Living Shorelines
for Property Owners and Decision Makers

Karen A. Duhring
Marine Advisory Scientist
Center for Coastal Resources Management
Virginia Institute of Marine Science
College of William & Mary

April 10, 2010

Living Shorelines
for Property Owners and Decision Makers
Part 2

- Ecosystem Services of Tidal Shorelines
- Why More Living Shorelines Are Needed
- Erosion Types
- How to Choose Best Design Option(s)
- **Living Shoreline Methods**
- **Construction and Maintenance**
- **Permit Process**

- Field Site Visit

Non-Structural Living Shoreline Methods

Bank Grading & Landscape Restoration

Planted Tidal Marshes

Fiber Logs

Bank Grading & Landscape Restoration

Bank Grading

- **Before grading, waves striking the bank toe would cause bank collapse from top to toe**

- **After grading, there is an elevation gradient for wave "run-up" and dissipation of wave energy**

Bank grading is appropriate when...

the bank condition is not providing erosion or water quality protection

- Unstable high banks with large, undercut trees
- Partially cleared or compromised forest buffers adjacent to wide or narrow marshes
- Construction access needed for necessary erosion protection structures

Examples Where Bank Grading May Be Appropriate

Sandy high bank with wide beach and lawn

No improvements close to shoreline

Short life expectancy for old trees with exposed roots
requires professional opinion

Bank grading may <u>not</u> be appropriate when...

the existing bank condition provides desirable ecosystem services

- Stable banks with no active erosion
- Undercut banks with stable forest above
- Low banks with active erosion but also mature riparian forest
- Erosion caused mostly by upland runoff that can be reduced in the upland

Bank grading may not be appropriate when...

there are human conflicts

- Buildings, utilities, accessory structures limit access or extent of grading
- Adjacent properties may be adversely affected
- Sentimental or historic trees are present
- Cultural resources would be disturbed

Examples Where Bank Grading May Not Be Appropriate

Historic Tree at Hull Springs Farm

2nd largest red oak

Existing buildings near top of bank

Landscape Restoration of Graded Banks

- Restore a vegetation buffer that intercepts runoff and stabilizes bank face
- Native shoreline plants are best suited to local soil, salt and wind conditions
- Non-native plants should be adapted to similar conditions
- Landscape design should comply with Chesapeake Bay Preservation Act requirements
- May require temporary irrigation until plants are established

Examples of Planting on Graded Banks

Low shrubs and ornamental grasses on graded bank above revetment

Various shrubs on graded bank required by Chesapeake Bay Preservation Act landscape agreement

Examples of Planting on Graded Banks

Various ornamental grasses in winter on graded bank

Ornamental grasses and daylilies in early spring on graded bank above bulkhead

Stark contrast to graded lawns on both adjacent parcels

Planted Tidal Marshes

Planted Tidal Marshes

Volunteers at Hull Springs Farm 2006

- Enhancing or creating suitable conditions for tidal marsh plants
- May require grading the bank and/or filling into the water
- Narrow marsh provides habitat value, wide marsh >15 ft provides wave reduction

How wide should the marsh be?

- The answer depends on the energy regime in your area—the bigger the waves, the wider the marsh
- Usually aim for a minimum of 15 feet
- Minimum target slope is 10:1 for drainage, 6:1 in high marsh acceptable
- You may need to grade the bank to widen the intertidal zone

Typical Grass Species Used for Brackish Marsh

Low Marsh

Saltmarsh cord grass
Spartina alterniflora

High Marsh

Saltmeadow hay
Spartina patens

Salt grass
Distichlis spicata

Switch grass
Panicum virgatum

More species possible for low salinity or fresh water, select those that remain above ground during winter e.g. *Spartina cynosuroides, Juncus effusus*

