# Recognizing Opportunities & Successful Implementation

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**January 13, 2016**

**Living Shoreline Professional Workshop**

Center for Coastal Resources Management
Virginia Institute of Marine Science

VIMS | William & Mary
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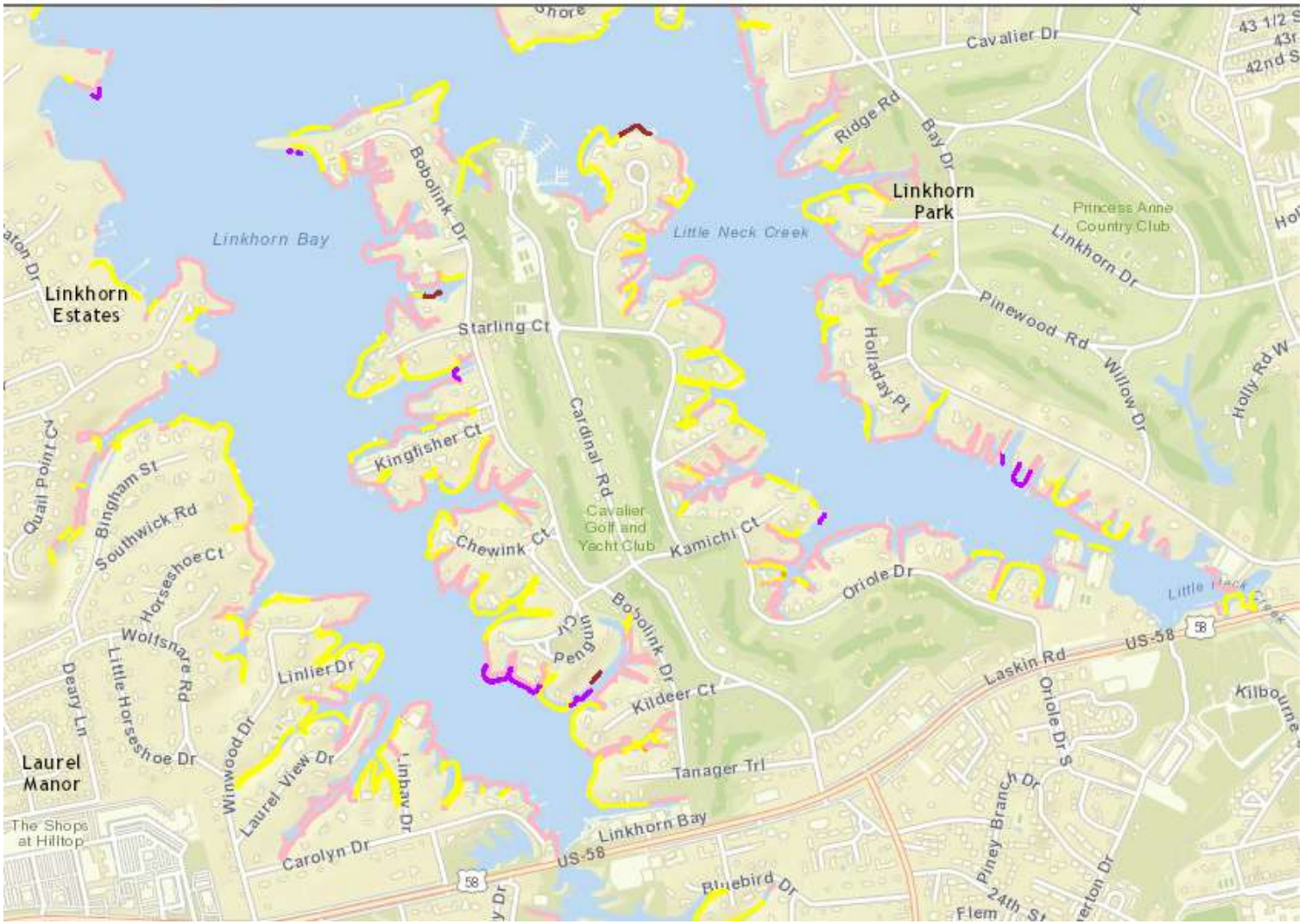
# Recognizing Opportunities & Successful Implementation

- Challenges in Developed Urban Estuaries
- Site Suitability Considerations
- Implementation Guidance
- Professional Service Opportunities

# Fitting Living Shorelines into a Developed Estuary




Bulkhead

Revetment

Marsh Sill

It is possible & may require innovative thinking, less than ideal designs

# Challenges for Living Shorelines in Developed Estuaries

- Small parcels
- Upland improvements in close proximity to shoreline
- Currently defended
  - Vertical elevation difference
  - Deep nearshore
- Navigation conflicts & boat wakes
  - Dredged channels
  - Sand migration concerns

# Recognizing Opportunities & Successful Implementation

- Step 1 – Is shoreline management necessary?

  Is there a risk problem that needs to be addressed?

Extra scrutiny for all
currently undefended shorelines

Especially those with valuable living resources
riparian forest, tidal marsh, oysters, SAV

# Shoreline Management Need Assessment

- What is the landscape setting?
- How do upland land uses affect shoreline & vice versa?
- Is erosion present & if so can it be tolerated?
  - Is erosion caused by upland runoff &/or wave action?
- Do storm surges impact the property?
- How does sea level rise over time affect the property?
- What risk is associated with navigation interests?
- What level of protection is necessary to reduce risk?

