Living shorelines as Best Management Practices

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Shoreline Management Model

- GIS analytical model uses bio-physical criteria
- Critieria:
  - Fetch
  - Marsh, Beach, SAV presence
  - Existing structures
  - Nearshore bathymetry
  - Landuse
  - Proximal infrastructure

- Output - One of Eleven Shoreline BMPS
- Analysis included all Virginia except:

King and Queen, King William and West Point

Shoreline Best Management Practices (V5.1)
Non-structural living shoreline*
Plant marsh with sill*
Maintain beach or offshore breakwater with beach nourishment
Groin field with beach nourishment
Revetment
Revetment/Bulkhead Toe Revetment
Ecological Conflict
Landuse Management
Highly Modified Area
No Action
Special Geomorphic Feature

Shoreline Erosion Management Recommendations

Groin Field with Beach Nourishment: Maintain beach. Remove unnecessary structures at the backshore (e.g. bulkheads) and stabilize the bank with grading and riparian plants. Repair/replace groins, add beach nourishment and plant beach vegetation.

Maintain Beach or Offshore Breakwater with Beach Nourishment: Shoreline > 200 feet: remove existing structure, nourish add beach, consider offshore breakwaters; consider planting nourished areas. Shoreline < 200 feet breakwater may not be practical. Remove failed structures; repair or construct a revetment as far landward as possible. Consider shoreline enhancement such as vegetated wetlands and/or riparian buffer and/or sandy beach/dune.

Non-Structural Living Shoreline: Remove existing structure if present; grade bank if necessary and install a non-structural living shoreline which may include marsh plants, riparian buffer planting, coir logs, or oyster reefs.

Plant Marsh with Sill: Remove existing structure if present and grade the bank if possible. Plant a marsh, add a sill and plant bank with riparian vegetation. If grading not possible, repair existing structure with a minimal footprint and consider incorporating a marsh with a sill or some other shoreline enhancement (e.g. oyster castles).

Revetment: Remove existing failing/ failed shoreline structure, if present. Construct new revetment as far landward as possible; grade the bank and plant vegetation buffers. If grading is not possible, construct or repair existing revetment in the same alignment. A bulkhead is considered only if previously present and the site is navigation limited. Consider shoreline enhancement such as vegetated wetlands and/or riparian buffer and/or sandy beach/dune.

Revetment/Bulkhead Toe Revetment: Grading possible: remove the failed bulkhead and replace with a revetment landward. Grading not possible: (re)construct bulkhead in the same alignment and/or add a toe revetment. Consider shoreline enhancement such as vegetated wetlands and/or riparian buffer and/or sandy beach/dune.

Special Considerations

Ecological Conflicts: Submerged Aquatic Vegetation (SAV) may limit management options. Seek advice from the VMRC.

Highly Modified Area: Highly developed upland (e.g. commercial wharfs), channel modifications (e.g. canals) or infrastructure directly adjacent to the shoreline (e.g. road). Seek expert advice on the design of your project.

Land Use Management: Tall banks greater than 30 feet limit possible solutions to address bank erosion. Assessment of all factors and modifications to address causes for bank erosion are recommended. This may include changes to vegetation management, implementation of projects to address storm water, relocating buildings, utilities, and other infrastructure. Seek expert advice to inform management options.

No Action Needed: No specific management actions are suitable for shoreline protection, e.g. boat ramps, undeveloped marsh, and barrier islands.

Special Geomorphic Feature: Spit features may not be persistent over longer timeframes. Maintain the natural condition of this shoreline to allow for unimpeded sediment movement and the corresponding response of wetlands, beach and/or dune. If primary structures are present and threatened, seek expert advice on the design of your project.

