Essential Skills for Living Shorelines

Practical
Shoreline Monitoring Protocols

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Reasons for Project Level Performance Monitoring

- Document how projects are built
- Comply with permit conditions for monitoring reports
- Track performance over time
- Identify maintenance needs
- Know when adaptive management is needed

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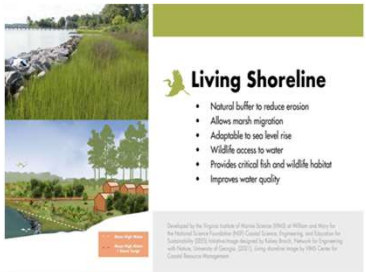
How Living Shorelines Work



Living Shoreline

- Natural buffer to reduce erosion
- Allows marsh migration
- Adaptable to sea level rise
- Wildlife access to water
- Provides critical fish and wildlife habitat
- Improves water quality

Suggests
What to Look For
during
Shoreline Monitoring

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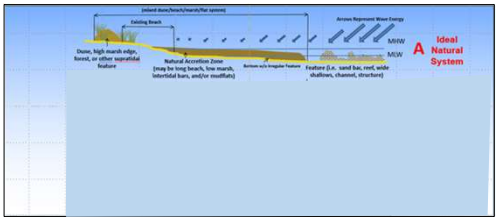
Natural System of Features *for energy attenuation*



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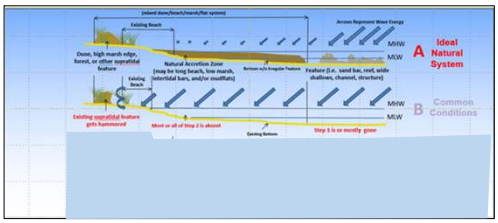
Common Shoreline Conditions *with fewer features*



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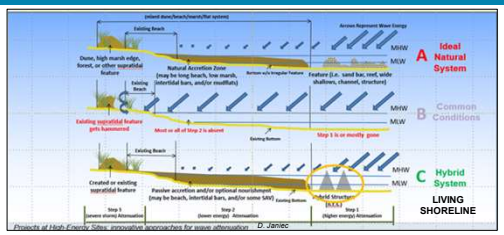
Living Shoreline Systems *to replace attenuating features*



LIVING SHORELINE MONITORING

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Target Conditions *for living shoreline systems*

RIPARIAN BUFFERS & BANKS

- Bank vegetation cover with minimal erosion
- Multiple strata with healthy soil community
- Low risk for falling trees
- Minor shade disruption for planted marshes

OYSTER SILLS

- Increasing height &/or width
- At least 50 healthy oysters/m^2 over 30% of sill
- Multiple size classes
- Silt & bio-fouling do not prevent spat settlement

TIDAL MARSHES

- Increasing stem height and flowering shoots until at least 70% plant cover where tidal flooding happens
- Adequate tidal exchange for dense marsh plants
- Connected above and below ground biomass

STRUCTURES - MATERIALS

- Remain where permitted to be placed
- Able to withstand local wave climate
- Hold system together without significant harm

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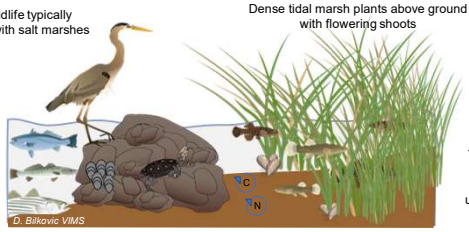
Positive Signs of Target Conditions *at sills & salt marshes*

Fish & wildlife typically associated with salt marshes

Dense tidal marsh plants above ground with flowering shoots

Incoming wave reduction



Tidal marsh rhizome expansion underground

Live oysters different ages

Ribbed mussels attached to marsh plants

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Shoreline Monitoring Timelines & Events

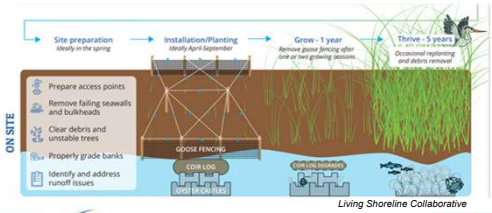
Baseline Pre-Construction

As-Built thru Establishment

Watch frequently until planted areas and structural materials are stabilized

Annual & Post-Storm Events

At least once May – September
After notable storm events



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Simple Monitoring & Management Required for Permits

Brief Monitoring Report at End of First Full Growing Season following planting and after the 2nd year of establishment of vegetation and Shall be conducted from June through September of each year

- At minimum shall include
  - Permit number
  - Representative photos of site
  - Brief statement concerning success of project
- Additional documentation is encourage to improved evaluation of techniques used

Any vegetation established and managed (replanted) for no minimum net loss for 2 years

- Shall not be cut or harvested
- If necessary for vegetation, additional sand placed to restore original proposed elevation.