Salt Bushes
planted at landward side of high marsh

Groundsel Bush
Baccharis halimifolia

Marsh Elder
Iva frutescens

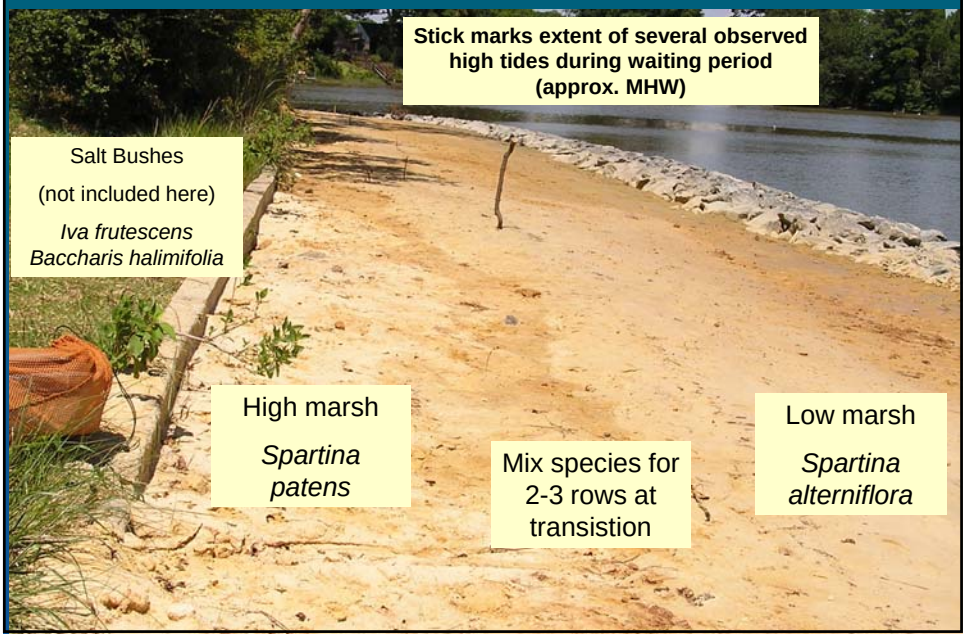
Not as flood tolerant, use at upland edge

Wax myrtle / Bayberry
Morella cerifera
M. pennsylvanica

Nursery Stock

Tidal marsh grasses grown in nurseries are irrigated with fresh water. The nursery must know what the local salinity is at the planting site ahead of time to gradually "harden" the plants before they are introduced.