Proceed to Step 2 only when absolutely necessary for risk reduction

# Recognizing Opportunities & Successful Implementation

- Step 2 – Alternatives analysis

Deliberate consideration for
non-structural & hybrid living shoreline options

# Stabilization Alternatives
## Simplistic Order of Preference

- Minor erosion with low risk → Maintain / enhance vegetation
- Minor erosion with some risk → Non-Structural Living Shoreline
- Major erosion with some risk, natural buffers present → Hybrid Living Shoreline
- Major erosion with high risk, natural buffers absent or not feasible → Structural

# Living Shoreline Suitability
## Anthropogenic Factors

| | More | Less |
|---|---|---|
| • Property owner | Willing | Not interested |
| • Parcel size | Large | Small |
| • Upland improvements | At risk | Not threatened |
| • Development setback | Wide | Narrow |
| • Accessory structures | Absent | Present |
| • Adjacent parcels | Same | Different |
| • Recreation uses | Passive | Active |

# Living Shoreline Suitability
## Environmental Factors

| | More | Less |
|---|---|---|
| • Riparian buffer | Open | Developed |
| • Natural marsh | Present | Absent |
| • Amount of sunlight | Full sun | Shaded |
| • Wind wave action | Minor | Heavy |
| • Boat wakes | Rare | Frequent |
| • Nearshore | Shallow | Deep |
| • Bottom substrate | Hard sand | Soft mud |
| • SAV | Absent | Present |

# VIMS Preferred Shoreline Management Practices

## CCRMP map viewer

Eldridge Case Study


Enhance riparian/marsh buffer

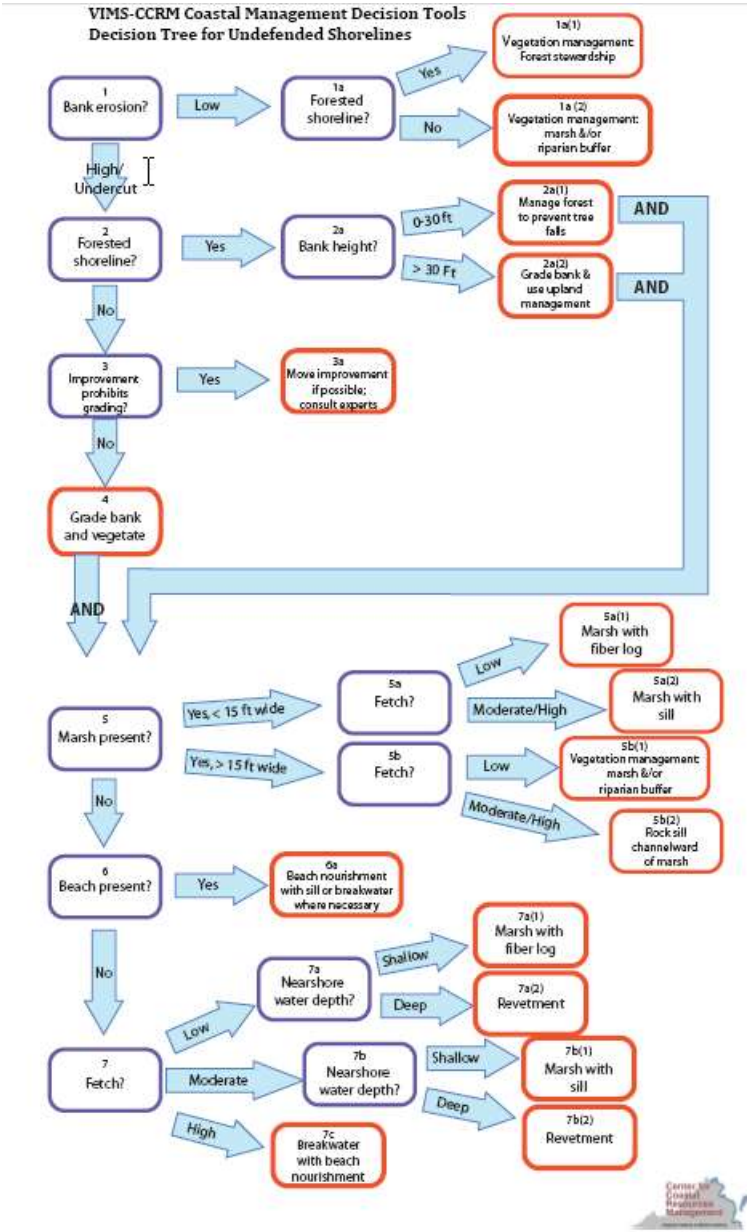
Widen existing marsh

Model may not accurately capture all local site-specific conditions, but these practices should at least be considered

# VIMS Decision Trees

Decision Tree for Undefended Shorelines and Those with Failed Structures

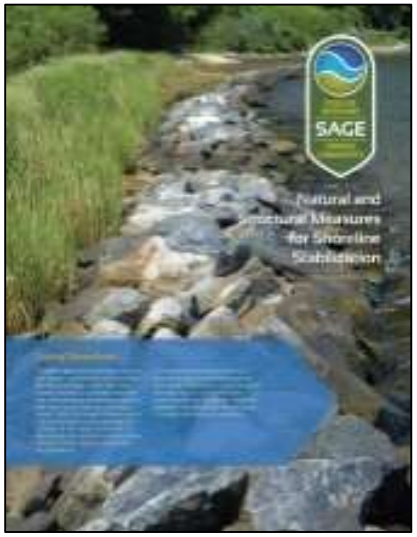
Decision Trees for Currently Defended Shorelines