Invasive species eradication – plan approved and noted on permit. Re-vegetate with native wetlands vegetation

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DCR Monitoring for BMP Performance Verification

Example

Protocol	Submitted Unit	Total Nitrogen (lbs per unit)	Total Phosphorus (lbs per unit)	Total Suspended Sediment (lbs per unit)
Protocol 1 - Prevented Sediment	Linear Feet	Project-Specific*	Project-Specific*	Project-Specific
Protocol 2 – Denitrification	Acres of re-vegetation	85	NA	NA
Protocol 3 - Sedimentation	Acres of re-vegetation	NA	5.289	6,959
Protocol 4 – Marsh Redfield Ratio	Acres of re-vegetation	6.83	0.3	NA
Non-conforming/Existing Practices *	Linear Feet	MD = 0.04756 VA = 0.01218	MD = 0.01362 VA = 0.00861	MD = 164 VA = 42

annual erosion rate = 1 foot

15.77 tons of sediment
27.14 pounds of nitrogen
19.19 pounds of phosphorus

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Relatively Simple Monitoring

PLANTS
Plant community diversity and connections
Elevation Indicator Species
Plant life cycle evidence
Plant cover estimates

FISH & WILDLIFE
General Presence / Absence
Wildlife evidence
Wildlife damage
Oyster sill height & width

STRUCTURES & MATERIALS
Integrity conditions
Missing parts or sections
Dislodged or collapsed materials



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More Difficult Monitoring

SURVEYING
Accurate elevations *within a typical tide range*
Sediment erosion/accretion

WAVES & WATER LEVELS
Wave climate *frequency, directions, energy*
Real world tide range
Groundwater elevations

PLANTS & WILDLIFE
Plant biomass – stem counts
Shorebird observations
Nekton diversity (fish & crabs)
Counting oysters by age class
Reef community diversity



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Practical Shoreline Monitoring Protocols

Low-cost, accessible monitoring protocols to collect data in a standardized manner

1. Define **MONITORING SITE**
2. Determine **PROTECTED SHORELINE LENGTH**
3. Delineate **MONITORING FEATURES**
4. Establish **FIXED PHOTO STATIONS**
5. Characterize **PLANT COMMUNITIES & EROSION AREAS**
6. Analyze **TRANSECTS & QUADS**

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Monitoring Site

A Monitoring Site is a unique geographic area where one or more living shoreline treatments were built.

East Oceanview Community Center Examples

One Monitoring Site for Phases 1 & 2

Separate Monitoring Sites

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Monitoring Site Information

Where have living shorelines been built?

How many unique treatments or features in each system?

Who is monitoring at this site?

What is the project history?

What are the performance goals?

MONITORING SITE INFO

- Unique Site Name
- Location
- Site & Lead Monitor Contact
- Site Access requirements & safety
- Permit numbers & construction dates
- Monitoring goals
- Protected Shoreline Length
- Monitoring Features
- Fixed Photo Stations

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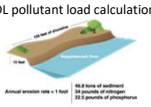
Protected Shoreline Length

User-defined length of shoreline treated by a living shoreline system in a Monitoring Site

For TMDL pollutant load calculations



To track living shorelines vs shoreline armoring

Virginia Coastal Resources Tool

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Monitoring Features or Treatments

Defined areas with unique characteristics for monitoring purposes.
Not all features can be monitored. Monitoring the same features over time is best.

Monitoring Feature Examples

Natural marsh
Planted high marsh
Planted low marsh
Oyster castle sill
Coir logs

Might include:
Existing *Phragmites*
Planted riparian buffer
Oyster castle habitat

Probably will not include:
Stormwater Management BMPs

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Additional Treatment Information

Tidal Marsh Features

- % cover all plants
- Dominant plant species
- *Phragmites australis* presence/absence
- High Marsh:
  - Live & dead shrubs & trees
- Marsh edge erosion evidence

Sills & Structures

- Length & width
- Structural integrity observations
- Rock sills:
  - Crest height above regular high water line
  - Oysters & ribbed mussels presence/absence
- Oyster sills:
  - Material type
  - Height at 3 locations
- Coir logs:
  - Grade & arrangement
  - Original installation, reinforcement or replacement
  - Height at 3 locations

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Fixed Photo Points

Places where repeated photos are taken to document visual changes at a fixed point through time.