Fringe Marsh Planting Zones



Plant Spacing & Growth Pattern

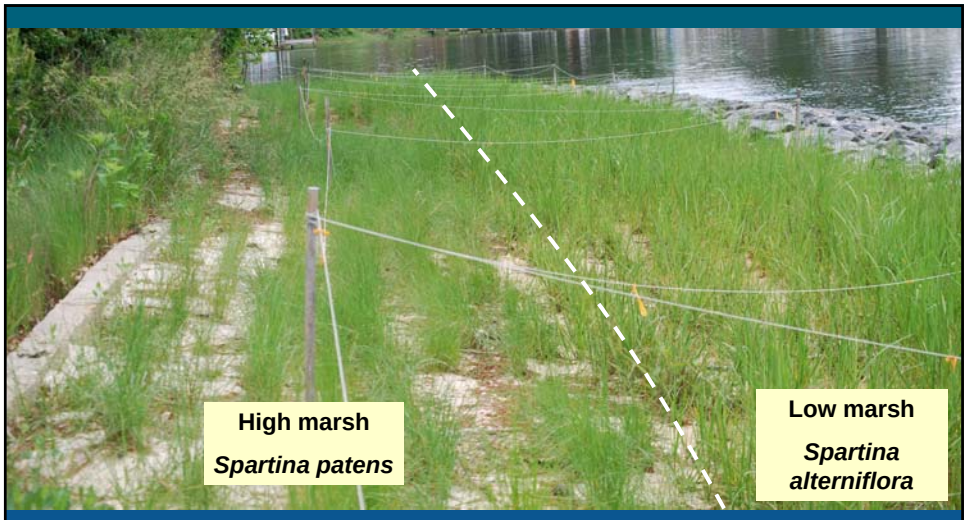
Plants spaced 18-24 inches apart

Closer spacing for more rapid cover

Increase spacing to cover large area with limited budget

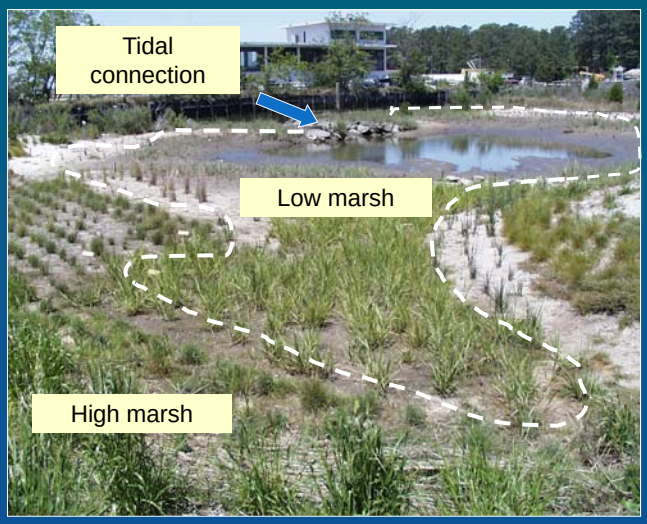
Marsh grasses will spread underground by rhizomes

Eventually space between plants will fill in naturally



Planted marsh must be sloped so it is completely exposed at low tide; plant failure may be caused by standing water

Embayed or "Pocket" Marsh



More complex planting zones

Upland excavation areas

VIMS Teaching Marsh Gloucester Pt, VA

Planted Freshwater Marsh

Photo Courtesy NC Coastal Federation

Grazing Exclusion Devices

Mute Swans & Canada Geese can pull new plants out of the ground, but not established well-rooted plants; exclusion device can be removed after 1 growing season

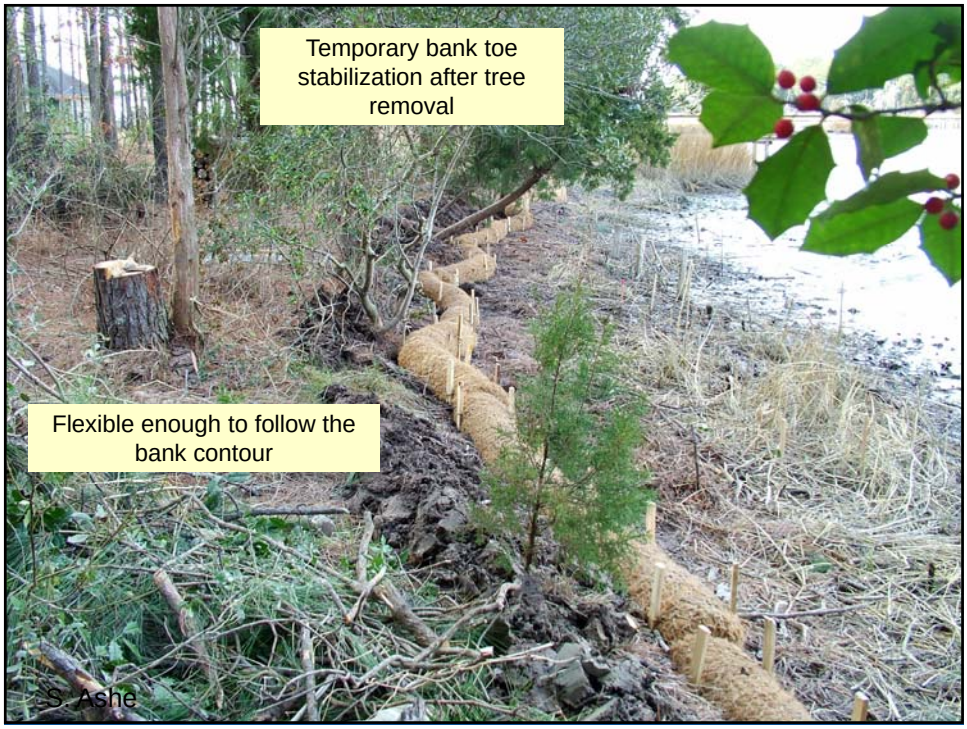
Planted marsh vegetation may not be effective when…

1. There is heavy wave activity
2. There are heavy boat wakes
3. The water depth increases quickly close to shore
4. There are historically high erosion rates
5. There are highly erodible soils
6. There are anaerobic (low oxygen) soils

Fiber Logs

Coir or Fiber Logs

- Manufactured biodegradable logs act as medium for plant propagation
- Slope stability increases with growth of fibrous root systems
- Decay within 5 yrs in marine environment
- Approximate cost $61 per running foot (in 1999 dollars)



Fiber log before sand fill & plants to repair storm erosion of natural marsh

Opposite stakes should be tied together across top of log

Fiber Logs

Sand fill contained by fiber logs with planted marsh

Will the planted marsh remain after the fiber logs decay?