# NOAA Living Shoreline Guidance & Brochure


- General Guiding Principles
- Conceptual Framework for considering Living Shorelines

- Natural & Structural Measures for Shoreline Stabilization




Extra copies available for distribution to clients & others

# Examples of High Suitability

- Failed bulkhead at abandoned boat basin

- Previously cleared rubble shoreline with erosion

# Colley Bay - Phase 1

Kevin R. Du Bois, PWS, PWD, CFM
City of Norfolk

Kevin R. Du Bois, PWS, PWD, CFM
City of Norfolk

# Planted Tidal Marshes

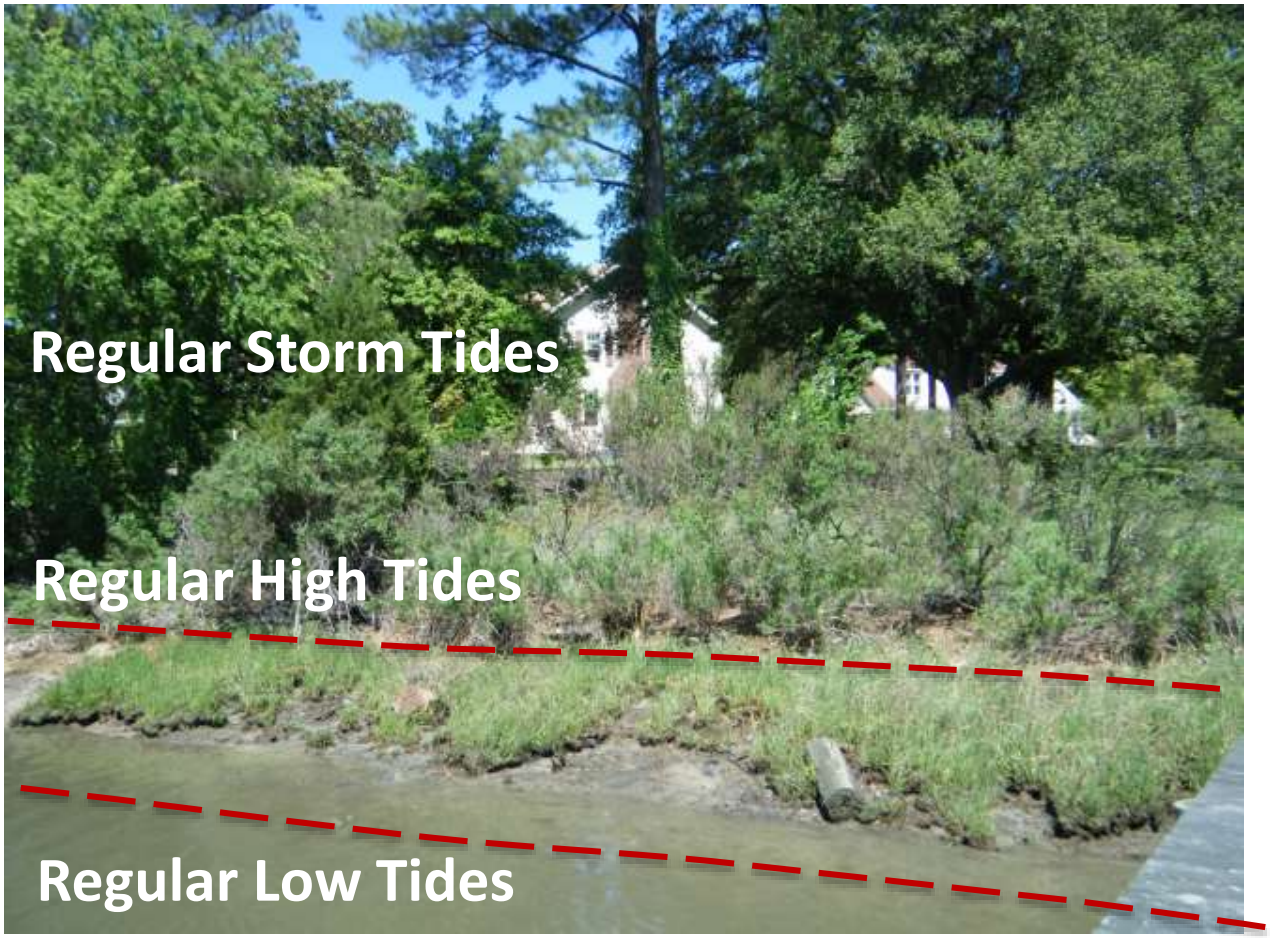
- Enhancing or creating suitable conditions for tidal marsh plants
- May require grading the bank and/or filling into the water
- Narrow marsh provides habitat value, wide marsh >15 ft provides wave reduction

# Planted Marshes – important considerations

- Good summary of design criteria
  - Walter I. Priest, III 2006 Living Shoreline Summit Proceedings
- Tidal benchmarks are critical, local tide range & extreme tide levels (both low & high)
  - Plant above mid-tide elevation only
- Patience & due diligence required
  - Wave attenuation provided by “well-established” marsh which takes at least 1 growing season ( 3-4 months)
  - More habitat benefits achieved after 5 years, especially benthic community due to lag time for organic matter accumulation & processing

