Increasing resilience and reducing risk through successful application of nature based coastal infrastructure practices in New England: The Maine Approach

Funding from:
OFFICE FOR COASTAL MANAGEMENT
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Why are we researching living shorelines?

- Increase in requests for permitting of shoreline stabilization projects, especially for **coastal bluffs** (both developed and undeveloped). As a result, there has been an increased interest from municipalities for "softer" approaches

- NOAA funded Project of Special Merit: ***Building Resiliency Along Maine's Bluff Coast***

- NOAA-funded regional project: ***High Resolution Coastal Inundation Modeling and Advancement of Green Infrastructure and Living Shoreline Approaches in the Northeast (Phase I)***

- NOAA-funded regional project: ***Increasing resilience and reducing risk through successful application of nature based coastal infrastructure practices in New England (Phase II)***

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Outcomes:

State of the Practice Report

https://www.conservationgateway.org/ConservationPractices/Marine/Pages/new-england-living-shorelines.aspx

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Outcomes: Living Shoreline Profile Pages

Dune – Natural
Dune – Engineered Core
Beach Nourishment
Coastal Bank – Natural
Coastal Bank – Engineered Core
Natural Marsh Creation/Enhancement
Marsh Creation w/Toe
Living Breakwater

Living Shorelines Introduction

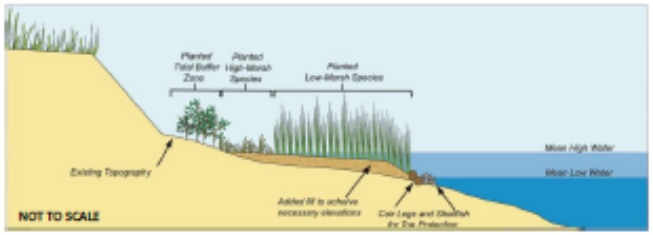
A detailed profile page was created for each of the eight (8) living shoreline types listed below. The purpose of these profile pages is to provide a comprehensive overview of the design recommendations, siting criteria and regulatory topics pertinent to a range of living shorelines designs that practitioners and regulators can use as a quick reference in the field or as an informational tool when educating home owners.

Living Shoreline Types

1. Dune – Natural
2. Dune – Engineered Core
3. Beach Nourishment
4. Coastal Bank – Natural
5. Coastal Bank – Engineered Core
6. Natural Marsh Creation/Enhancement
7. Marsh Creation/Enhancement w/Toe Protection
8. Living Breakwater

Design Schematics

The following living shoreline profile pages provide an example design schematic for each of the eight living shoreline types. Each schematic shows a generalized cross-section of the installed design. In addition, they illustrate each design's location relative to MHW and MLW, whether plantings are recommended, if fill is required, and any other major components of the design. It is important to note that these are not full engineering designs, and due to each sites unique conditions, a site specific plan, developed by an experienced practitioner is required for all living shoreline projects. Also note that these design schematics are meant to provide a general concept only, and are not drawn to scale.



Case Study

One example case study, with the following information, is provided for each living shoreline type.

Project Proponent	The party responsible for the project.
Status	The status of the project (i.e. design stage, under construction, or completed) and completion date if appropriate.
Permitting Insights	This section notes any specific permitting hurdles that occurred, or any regulatory insights that might help facilitate similar projects in the future.
Construction Notes	This section identifies major construction methods or techniques, any unique materials that were used, or deviations from a traditional design to accommodate site specific conditions.
Maintenance Issues	If the project is complete and has entered the maintenance phase, this section will note whether the project has functioned correctly, if it is holding up, and/or if any specific maintenance needs have been required since construction.
Final Cost	This section provides costs for the project, broken down into permitting, construction, monitoring, etc. when possible.
Challenges	This sections highlights any unique challenges associated with a particular project and how they were handled.

Explanation of Design Overview Tables

Materials	A description of materials most commonly used to complete a living shoreline project of this type.
Habitat Components	A list of what types of coastal habitats are created or impacted by a living shoreline project of this type.
Durability and Maintenance	Although specific timelines are impossible to provide in this context, general guidelines and schedules for probable maintenance needs, and design durability are detailed here.
Design Life	Although specific design life timelines will vary by site for each living shoreline type, this section provides some insight into factors that could influence design life.
Ecological Services Provided	This section provides an overview of the ecological services that could be provided or improved through the installation of that particular type of living shoreline project.
Unique Adaptations to NE Challenges (e.g. ice, winter storms, cold temps)	This section provides any unique practices or design improvements that could be made to improve the performance of the design given New England climactic and tidal challenges.

