000 ft
Webster Field Annex, Maryland
Sand fill with stone sills and marsh

before installation

after installation but before planting

after four years

the cross-section used for construction.

Existing Ground

Proposed sill

+2.5 ft

Proposed sand fill

+0.8 ft

Armor stone

Core stone

Filter fabric

Spartina patens

S. alterniflora

Remove existing broken conc.

Above +3

Replace with sand

19 Jun 2007

19 Jun 2007

Plant

Plant

Webster Field Annex, Maryland
Sand fill with stone sills and marsh

before installation

after installation but before planting

after four years

the cross-section used for construction.

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19 Jun 2007
The sill at St. Mary’s City at low tide depicting two of the access pathways including the sill windows and macro-pores in the sill.

(from Hardaway et al., 2008)
Photos showing a window in the Historic St. Mary’s City sill post construction in 2002 and in 2006. The window 9 has a stone revetment along the backshore shown in the planform and cross-sectional design.

(From Hardaway et al., 2008)
Marsh Fringe Applications

1) Plant existing substrate, provide sun.

2) Add sand fill with minimal containment structures such as stone groins, coir logs, etc.)

3) Use stone sills, add sand and plant new marsh.

Define “Level of Protection”
10 year, 25 year???
Marsh Fringe Applications

Bank Grading

Backshore Wedge Without Bank Grading

Sand Fill

Slope 10:1

Existing Bottom

10 yr storm surge

MHW

MLW

Virginia Institute of Marine Science

William & Mary
Mathews County, Virginia

Sill with marsh and pocket beach.
Mathews County, Virginia

Aerial view of entire project which included sills, pocket beach, and revetment to stabilize spit with historic mill.
Ecosystem Services: Beaches

**Importance and Features**

- **Beaches provide habitat for invertebrates, crustaceans and birds.**
  - Microalgae on the sand are important primary producers.

- **Turtles lay their eggs on sandy beaches.**
  - Extensive nutrient cycling takes place on sandy beaches.

**Icon Key**

- molluscs
- worms
- phytoplankton
- turtle
- shrimp
- wading birds
- crabs
- sand

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**VIMS**

Virginia Institute of Marine Science
Beaches

• Naturally occurring beaches can provide shore protection if wide and high enough.

• Beach nourishment is a method used to maintain a protective beach.

• In Chesapeake Bay, ongoing beach nourishment projects are usually done in conjunction with some type of securing structure such as groins or breakwaters.

• The use of breakwaters on private property began in 1985.
First Chesapeake Bay Breakwater Project

Installed 1985

Drummond Field; James River
June 2005
Drummond Field performance

2002

2007

2009
Headland Breakwater Systems
Assisted Living Shorelines

Luter, Isle of Wright; James River
May 2004
Luter, Isle of Wright; James River
January 2010
Chesapeake Bay
Headland
Breakwater Sites

2005
Maximum Bay Indentation : Gap Width
Mb:Gb
1:1.65

Crest Length : Gap Width
Lb:Gb
1:1.4
Kingsmill, James River, Virginia

Pre Isabel
21 Aug 2003

Post Isabel
16 Oct 2003

Minor scarping of the bank and a loss of vegetation were the major impacts to this site.
City of Hampton
Factory Point

May 2012
VIMS, Gloucester Point, Virginia

Locally-owned Public Beach

VIMS, West Shore

VIMS, East Shore
Tropical Storm Ernesto, September 1, 2006
VIMS West Shore

During Construction
After Construction

Jan 2012

VIMS West Shore
Summary: Marshes

- As fetch exposure increases so does the marsh width and elevation needed to attenuate wave action.

- At some point (> 0.5 nm fetch) a sill may be needed for long term marsh fringe stabilization.

- Marshes can provide long term protection if properly maintained.

- A large data base of marsh sites exists around the Bay along with various brochures and reports to support the Living Shoreline concept.

- This historical site data allows us to proclaim that shore erosion control can be achieved by creating Living Shorelines (i.e. marsh fringes).

Beaches are generally more suitable for greater fetch exposures > 1 nm.

In Chesapeake Bay, maintaining a stable, wide protective beach requires:
- some type of breakwater (s),
- ongoing beach nourishment
- or some combination.
Dalton Point, New York
Dalton Point, New York
1. SURVEY PERFORMED ON 11/29/05 USING CLOSED LOOP, LOCAL HORIZONTAL CONTROL, VERTICAL CONTROL BASED ON WATER LEVEL AND TIME OF TIDE AT LINDENHERST TIDE GAUGE APPROX. 2 MILES WEST OF SITE.

2. MEAN TIDE RANGE IS +1.2 FEET, DATUM IS MLW=0.0'.

3. BEACH NOURISHMENT SHALL BE COARSE SAND.

4. WETLAND GRASSES SHALL BE PLANTED ON 1.5 x 15 FOOT CENTERS.

5. ALL PROPOSED STRUCTURES SHALL BE GRANITE STONE.
Dalton Point, New York

TYPICAL SILL
A-A 1"=10'

TYPICAL REVETMENT
E-E 1"=10'

TYPICAL BREAKWATER
B-B 1"=10'

TYPICAL POCKET BEACH
C-C 1"=10'

TYPICAL SPUR/BREAKWATER
D-D 1"=10'

Scale: 1"=20'  Sheet: 3 of 3

COASTLINE DESIGN, P.C.
St. Mary's City Cobble in window to reduce scour

November 2006
St. Mary's Sill
Small granite revetment in window

November 2006