Holly Point Nature Park, Deltaville by Middlesex Chapter Master Gardeners

Fiber Logs

Not effective as wave break where there is wide fetch or boat wakes

Marsh planting at grade, fiber logs near mean low water elevation

1 year later
The planted marsh was fine

Fiber Logs

May not be effective wedged into shady undercut banks

Hybrid Methods

strategically placed structures to enhance or create vegetation buffers

Marsh Sills
Oyster Reefs
Breakwaters with Beach Nourishment

Marsh Sills

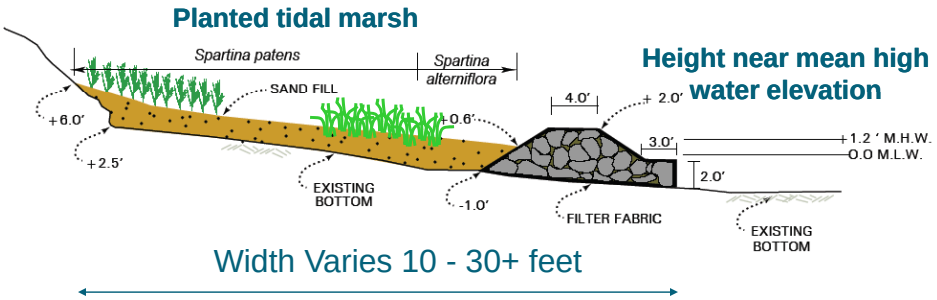
Marsh Sill

Hull Springs Farm

Marsh sill (foreground) compared to natural marsh (background) not wide enough to prevent bank erosion

- Low profile revetment backfilled with sand to create or enhance tidal marsh
- Import sediment from upland source or use suitable bank grading material

"Typical" Sill Cross-Section



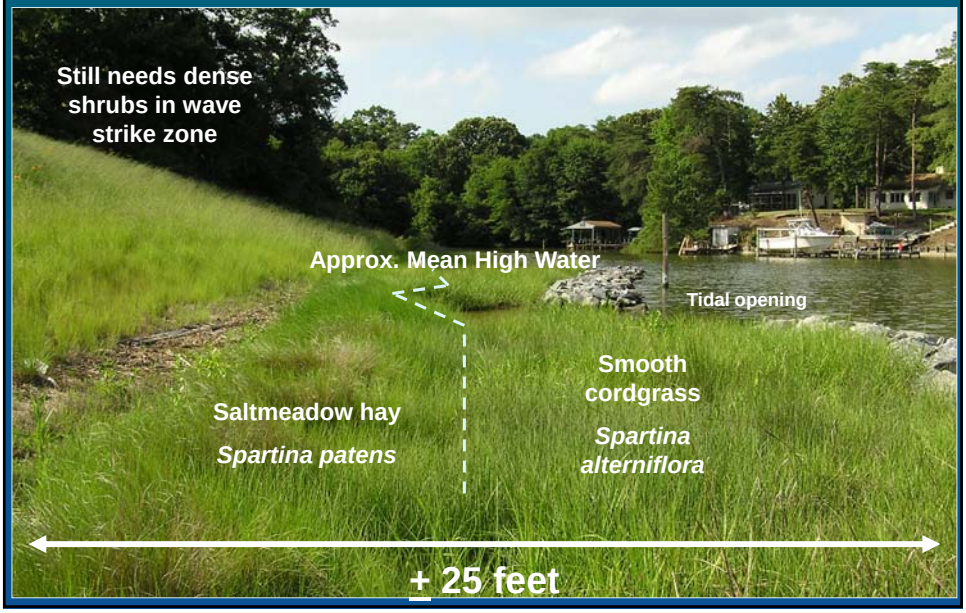
Distance offshore depends on bank height and condition

Stone size and base width depend on location

Graphic: Jefferson Patterson Park project, Maryland

Marsh Sill at VIMS since 1983
replaced old bulkhead

Bank Grading + Planted Tidal Marsh + Sills



Tidal Openings

Straight gaps can be problematic, shoaling just inside the gap may restrict tidal exchange, contrary to the gap's purpose.