Acronyms and Definitions

cy	Cubic yards; one cubic yard equal 27 cubic feet. Project materials are often measured in cubic yards.
MHW	Mean High Water: The average of all the high water (i.e. high tide) heights observed over a period of time.
MTL	Mean Tide Level: The average of mean high water and mean low water.
MLW	Mean Low Water: The average of all the low water (i.e. low tide) heights observed over a period of time.
SAV	Submerged aquatic vegetation, which includes seagrasses such as eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*).
Sediment	Naturally occurring materials that have been broken down by weathering and erosion. Finer, small-grained sediments are silts or clays. Slightly coarser sediments are sands. Even larger materials are gravels or cobbles.

Misquamicut Beach Dune Restoration, Westerly, RI
Photo courtesy of Janet Friedman

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https://www.conservationgateway.org/ConservationPractices/Marine/crr/Documents/FINAL_CombinedProfilePages_7_12_2017.pdf

Outcomes: Living Shoreline Profile Pages

Dune – Natural
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Living Breakwater

Living Shorelines Introduction

Overview of Regulatory and Review Agencies Table

This table is intended to provide a comprehensive list of all the regulatory and review agencies that would potentially need to be contacted for a particular type of living shoreline project. State agencies are listed separately for each of the five coastal northeast states (Maine, New Hampshire, Massachusetts, Rhode Island and Connecticut). Federal agencies that may need to be contacted for a project in any state are also listed. Note that these lists represent the full range of potential agencies. If projects do not exceed certain thresholds (e.g. extending below MHW, exceeding a certain footprint area) they may not be required to contact or receive a permit from all agencies listed.

City Beach Nourishment, Warwick, RI
Photo courtesy of Janet Freedman

Reef Ball Living Breakwater and Marsh Restoration
Stratford, CT
Photo courtesy of Jennifer Mattei

Use and Applicability of Profile Pages

The profile pages that follow have been developed to improve the understanding of eight (8) different living shoreline designs. They have been designed to facilitate communication among the public, regulators, practitioners and researchers and to provide a common starting place for more detailed design discussions to follow. They are one of many resources available to those interested in coastal resilience. The compact layout provides a printable 11" x 17" page that can be used in the field or office. The format captures the primary focus areas required to identify which living shoreline designs are a good fit for a specific site (note that there may be multiple living shoreline options for some sites). The reader is presented with specific site characteristics, a conceptualization of the overall design, the challenges and benefits associated with each living shoreline design type, identification of the regulatory agencies involved in approving a design, and an illustration of how all of those components come together in a case study for each living shoreline type. These profile pages are expected to be updated periodically as more data become available. These profile pages should not take the place of a more comprehensive site evaluation and design process, but are intended to help further engage stakeholders and experts in an informed discussion about various living shoreline types.