Unmarked easy to access locations like piers or unmarked GPS coordinates

Examples of marked photo stations

Lafayette Wetlands Partnership C. Gibson

chronolog
Annual subscription service includes online timelapse viewer

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Characterize Upland Bank Conditions

Record general upland & bank conditions for entire Monitoring Site or each unique upland bank section.

- Bank Vegetation Cover
- Extent of tidal marsh shading
- Bank Height Category
- Measure Bank Slope: Gentle Mid-range Steep ranges
- Bank Erosion Evidence: capture locations & describe

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Wrack Lines

Wrack Lines are debris fields deposited on shore by tidal flooding. They indicate energy attenuation effectiveness. Material in wrack lines may trigger maintenance activity.

Organic wrack material is generally beneficial to established tidal marsh habitat

vs.

Floating trash, large woody debris, construction materials may overwhelm living shoreline habitats

MAINTENANCE

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Plant Community Transects & Quadrats

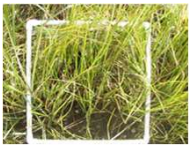
Measure plant zone widths & monitor plant integrity, cover, and composition at the same locations every monitoring event.

Transects

Lines drawn perpendicular to the water's edge through representative monitoring features.

Plot or Quadrat

A small habitat sampling area at pre-determined assessment points along a transect.



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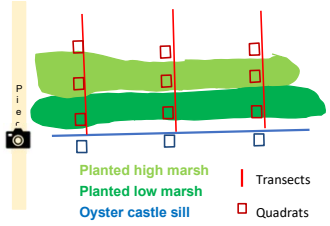
Plant Community Transects & Quadrats

Number & placement of transects depends on project size and Monitoring Features



Quad Assessment Point Examples

Upland Bank

Low Marsh – High Marsh Transition

Low Marsh Edge

Sill quadrats or observations *associated with plant transects*

FOR ILLUSTRATION ONLY

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Quadrat Monitoring

TIDAL MARSH QUADS

% cover all plant species combined
% cover each plant species
Oysters presence/absence
Ribbed mussels presence/absence
Periwinkles presence/absence
Crab burrows presence/absence
Dominant sediment type

UPLAND BANK ASSESSMENT POINTS

Count woody shrubs & saplings
Count trees within set distance
ID dominant riparian species
ID invasive riparian plants
Ground condition

OYSTER SILL QUADS

Oysters presence/absence
Oysters age classes presence/absence
Ribbed mussels presence/absence

Similar observations at stone sills without quad

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Fish & Wildlife Observations & Evidence

Casual fish & wildlife observations are popular and easy.
Collecting data to assess ecological performance can be tricky.

Record direct observations made during monitoring event

Record evidence of wildlife utilization
- Tracks & trails
- Scat
- Prey refuse middens

Note invasive or nuisance species that may trigger maintenance

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Monitoring Data Collection & Sharing

Anecdotes

Professional exchange meetings, social media, lessons learned group discussions, reports

Crowd-Sourced Platforms

Photo uploads & simple observations by general public
May require subscription service & management entity

NATIONAL

MyCoast
CitSci
chronolog

LOCAL

Eyes on the River
Lafayette Wetlands Partnership
Sea Level Rise
Wetlands Watch

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Monitoring Data Collection & Sharing

ArcGIS

Standardized data collection

GPS-enabled field tablet & desktop maps

VIMS ShoreWatch APP
in progress

INTERACTIVE GIS MAPS & DATABASE

Map example of two Monitoring Sites

Potential
GIS INFORMATION PRODUCTS

Living Shoreline Project Catalog & Dashboard

BMP Certification Calculator template

VMRC – ACOE monitoring report templates

Project Type & Performance Trends *across all projects*

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REVIEW Practical Shoreline Monitoring Protocols

Monitoring Site	Capture as-built project areas, define Protected Shoreline Length, document legal & access conditions for monitoring
Monitoring Features	Delineate features in LS system across elevation gradient, use standardized categories to allow for comparisons between other projects with similar features
Monitoring Events	Different reasons for monitoring based on timeline, e.g. pre-construction baseline, as-built until establishment, routine annual, post-storm
Observations & Characterizations	Some metrics do not require intensive analysis to monitor for basic performance like fish & wildlife, upland bank characterizations
Transects & Quads	Track plant community & sill evolution in small sample areas re-visited each monitoring event
Data Collection & Sharing	Project-level monitoring data collected and shared by multiple stakeholders can support analysis of living shoreline trends & reporting templates

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Contact Information

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