Straight

Offset gaps have proven to be more effective.

Offset

Marsh Sill Design at Hull Springs Farm

- High Bank unstable, no bank grading
- Variable sill height
- Marsh width ± 20 ft with high and low marsh
- Sand fill height ± 2 ft, upland sand source
- 3 kinds of tidal openings

Longwood University's Hull Springs Farm
Westmoreland County
2005
Before

View looking south

Construction Access

Access "ramp" for heavy equipment to haul in sand and stone

Filter Cloth
Must Be Placed Under Stone

Filter cloth distributes weight of stone, limits settling and lowering of sill height, contributes to structural integrity, helps contain sand fill

Sill Construction – North Section

Sand fill needed first at north section to support excavator

Sill Construction – South Section

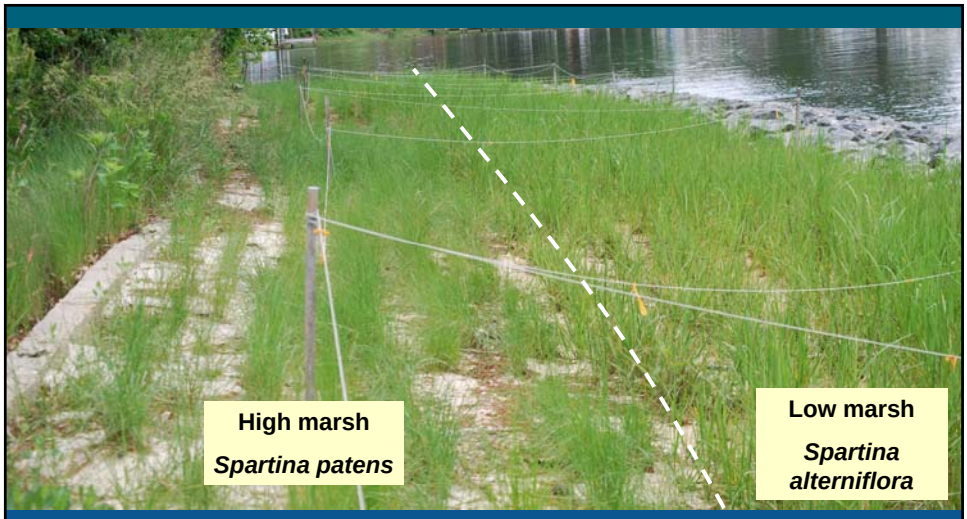
Experienced contractors provide close oversight during construction

Cobblestone Tidal Opening

New tidal opening design prevents shoaling and interruption of tidal inundation

Tidal Marsh Planting

After a 1 month waiting period for the sand fill to settle, volunteers planted 2 kinds of tidal marsh grasses



Planted marsh after 1 growing season
Plants spread naturally into bare areas

Nor'easter Storm Protection ?

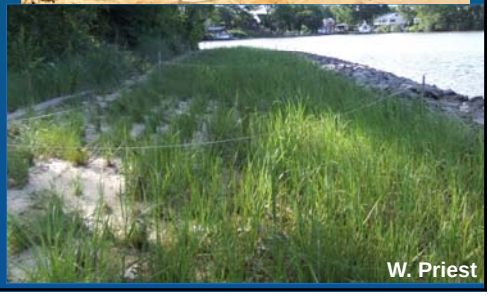
During a severe storm, the wave height reaching the upland bank is reduced by the "roughness" of the sill and planted marsh

After 1 growing season

Longwood University's Hull Springs Farm
Westmoreland County

View looking south

View looking north



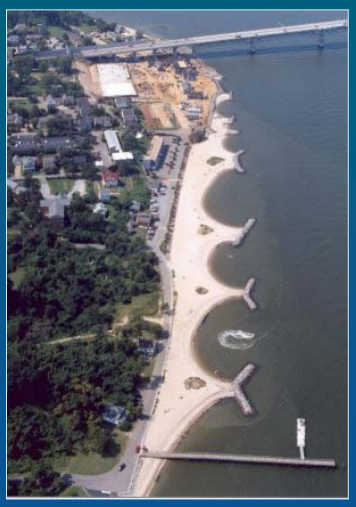
Oyster Reefs

- Habitat for native oyster restoration
- Not always effective for wave reduction
- Monitoring & research underway by VIMS, CBF, TOGA, et al.