Explanation Key for Siting Characteristics and Design Considerations

Selection Characteristics	Definitions and Categories
ES Energy State	A measure of the wave height, current strength and storm surge frequency of a site that would be suitable for a particular living shoreline project type. **High**: Project site has waves greater than 5 feet, strong currents, high storm surge **Moderate**: Project site has 2 to 5 foot waves, moderate currents, moderate storm surge **Low**: Project site has waves less than 2 feet in height, low current, low storm surge
EE Existing Environmental Resources	Existing environmental resources that a proposed living shoreline project is able to overlap with. **Coastal Bank** **Salt Marsh** **Vegetated Upland** **Coastal Dune** **Mudflat** **Coastal Beach** **Subtidal**
SR Nearby Sensitive Resources	Nearby sensitive resources that, with proper planning and design, may be compatible with a particular living shoreline type. **Endangered/Threatened Species** **Submerged Aquatic Vegetation (SAV)** **Shellfish** **Cobble or Rocky Bottom Habitat**
TR Tidal Range	The magnitude of tidal range at a site that would be suitable for a particular type of living shoreline design. **High**: Tide range at project site is more than 9 feet **Moderate**: Tide range at project site is between 3 and 9 feet **Low**: Tide range at project site is less than 3 feet
EL Elevation	The elevation, with respect to the tide range, where a particular living shoreline project type should be sited. **Above MHW**: Project footprint is entirely above MHW **MHW to MLW**: Project footprint is located within the intertidal zone **Below MLW**: Project footprint is located in subtidal areas
IS Intertidal Slope	The intertidal slope appropriate for siting a particular living shoreline project type. **Steep**: Project site has an intertidal slope steeper than 3:1 (base:height) **Moderate**: Project site has an intertidal slope between 3:1 and 5:1 (base:height) **Flat**: Project site has an intertidal slope flatter than 5:1 (base:height)
BS Bathymetric Slope	The nearshore bathymetric slope appropriate for siting a particular living shoreline project type. **Steep**: Project site has an bathymetric slope steeper than 3:1 (base:height) **Moderate**: Project site has an bathymetric slope between 3:1 and 5:1 (base:height) **Flat**: Project site has an bathymetric slope flatter than 5:1 (base:height)
ER Erosion	The rate of coastal erosion at a site that would be suitable for a particular living shoreline project type. **High**: Erosion at project site is high (>3 feet/year) **Moderate**: Erosion at project site is moderate (1-3 feet/year) **Low**: Erosion at project site is low (<1 foot/year)

