

Essential Skills for Living Shorelines

Practical Shoreline Monitoring Protocols

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1

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



2

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

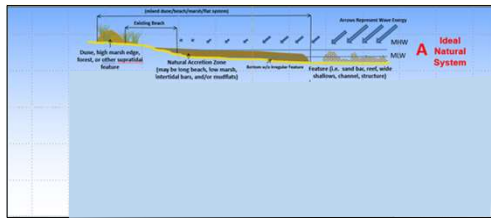
Suggests
What to Look For
during
Shoreline Monitoring

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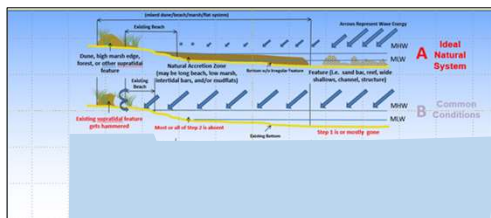
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Natural System of Features for energy attenuation



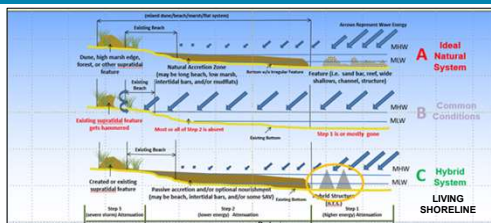
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Common Shoreline Conditions with fewer features



5

Living Shoreline Systems to replace attenuating features



6

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

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

OYSTER SILLS



- Increasing height &/or width
- At least 50 healthy oysters/m² over 30% of sill
- Multiple size classes
- Silt & bio-fouling do not prevent spat settlement

STRUCTURES - MATERIALS



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



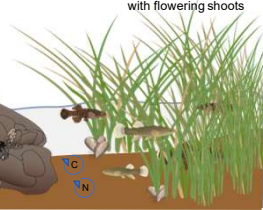
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Positive Signs of Target Conditions at sills & salt marshes

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



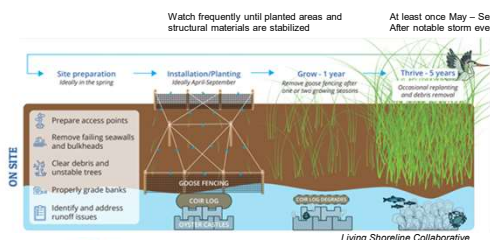
8

Shoreline Monitoring Timelines & Events

Baseline Pre-Construction

As-Built thru Establishment

Annual & Post-Storm Events



9

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 encouraged to improve 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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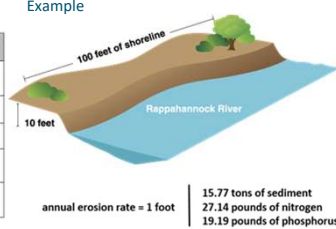
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10

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 - Desilting	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 = 0.03238	MD = 0.03362 VA = 0.00863	MD = 164 VA = 42



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DCR
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11

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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12

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



13

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 **LIVING SHORELINE TREATMENTS**
4. Establish **FIXED PHOTO STATIONS**
5. Characterize **PLANT COMMUNITIES & EROSION AREAS**
6. Analyze **TRANSECTS & QUADS**



14

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



15

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

Living Shoreline Treatment Types

Fixed Photo Stations

16

Protected Shoreline Length

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

For TMDL pollutant load calculations

Annual erosion rate = 1 foot

46.8 tons of sediment
14 pounds of nitrogen
22.2 pounds of phosphorus

To track living shorelines vs shoreline armoring

Virginia Coastal Resources Tool

17

Monitoring Features

Defined Living Shoreline Treatments with unique characteristics for monitoring purposes. Monitoring the same features over time is best.

FOR ILLUSTRATION ONLY

Common Living Shoreline Treatments

Planted Marsh

High marsh

Low marsh

Marsh with Coir Logs

Marsh with Oyster Structure

Marsh with Rock Sill

Other Treatment Types:

Planted riparian buffer

Stormwater Management BMPs

18

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
 Width of low & high marsh zones

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 & width evolution
 Coir logs:
 Grade & arrangement
 Original installation, reinforcement or replacement
 Height & degradation



19

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



20

Characterize Upland Bank & Erosion Evidence

Record conditions for entire Monitoring Site or unique sections.