VIMS

Breakwaters with Beach Nourishment

Offshore Breakwater System



Yorktown, VA

- A series of revetments positioned offshore to refract waves producing a scalloped but stable shoreline
- Used for high energy beaches
- Requires large volume of beach nourishment

Headland Breakwaters

Original shoreline erosion rate -10 ft/yr

New beach more stable after reaching equilibrium

This approach controls existing points of land (i.e. headlands) or strategically creates new points of land with stone breakwaters and **lets the land between erode** into a predicted embayed shape.

Cautionary Statement

- Designing breakwaters properly is an engineering task
- Improperly designed breakwaters may not work and may have adverse effects on adjacent shorelines or navigation channels
- Therefore, breakwater design is best left to the experts!

VIMS

Construction and Maintenance

Basic Construction Sequence

1. Clear site of debris and unstable trees
2. Remove derelict structures and dispose properly
3. Stage materials out of sensitive areas
4. Install construction mats where needed
5. Install sand containment structures then backfill
6. Waiting period for settling before planting to verify tide levels
7. Temporary erosion and sediment control measures until vegetation cover is restored
8. Planting according to recommended schedules
9. Grazing exclusion devices
10. Inspection and corrections until stabilization is apparent

Minimize construction access impacts

- Water access or hand-placement if possible
- For upland access, minimize vegetation removal
- Limit number of access paths
- Downsize equipment
- Use construction mats to distribute weight of machinery crossing through forest buffers and tidal marshes

Material Staging

Stockpile areas for stone and sand should be planned and located outside of sensitive areas, e.g. wetlands, forested areas, underground drainfields

Construction crew and delivery vehicles should park in designated areas

Construction Mats

Plywood mats recently used for sill access

Mats placed across a tidal marsh will crush vegetation, but the marsh should recover naturally during the next growing season

Restoration of these access paths may be needed if natural recovery does not occur after 2 growing seasons

Minimize Damage to Preserved Trees

Trees may gradually die when heavy equipment compacts the soil or scars the trees during clearing

Dead and dying trees in disturbed area with lag time

Timeframes

- Tidal marsh planting should be done in the early or late part of the growing season (Mar-May, Sept-Oct)
- Beach nourishment should be scheduled to avoid impacting protected species. Avoid the following months when these species are present:
  - Northeastern beach tiger beetles: June - Sept
  - Piping plover: May – Aug
  - Terns/Black skimmers: Apr – Aug
  - Loggerhead sea turtles: May - Nov

Monitoring & Maintenance

Graded Banks

- Inspect new plantings
- Irrigate woody plants during first growing season
- Remove nuisance, invasive species
- Allow recruitment of native species
- Use only permeable materials for access paths

Monitoring & Maintenance

Planted Marshes

- Replace washed out plugs
- Survey elevations at failed areas, re-grade and re-plant as needed
- Remove tidal debris & trash at least annually
- Irrigate high marsh during dry spells until established
- Prune overhanging branches
- Remove nuisance, invasive species
- Do not mow
- Avoid using lawn chemicals nearby

Monitoring & Maintenance

Fiber Logs

- Inspect frequently
- Pound loose stakes back into ground ASAP

Hybrid Structures

- Inspect revetments after storms
- Replace scattered stones
- Modify tidal openings if needed
- Raise sill height if bank erosion continues

Permit Process

Permits & Regulations
General Guidelines

Design projects based on shoreline conditions & desired level of protection, not jurisdictional boundaries

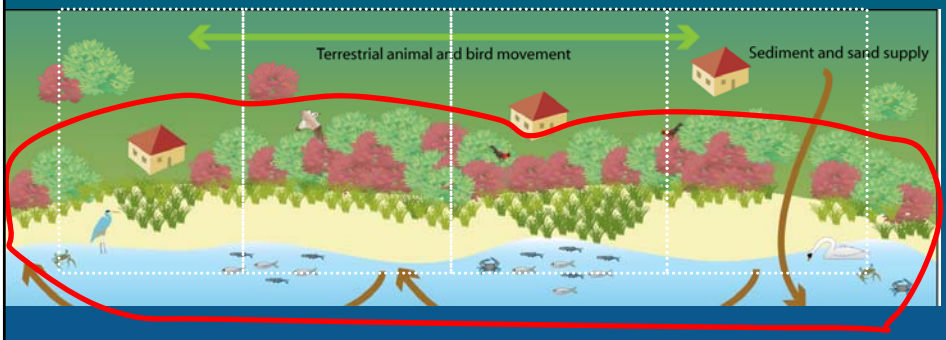
Pre-application review with regulatory agencies encouraged