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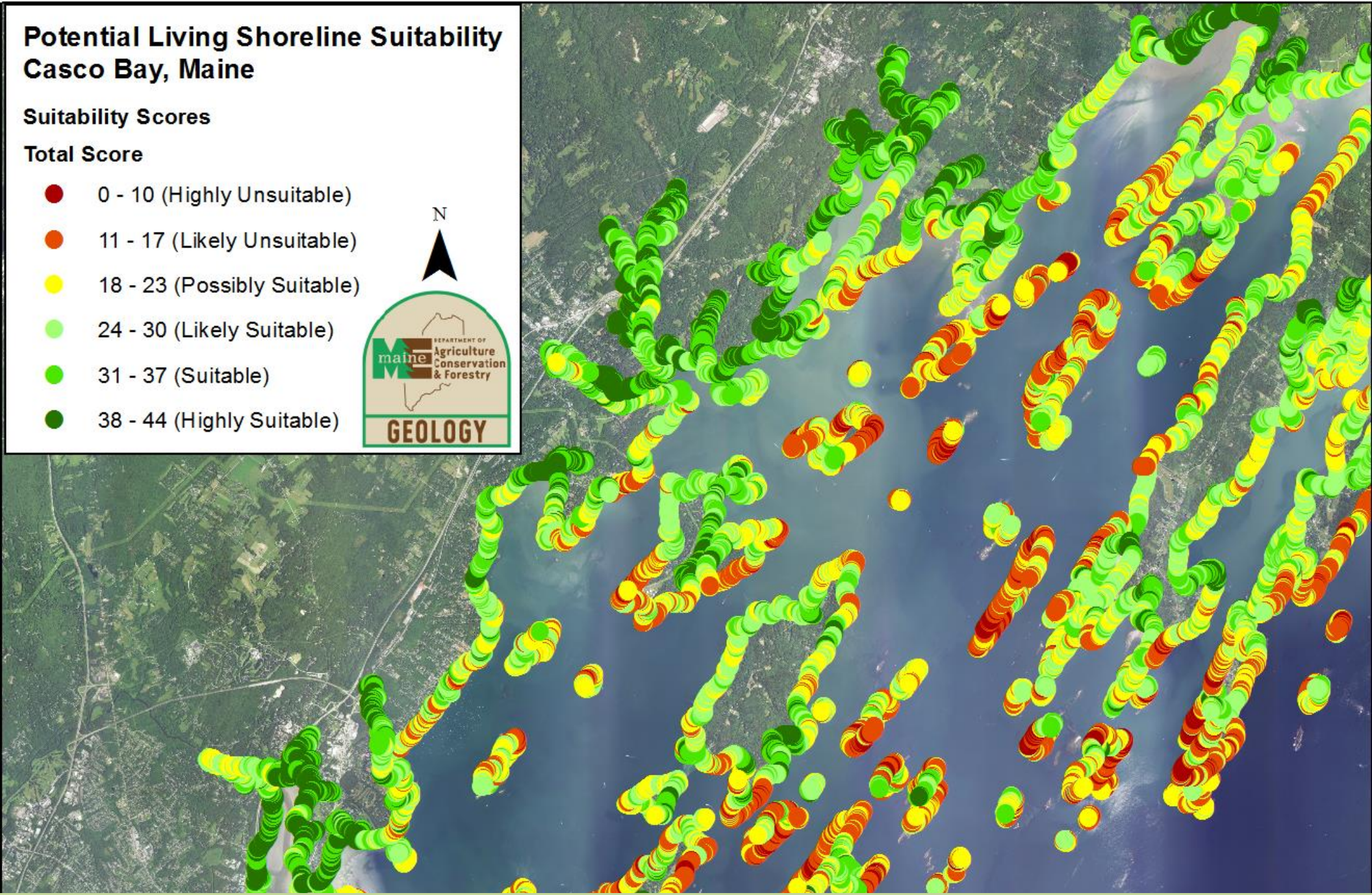
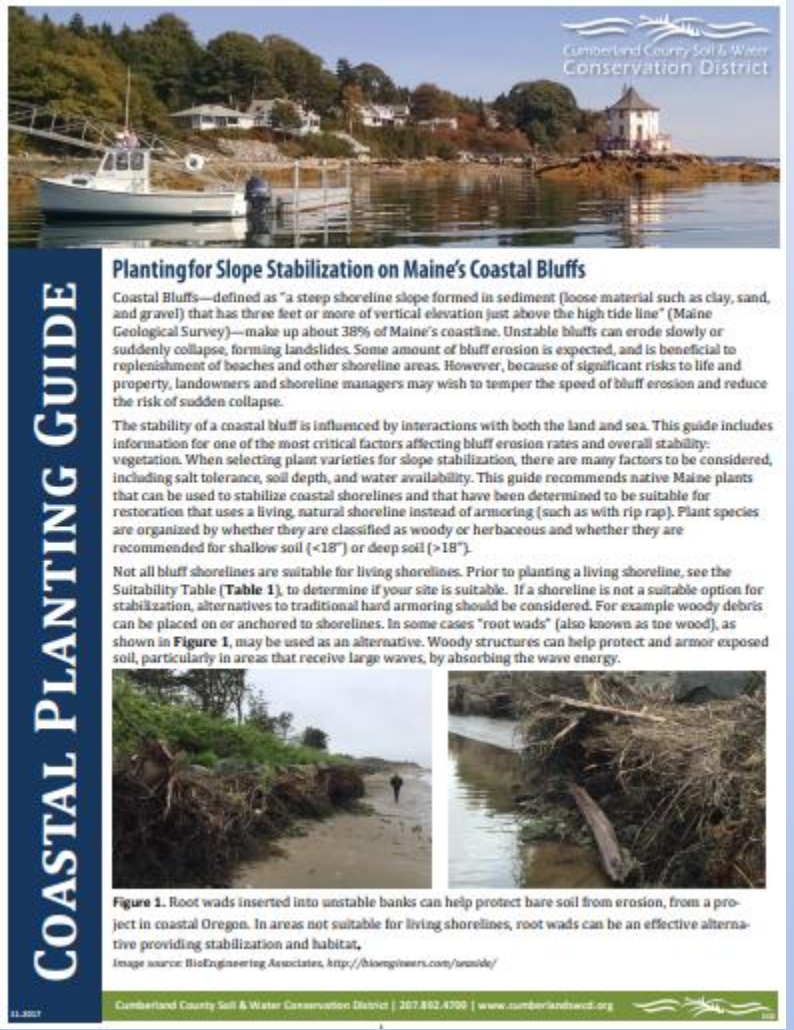
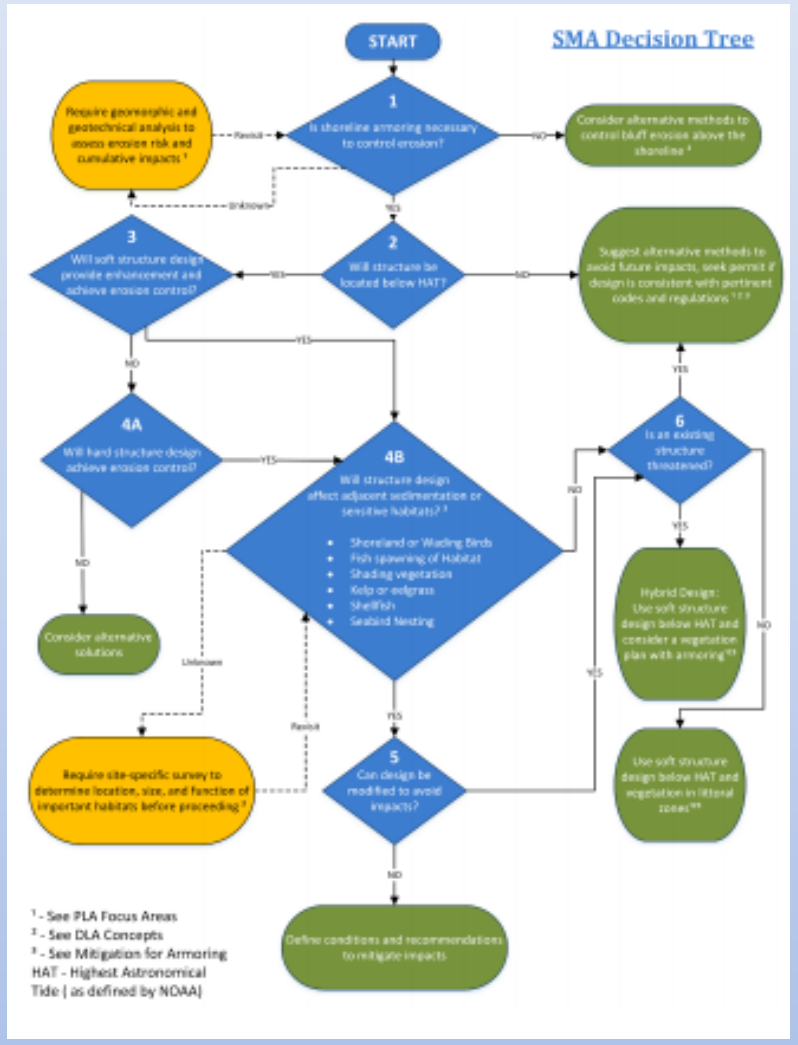
https://www.conservationgateway.org/ConservationPractices/Marine/crr/Documents/FINAL_CombinedProfilePages_7_12_2017.pdf