Modeled Living Shorelines Load Reductions

CBP Tidal Shoreline BMP Protocols

- Protocol 1: Prevented Sediment provides an annual mass sediment reduction credit for qualifying shoreline management practices that prevent tidal shoreline erosion that would otherwise be delivered to nearshore/downstream waters. The pollutant loads are reduced for sand content and bank instability (based on the state's assessment).
- Protocol 2: Credit for Denitrification provides an annual mass nitrogen reduction credit for qualifying shoreline management practices that include vegetation.
- Protocol 3: Credit for Sedimentation protocol provides an annual mass sediment and phosphorus reduction credit for qualifying shoreline management practices that include vegetation.
- Protocol 4: Credit for Marsh Redfield Ratio provides one-time nutrient reduction credit for qualifying shoreline management practices that include vegetation.
- A "Default Rate" provides an annual mass sediment and nutrient reduction credit for qualifying shoreline management practices.

CBP Shoreline Approved BMP

Protocol	Submitted Unit	Total Nitrogen (lbs per unit)	Total Phosphorus (lbs per unit)	Total Suspended Sediment (lbs per unit)
Prevented Sediment	Linear Feet	Project-Specific*	Project-Specific*	Project-Specific
Denitrification	Acres of re-vegetation	85	NA	NA
Sedimentation	Acres of re-vegetation	NA	5.289	6,959
Redfield Ratio	Acres of re-vegetation	6.83	0.3	NA
Non-conforming/ Existing Practices*	Linear Feet	MD= 0.04756 VA = 0.01218	MD= 0.03362 VA = 0.00861	MD= 164 VA = 42

Shoreline BMP Qualifying Criteria

Shoreline Management Practice	The Practice Must Meet these Criteria for TMDL Pollutant Load Reduction[1]
Living Shoreline – a) nonstructural; b)hybrid system including a sill; and c)hybrid system including a breakwater	1. The site is currently experiencing shoreline erosion or is replacing existing armor. The site was graded, vegetated, and excess sediment was removed or used.[2] **AND** 2. When a marsh fringe habitat (a or b) or beach/dune habitat (c) is created, enhanced, or maintained.
Revetment AND/OR Breakwater system without a living shoreline	1. The site is currently experiencing shoreline erosion, **AND** 2. A living shoreline is not technically feasible or practicable as determined by substrate, depth, or other site constraints. **AND** 3. When the breakwater footprint would not cover SAV, shellfish beds, and/or wetlands.
Bulkhead/Seawalls	1. The site is currently experiencing shoreline erosion. **AND** 2. The site consists of port facilities, marine industrial facilities, or other marine commercial areas where immediate offshore depth (e.g., depths deeper than 10 feet 35 feet from shore) precludes living shoreline stabilization or the use of a breakwater or revetment.

[1]Projects that impact the Chesapeake Bay Preservation Act protected vegetation without mitigation receive no Chesapeake Bay TMDL pollutant load reduction. Further, WQGIT agreed to allow States to determine, on a case-by-case basis, when the unintended consequences of negative impacts to wetlands and SAVs caused by these shoreline management techniques, outweigh the benefits, in which case the practice will not be reported to the Bay Program for model credit.

Load Reduction Calculation Method

- Two management practices specifically inclusive of marsh vegetation planting: Non-structural and Plant Marsh with Sill
- Selected Shoreline with no marsh
- Converted shoreline arcs into polygons with an 8 foot width
  - Uses VMRC Living Shoreline General Permit 2 Criteria for minimum marsh dimensions
- Determined areal extent of created marsh and applied protocols for load reductions.
  - For Projections uses Protocols 2, 3 & 4
  - For Back-casting uses all 4 protocols