# Biological Benchmarks

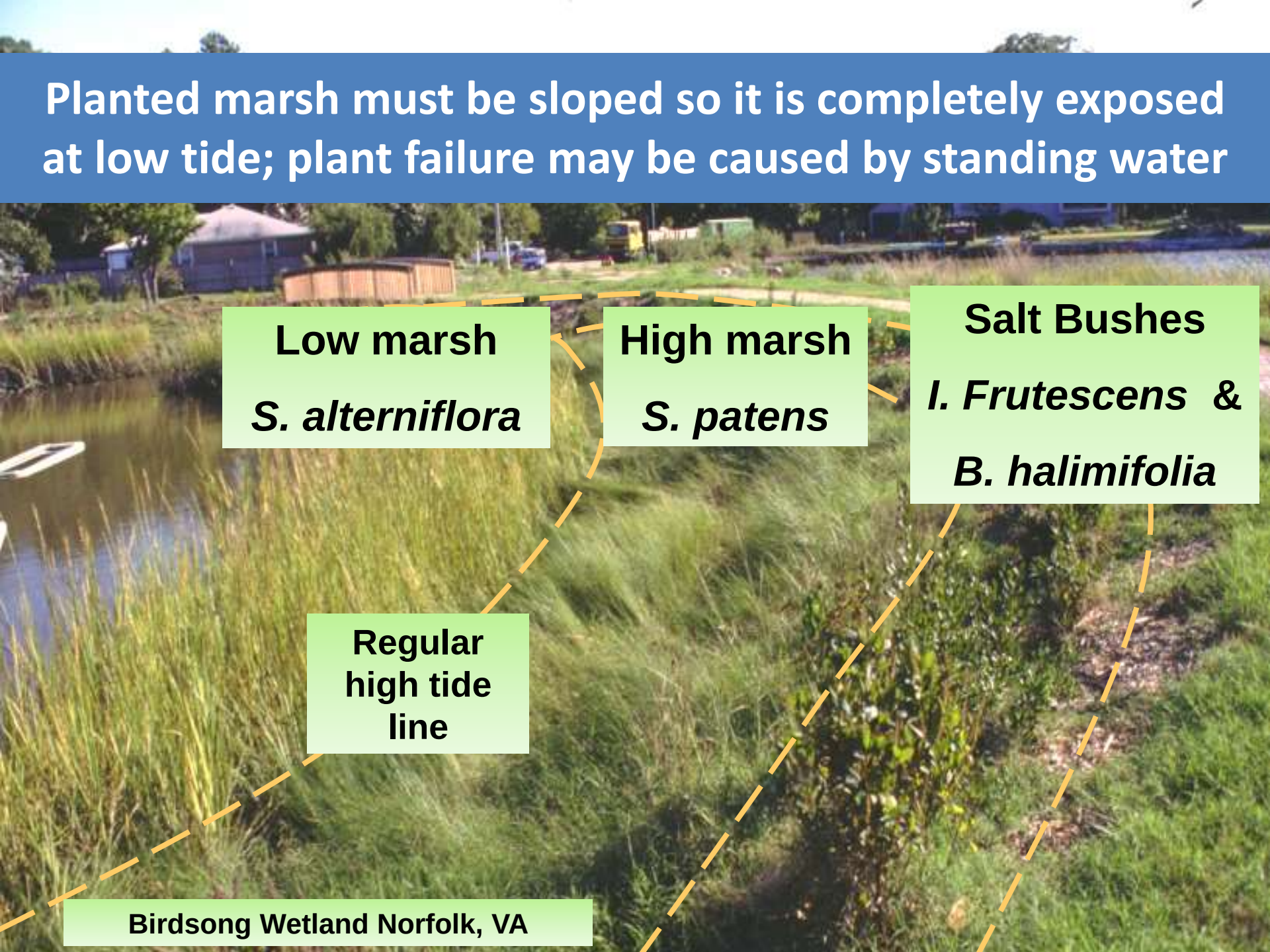
- Elevation ranges of natural marshes & riparian buffers in vicinity