Outcomes: MGS GIS-based decision support tool for **living shoreline suitability**

Outcomes: Cumberland County Soil and Water Conservation District





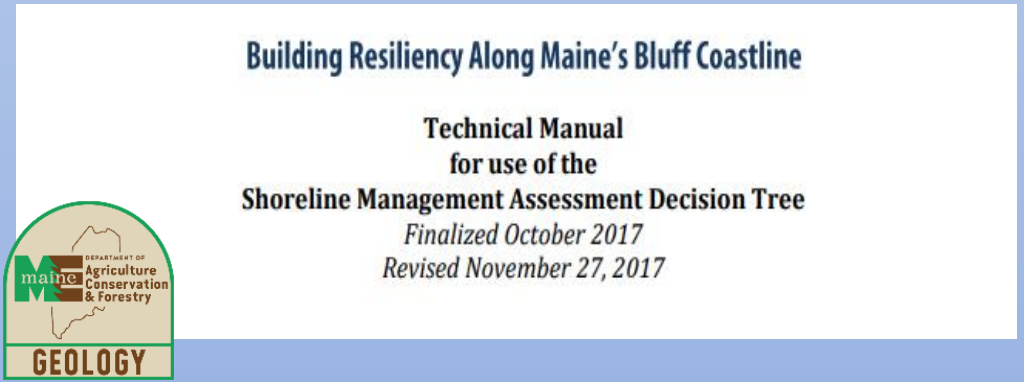
Shoreline Management Assessment Decision Tree