Determine Area of Marsh Creation

Shoreline Converted from a Line on Left to an 8 Foot Buffer on Right

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Living shorelines as BMPs

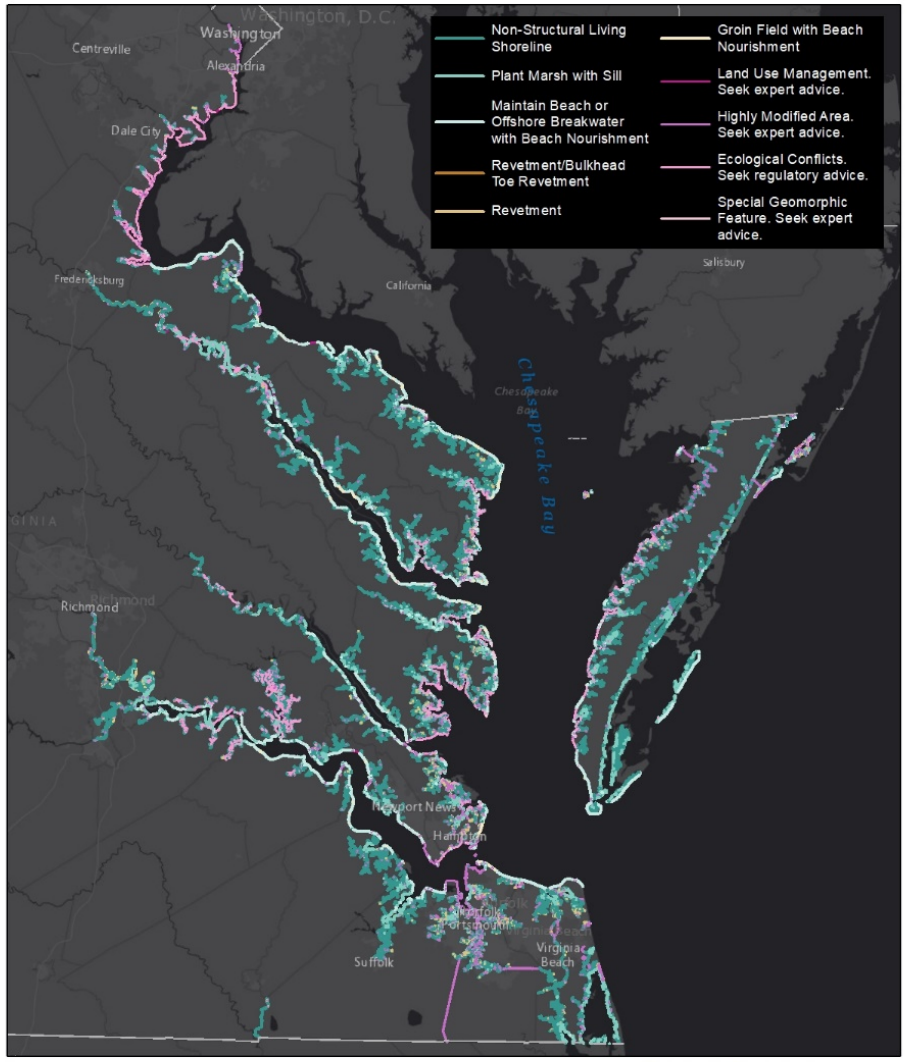
Tidal Shoreline Preferred BMPs - Length of Shoreline in Linear Feet												
Shoreline Type	**Maintain Beach/ Breakwater w/ Beach Fill**	**Ecological Conflicts**	**Groin Field with Beach Fill**	**Highly Modified Area**	**Landuse Management**	**No Action Needed**	**Non-Structural Living Shoreline**	**Plant Marsh with Sill**	**Revetment**	**Revetment / Bulkhead Toe**	**Special Geomorphic Feature**	**Total**
Undefended - Marsh	168892	2145334	0.00	4441823	21765	8575671	23945516	2479651	7579	0.00	31211	37819802
Undefended - No Marsh	1044630	917796	0.00	342682	93613	134344	5710913	522189	486668	0.00	44640	9297473
Defended - Marsh	91959	121588	4917	147415	5246	3901	614035	186953	49997	3832	1077	1230921
Defended - No Marsh	905048	466089	92077	1168978	12475	524	12453745	266835	152003	13897	2997	4326299
Total	2210531	3650806	96994	2103257	133099	8714439	**31515839**	**3455629**	696247	17730	79924	52,674,495