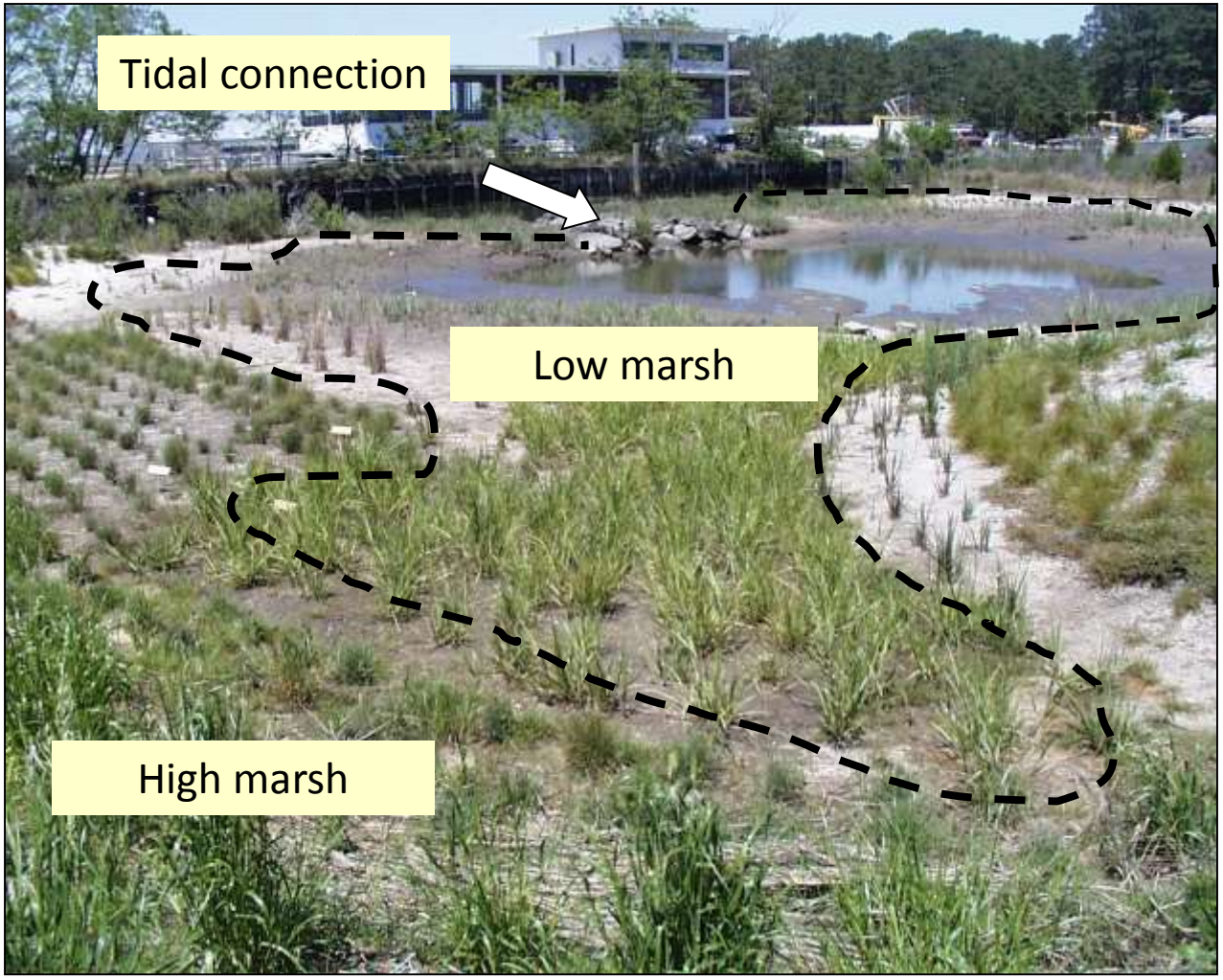
# How wide should the marsh be?

- The answer depends on the energy regime at project site & the erosion problem—the bigger the waves, the wider the marsh
- Include both low marsh & high marsh zones
- Adjacent development & navigation interests may limit marsh width
- Connect & blend marsh with riparian buffer zone where possible

# 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
## Alternative design to fringe marsh




More complex planting zones

Upland excavation areas

**VIMS Teaching Marsh**
**Gloucester Pt, VA**


Tidal wetland plants need to be gradually hardened by nursery for site salinity & temperatures

# Plant Spacing & Growth Pattern

Closer spacing for more rapid cover

Wider spacing to cover large area with limited budget

Marsh grasses will spread underground by rhizomes

Eventually space between plants will fill in naturally

Planted rows not visible over time

# If it’s done correctly…..

**Planting Day**

**4 Months Later**

Successful establishment indicated by flowering grasses

# Grazing Exclusion Devices


Mute Swans & Canada Geese can pull new plants out of the ground, but not established well-rooted plants

Exclusion devices typically removed after 1st growing season

# Planted Marsh TLC During 1st Growing Season

- Regular inspections
- Monitor ebb & flood tides
- Look for & re-plant washed out plugs
  - Pack in deep
  - Keep grazers out

# Main Reasons Planted Marsh Does Not 'Take'

- Planted too low - below mid-tide elevation
- Washed out plugs
- Incomplete drainage & ponding at low tide
- Rapid sediment accretion

## Other Reasons

- Flow stresses – bottlenecks, runoff, waves
- Foot traffic & recreational uses
- Soil contamination
- Undetermined

Need monitoring & analysis of monitoring results

# Planted Marsh Maintenance – After Establishment

- Remove excessive tidal debris & trash periodically as needed
- Prune overhanging branches if shading leads to reduced cover
- Remove nuisance, invasive species
- Inspect & document storm effects, storm tide levels
- Do not mow, install landscape design features to control adjacent mowing, e.g. split rail, timbers
- Avoid using lawn chemicals nearby

# Fiber Logs & Mats

Provide temporary support for planted tidal marshes and/or riparian buffer restoration

May be effective for trapping sediment

Not usually effective for wave attenuation


# Fiber Logs – important considerations

- Easily lifted out of place by the force of water
  - Most suitable sites are low flow velocity
  - Staking & anchoring essential if they are in the water
  - Full contact with ground should be maintained
- Temporary, biodegradable
  - May or may not need to be replaced
- Planting into logs has mixed results
  - Saturation is important for plants
  - Adjacent planted marsh usually grows into them
- Some reported fiber log project ‘failures’ due to unrealistic expectations or incorrect applications
  - Cannot stand alone, usually combined with another element

# Monitoring & Maintenance

## Fiber Logs

- Inspect frequently
- Pound loose stakes back into ground ASAP
- Add more logs or blankets to repair sand ‘leaks’

# Beach Nourishment & Dune Restoration

- Addition of sand to a beach to raise its elevation and increase its width
- Reshaping and stabilizing with dune plants