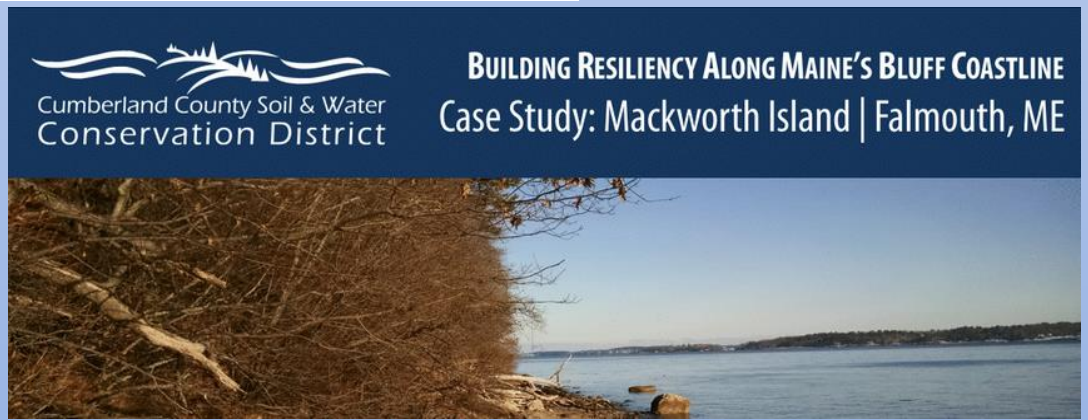
Shoreline Management Assessment Chart

Technical Manual

Case Studies in Casco Bay

Bluff Planting Guide





Outcomes: Regulatory Considerations

- There are **numerous regulatory challenges** regarding permitting of living shorelines in New England, mostly relating to activities in regulated resources. As a result, it is **generally easier to receive a permit to construct a rip-rap wall outside of a regulated resource than it is to pursue a living shoreline in a regulated resource**.

- There are **unique physical challenges in New England** facing living shorelines (e.g., tide, ice, decreased growing season, etc.).

- Monitoring protocols **are not standardized and not implemented in a way to develop science and learn from mistakes**.

- There are **few projects actually "in the ground"** in New England making it difficult to develop a better understanding of living shoreline **efficacy, potential short and long-term benefits and impacts on regulated resources.**

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The goals of the current NOAA grant effort are to:

(1) develop **standardized New England-wide guidance and metrics** for nature-based coastal infrastructure project siting, design, permitting, construction/maintenance, and **monitoring**, identifying research priorities, and funding mechanisms;

(2) Implement and/or monitor nature-based coastal infrastructure projects; and

(3) increase capacity and awareness of regulators, planners, practitioners, coastal property owners, and the general public of the issues of coastal inundation and erosion, while considering the potential effectiveness, co-benefits, and expanded application of nature based coastal adaptation strategies, where appropriate.

In order to achieve these overall goals, Maine decided to pursue a project that **includes the design, permitting, construction, and monitoring of lower cost living shoreline demonstration treatments that beneficially reuse materials in Casco Bay, ME**.

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Maine Direct Project Partners

State

NGO

Municipal/NGO

With participation from:

Site Selection: characteristics

- Eroding bluff or marsh toe
- Ownership
- Access
- High Living Shoreline Suitability (MGS matrix)
- Relatively straight/consistent shore type
- Approximately 150 feet (if possible)
- Representative geography/geology
- Proximity to mapped special habitat types
- Educational opportunity
- Proximal previous or additional work