Bank Vegetation Cover
 Habitat transition evidence
 Bank Height Category: Low High Bluff
 Bank Slope: Flat Moderate Steep
 Bank & Marsh Edge Erosion Evidence



Upland Runoff Erosion
 in a living shoreline



Stone Sill
 End Effect
 Erosion



21

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



22

Plant Community Transects & Plots

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

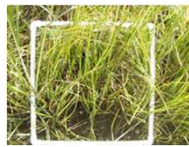
Transects

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



Plot or Quadrat

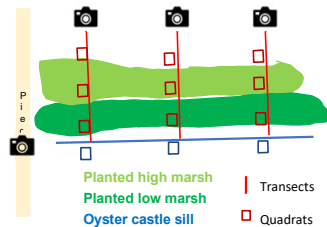
A small habitat sampling area at pre-determined assessment points along a transect.



23

Plant Community Transects & Plots

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






Plot Assessment Point Examples
Upland – High Marsh Transition
Low Marsh – High Marsh Transition
Low Marsh Edge
Sill plots or observations




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24

Plot Monitoring

TIDAL MARSH PLOTS	UPLAND BANK ASSESSMENT POINTS	OYSTER SILL PLOTS
 <p>% cover all plant species combined Observed plant species Dominant sediment type</p>	 <p>Count woody shrubs & saplings Count trees within set distance ID dominant riparian species ID invasive riparian plants Ground condition</p>	 <p>Oysters presence/absence Oysters age classes presence/absence Ribbed mussels presence/absence <i>Similar observations at stone sills</i></p>

25

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








26

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 living shoreline treatments 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 & Plots	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

27

Tracking Metrics Over Time

How can we compile and compare collected data to effectively assess the performance of Living Shoreline projects?



28

Living Shoreline Monitoring with ShoreWatch App

ShoreWatch App Purpose

Collect standardized monitoring data for living shorelines

- Understand performance and effectiveness of projects in different settings and for varied designs

Designed for organizations and groups involved in living shoreline management and/or application



29

Equipment and Apps



ArcGIS Field Maps

Geolocate and collect baseline data for Living Shoreline elements



ArcGIS Survey123

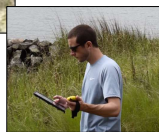
Forms to collect and link data to created element features to track changes over time

- Bluetooth enabled phone or tablet
- Seamless integration
- Username and Password
 - Data integrity



Accessible and affordable

GPS Survey Tool and Phone/Tablet connected via Bluetooth for enhanced accuracy



30

Initial Set-Up Site Visit



Monitoring Site

- Capture as-built project areas
- Name, location, and details of site

Living Shoreline Treatment(s)


- Type of treatment (Rock Sill, Oyster Structure, Coir Logs)
- Details of Living Shoreline project

Used to link features and data for Living Shoreline projects

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31

Initial Set-Up Site Visit



Monitoring Features

- Delineate living shoreline features
 - ✓ Structures
 - Marsh Zones
 - Planted Marsh Areas
- Standardized categories to allow for comparisons between other projects with similar features

Transects & Quads

- Track plant community and structure evolution in small sample areas re-visited each monitoring event
 - Transect Plot Points
 - Structure Plot Points

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32

Routine Monitoring

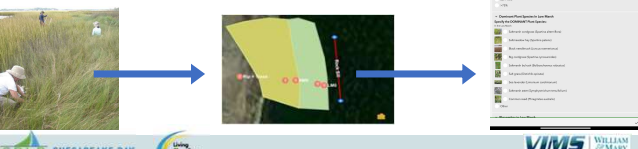
Monitoring Events - Different reasons for monitoring based on timeline

- As-Built (post construction)
- Long Term (annual, semi-annual)
- Post Storm

Observations & Characterizations - Some metrics do not require intensive analysis

- Basic performance like fish & wildlife, upland bank characterization

Data collected in forms stored in each feature



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33

Future Monitoring Data Collection & Sharing

Living Shoreline community monitoring website

- Monitoring manual, appendices, plant guides, etc.
- Dashboard - to view and export data collected

Dashboard Capabilities

- Display summary performance metrics & highlight changes over time
 - E.g., average oyster density, plant cover, plant diversity, average marsh width
- Report generation (includes map of site and performance measures)
- Each organization can export their collected data



34

Ryan Resilience Lab Field Exercise



We will venture outside and review monitoring metrics for Planted Marsh Areas and Marsh Zones



- ✓ Rock Sill
- Structure Plot Point
- Low Marsh Zone
- High Marsh Zone
- Transect Plot Point
- Low Marsh Planted Area
- High Marsh Planted Area
- 📷 Photo Station



35

Contact Information



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36