# Beach & Dune Vegetation

American beach grass
*Ammophila breviligulata*

Bitter panicum
*Panicum amarum*

Saltmeadow hay
*Spartina patens*

Cool-season grass

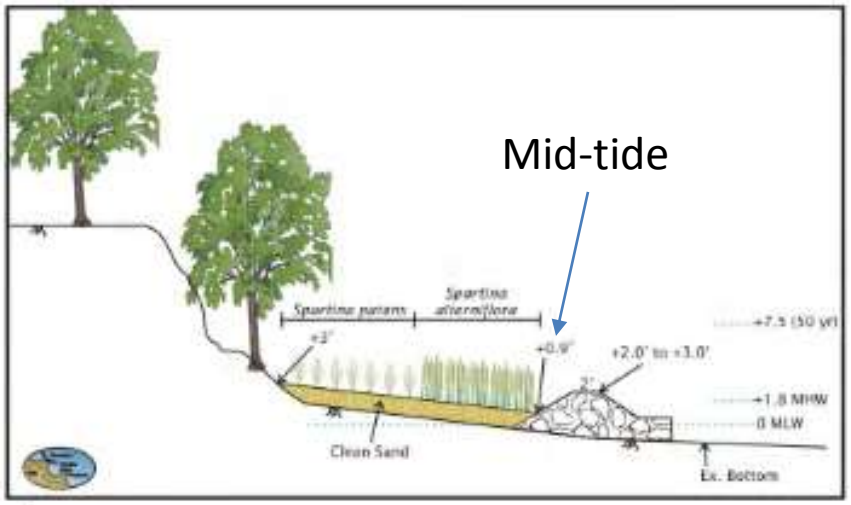
Winter planting

Sea oats
*Uniola paniculata*

Cold hardy varieties
under development

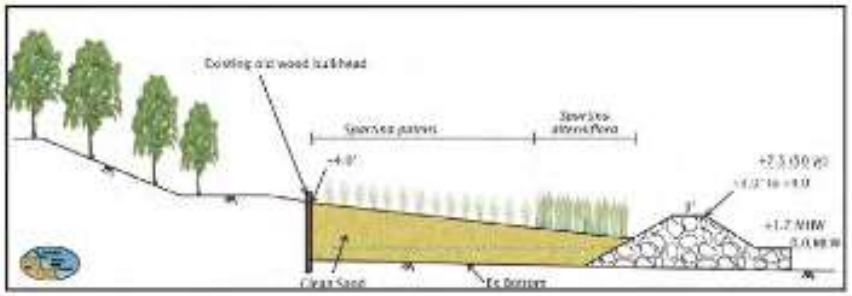
# Marsh Sills

# VIMS Guidance for Sills in Lynnhaven Estuary




Low sill with clean sand at 10:1 planted high & low marsh

Plus bank grading to a minimum 2:1 slope if appropriate




Higher sill to replace or protect failing bulkhead


Available in VA Beach CCRMP

Example of sill & planted marsh next to bulkhead with natural marsh on Eastern Branch Lynnhaven River

Noticeable retreat of marsh edge after adjacent channel dredging & more boat traffic

Bulkhead removal & bank grading preferred
but not acceptable to property owner

# Marsh Sill Tidal Openings

- Maintain marsh-shallow water connections & processes
  - Sediment accretion into marsh
  - Organic matter leaving marsh
- Tidal inundation and positive drainage for healthy plant growth
- Marsh access for fish, crabs, terrapins – all sizes

Tightly packed stone in gabions restricts water movement through stones

Algae bloom in warmer, stagnant area

# Tidal Openings
## Where & when should they be included?

- Site-specific
  - Tidal ponds
  - Natural or created channels
  - Open ends
  - Recreation access
- Sill crest height > MHW
- Sill length > 100 Ft
  - Not a definitive standard
  - May need more or less

Tidal openings are needed but they introduce wave energy into the planted marsh.

Stable embayments eventually form at straight gaps.

# Tidal Openings
# Other Design Types

Weir Opening or Vented Sill

Gap covered with stone at lower elevation

Sediment deposition still evident

Narrow & curved

Reduces sand deposits

Pinches flow & access

*More research needed*

# Potential Stone Sill Alternatives

- Mid-tide bulkheads
  - Restricted waterways
  - Deep nearshore depths

- Oyster reefs (?)
  - Bagged shell
  - Concrete products

*More research needed on performance*

# Offshore Breakwaters with Beach Nourishment

- Most appropriate for high energy sand beach sites
- Create stable pocket beaches between fixed headlands
  - Requires at least 2 units
- Proper design requires advanced knowledge of coastal processes at site
- Combine with dune planting

# Monitoring & Maintenance

## Hybrid Structures

- Periodic trapped debris removal
- Add sand & plants
- Modify tidal openings if needed
- Raise sill height if bank erosion continues
- Lower sill height if marsh invaded by *Phragmites*
- Storm damage assessments
- Replace scattered stones

# Recognizing Opportunities & Successful Implementation

- Step 3 – Construction Planning

Part of feasibility determination & design process before permit application

Don’t wait until after permits issued

# **Constructability** must be determined EARLY in planning process



- Construction access from land or water?
- Any marsh crossings required?  May need to use mats
- Machine size?
  - Excavator reach
  - Bobcat
  - Wheelbarrows for hand placement
- Soft substrates – machines can get stuck

Construction equipment operators might need to work together…..