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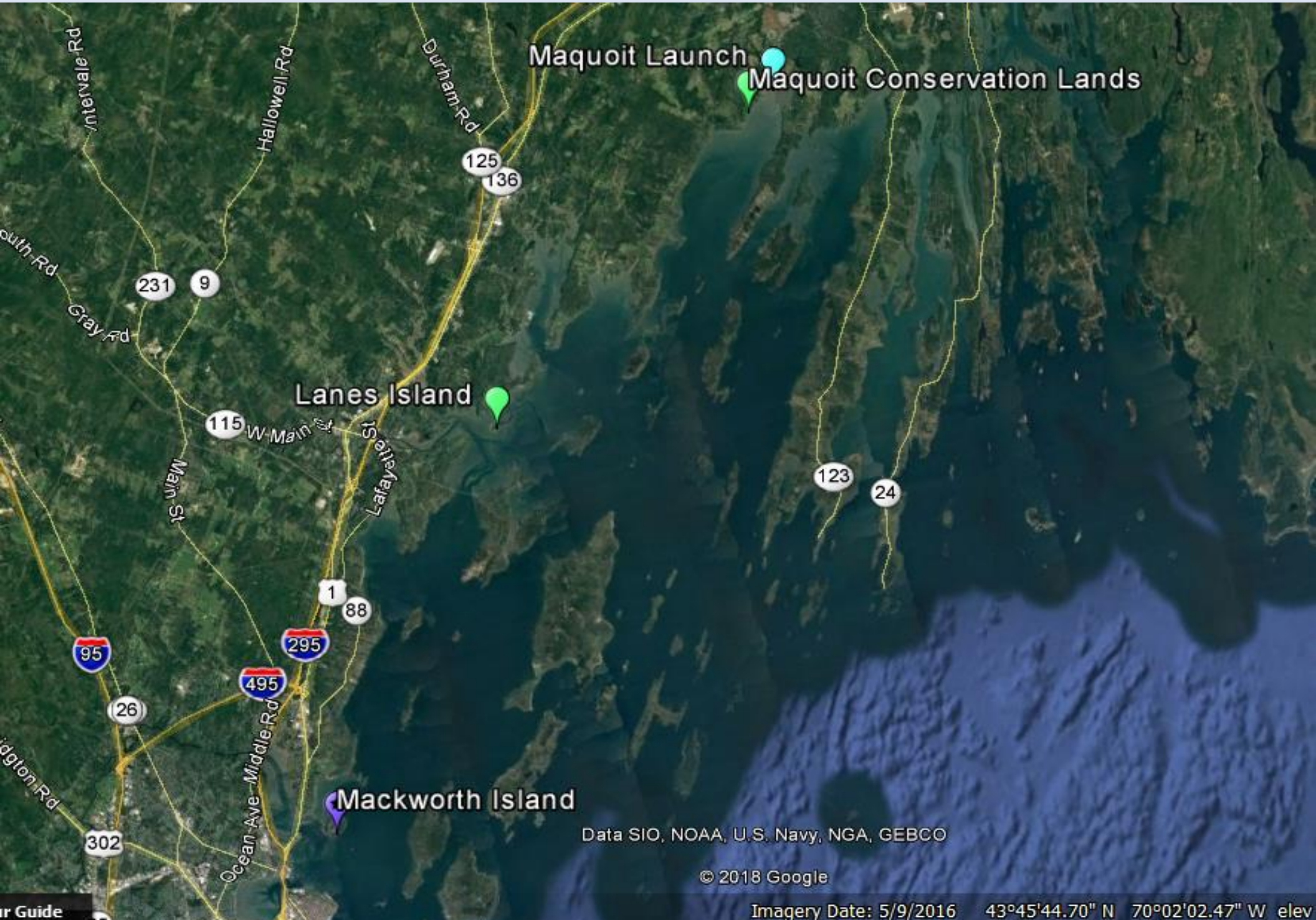
Potential Demonstration Sites




Potential Living Shorelines
Demonstration Sites
N
Potential Demonstration Site
bluff
marsh
upland
marsh
maine
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Maquoit Launch, Wharton Point (Brunswick)
Marsh toe
100 50 0 100 Feet


Potential Living Shorelines
Demonstration Sites
N
Potential Demonstration Site
maine
DEPARTMENT OF
Agriculture
Conservation
& Forestry
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Unstable bluff
Stable bluff
mudflat
marsh
Maquoit Bay Conservation Lands (Brunswick)
Marsh and/or bluff
50 25 0 50 Feet