Concept plans may have to be adjusted as permit review process takes place

Allow at least 2 months, more likely 4-6 months for complicated projects

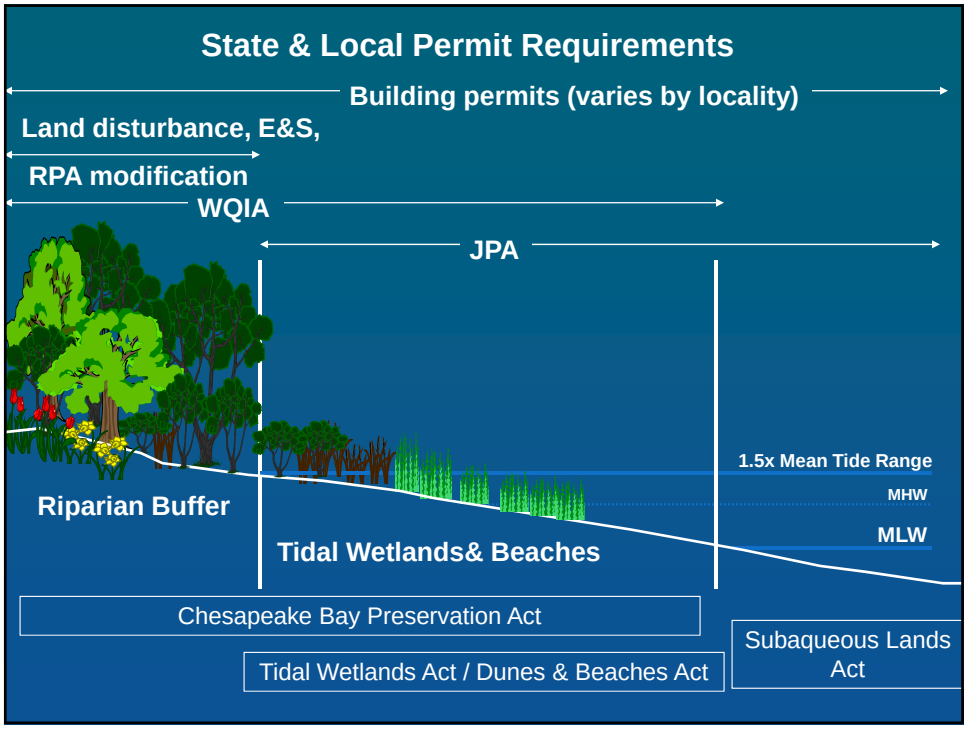
Check with the local county or city environmental office <u>BEFORE</u> doing <u>ANY</u> shoreline work

Integrated Shoreline Management



- **Mutually beneficial approach**
- **Take advantage of natural erosion and flood buffers across property lines and across habitat types**

- **Will the permit process allow for it ???**



Living Shoreline Project Permits may be required

Local	State	Federal
Land disturbance permit	Subaqueous lands permit	Nationwide or regional permit
Water Quality Impact Assessment		Individual permit for large projects (rare)
Landscape Restoration Agreement		
Local Wetlands Board permit		
Building Permit		

Potential conflicts that may arise

Local	State	Federal
Adjacent property owners	Navigation	Navigation
Adjacent shoreline effects	Submerged aquatic vegetation (SAV)	Exceed thresholds for simple permits
Wetland and tree removal compensation requirements	Shellfish grounds public or private	Time of year restrictions for protected species
Setback requirements		

Special Thanks to Bobbie Burton and Katie Register

also Longwood University

For sharing this public demonstration project and being a supportive community partner

VIMS

Thanks for your interest – spread the word !

Contact Information:

Karen Duhring karend@vims.edu 804-684-7159