…..to avoid costly errors with liability & environmental harm

# Other Considerations

- Erosion & Sediment  controls
  - Use silt fences & booms as required
- Stormwater runoff interruptions
  - Know where outfalls are

# Other Considerations

- Customer satisfaction & liability
  - Includes post-construction site restoration
- Working with non-traditional clients & volunteers
  - Volunteer coordinators very useful

# Bottom line

- Living shoreline projects must be designed for site-specific conditions
  - No ‘cook book’ standards
  - Seek technical advice & support from LS partners & available resources

- Engineering ‘comfort level’
  - Try not to ‘over-design’ just for assurance
  - Try to deal with uncertainty  trial & error
  - Need to be flexible, adaptive

# Professional Service Opportunities

## Design & Construction

- Scouting out suitable sites
- Site evaluations & alternatives analysis
- Concept drawings
- Permit applications & coordination
- Construction management
  - Sub-contractors for heavy lifting
  - Horticulture industry partners (nurseries & installers)
- Post-construction as-built surveys
  - To confirm design standards, permit compliance

# Professional Service Opportunities

## Long-Term

- Routine inspection & maintenance contracts
  - Provide assurance, document performance
- Debris removal
- Planted area enhancements – gardening, pruning
- Invasive species management
- Storm damage assessment & recovery

# Recognizing Opportunities & Successful Implementation SUMMARY

- It’s possible to have living shorelines in developed estuaries
- Consider all possible alternatives deliberately, don’t automatically rule out living shorelines
- Consult peers & available resources for implementation guidelines, share experiences
- Encourage industry to expand professional service opportunities to meet public demand

# Please Share Your Living Shorelines Observations & Experiences!

Contact Information: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# Typical Grass Species Used for Salt 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***