Modeled shoreline used for calculations

Additional Shoreline possible for marsh creation

Living shorelines as BMPs

Virginia Preferred Shoreline BMPs



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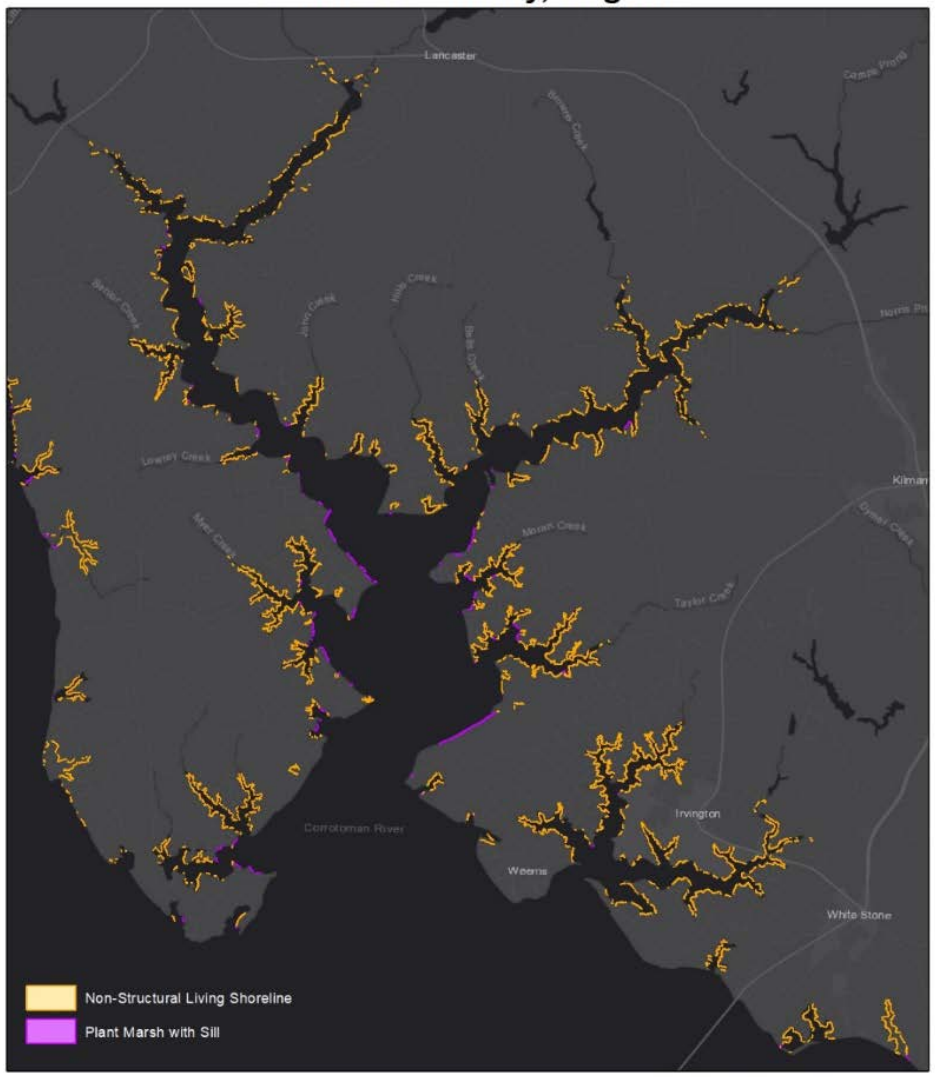
Living Shoreline Modeled Extent in Corrotoman River, Lancaster County, Virginia



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Undefended shoreline: Marsh area created 761 acres
Defended shoreline: Marsh area created 277 acres
TOTAL = 1038 acres

Annual:
Load Reduction Nitrogen = 88,230 (Applied over 10 years)
Onetime (protocol 4) = 7090
Load Reduction Phosphorus = 5,490
Onetime (protocol 4) = 311

Estimates are Conservative: Options that could increase Marsh Creation

1. Only 2 management practices specifically inclusive of marsh vegetation planting: Non-structural and Plant Marsh with Sill

→ Other Management approaches could incorporate (or sometimes do) marsh plantings: Breakwater, No Action, Ecological Conflict, Special Geomorphic Feature

2. Selected Shoreline with no marsh

→ Existing marsh can be widened to increase erosion benefit. Also as restoration for WQ and habitat benefits. CCI data does not include marsh width.

3. Used minimum 8 foot marsh width

→ Living shoreline marsh are generally wider than 8 feet

4. Does not account for voluntary restoration

→ Only considers erosion control efforts, not restoration for habitat or resilience