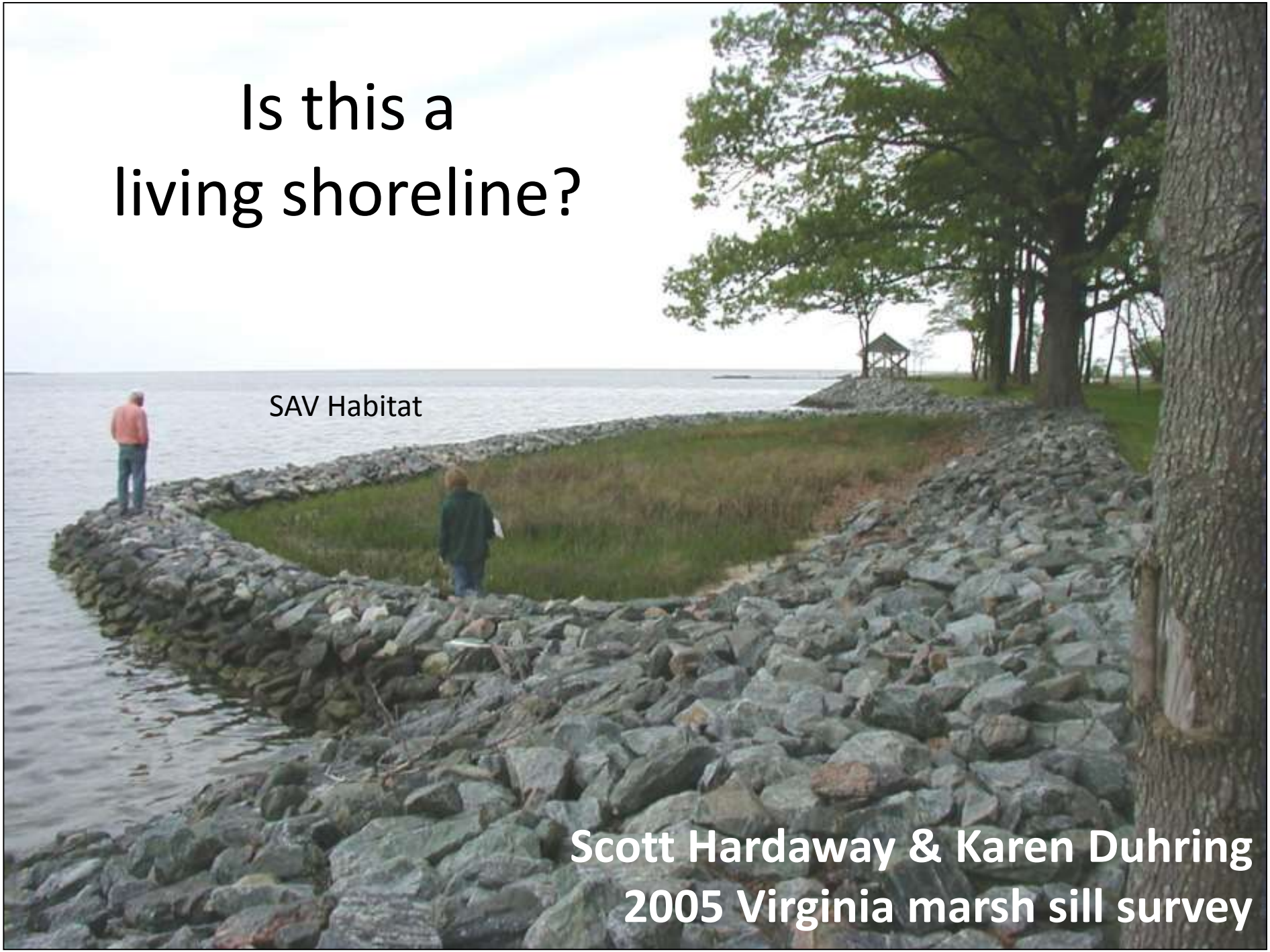
**Marsh Elder**
***Iva frutescens***

**Not as flood tolerant, use at upland edge**

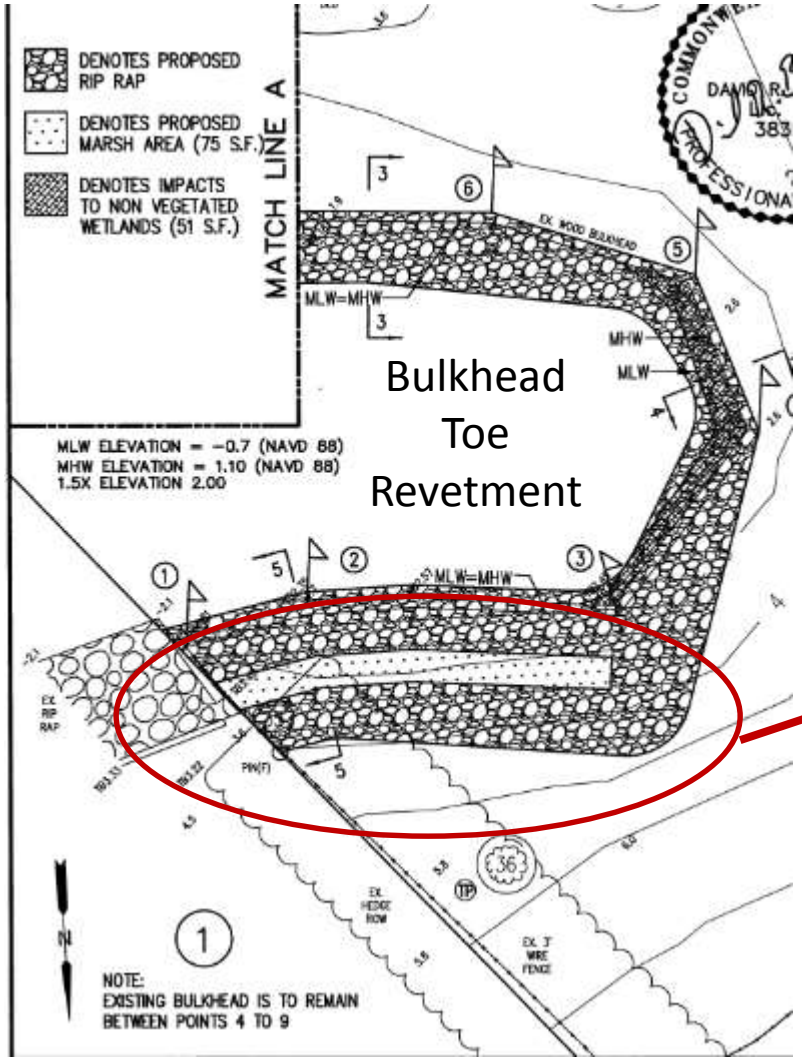
**Wax myrtle / Bayberry**
***Morella cerifera***
***M. pennsylvanica***

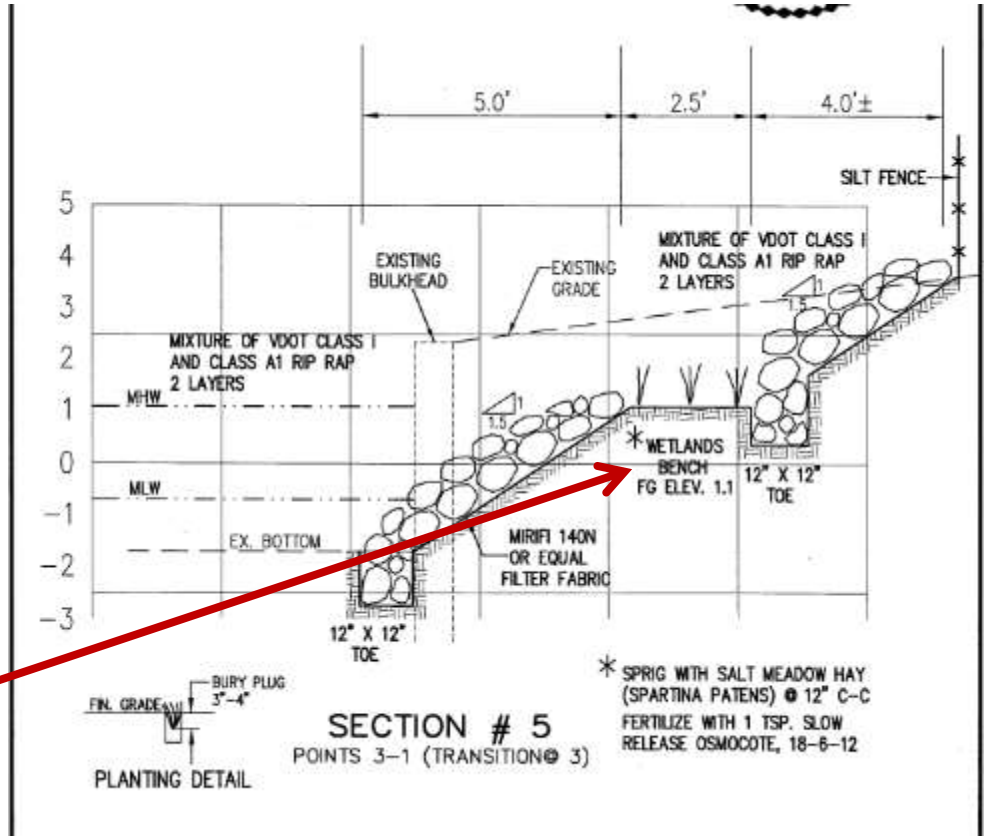

# Planting Process

New Gosport Wetland, Portsmouth


Is this a
living shoreline?
SAV Habitat
Scott Hardaway & Karen Duhring
2005 Virginia marsh sill survey

# Recent “Living Shoreline” JPAs
## Planted Marshes Caught in the Middle

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