Potential Living Shorelines
Demonstration Sites
N
Potential Demonstration Site
Lanes Island, Yarmouth
Bluff and/or marsh
500 250 0 500 Feet
maine
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& Forestry
GEOLOGY


maine
DEPARTMENT OF
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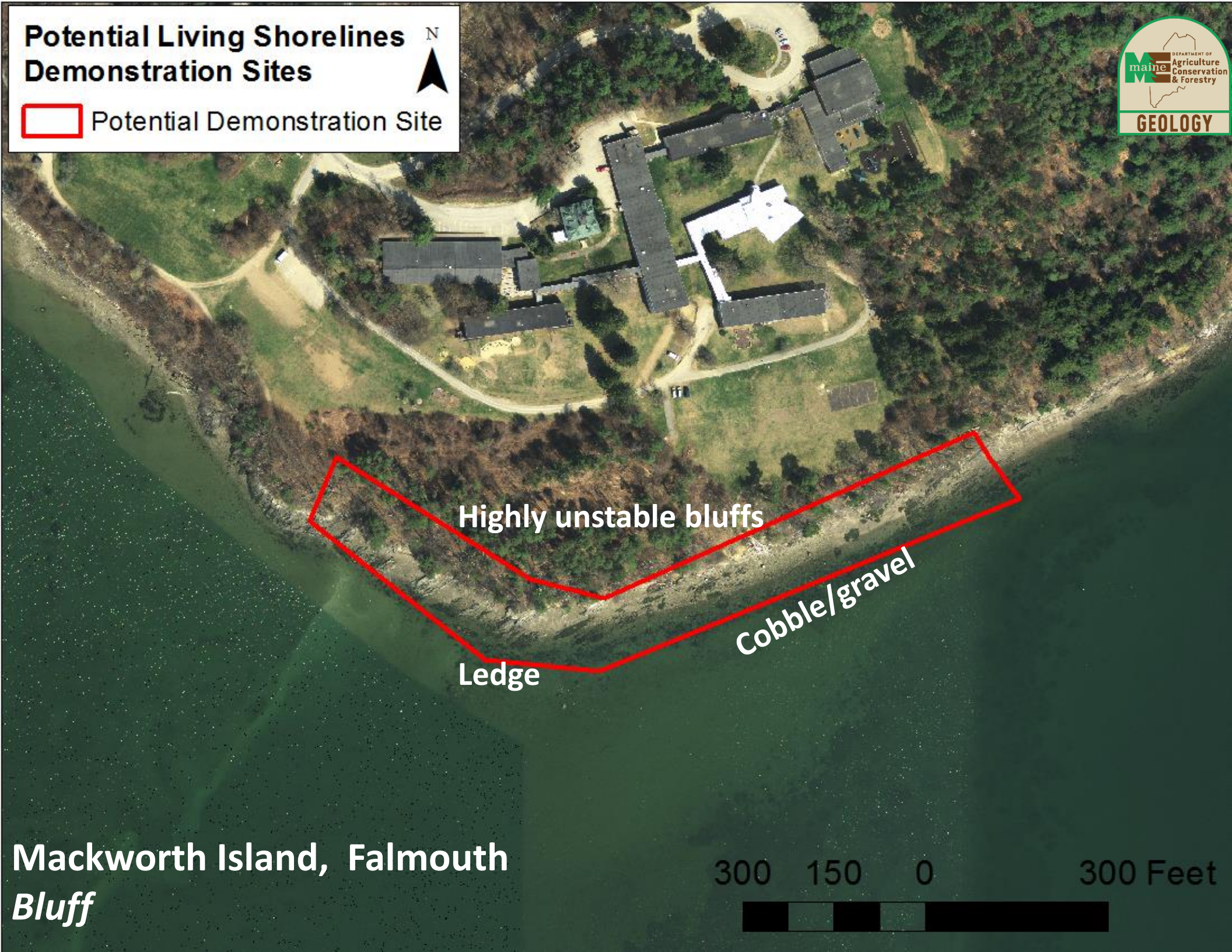
Stable bluff
beach
Fringe marsh
Unstable bluff
beach
0
75
150 Feet
Lanes Island, Yarmouth
Bluff and/or marsh


Potential Living Shorelines
Demonstration Sites
N
Potential Demonstration Site
maine
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& Forestry
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Highly unstable bluffs
Cobble/gravel
Ledge
Mackworth Island, Falmouth
Bluff
300 150 0 300 Feet

Initial Demonstration Treatment Concepts for Living Shoreline Sites in Casco Bay

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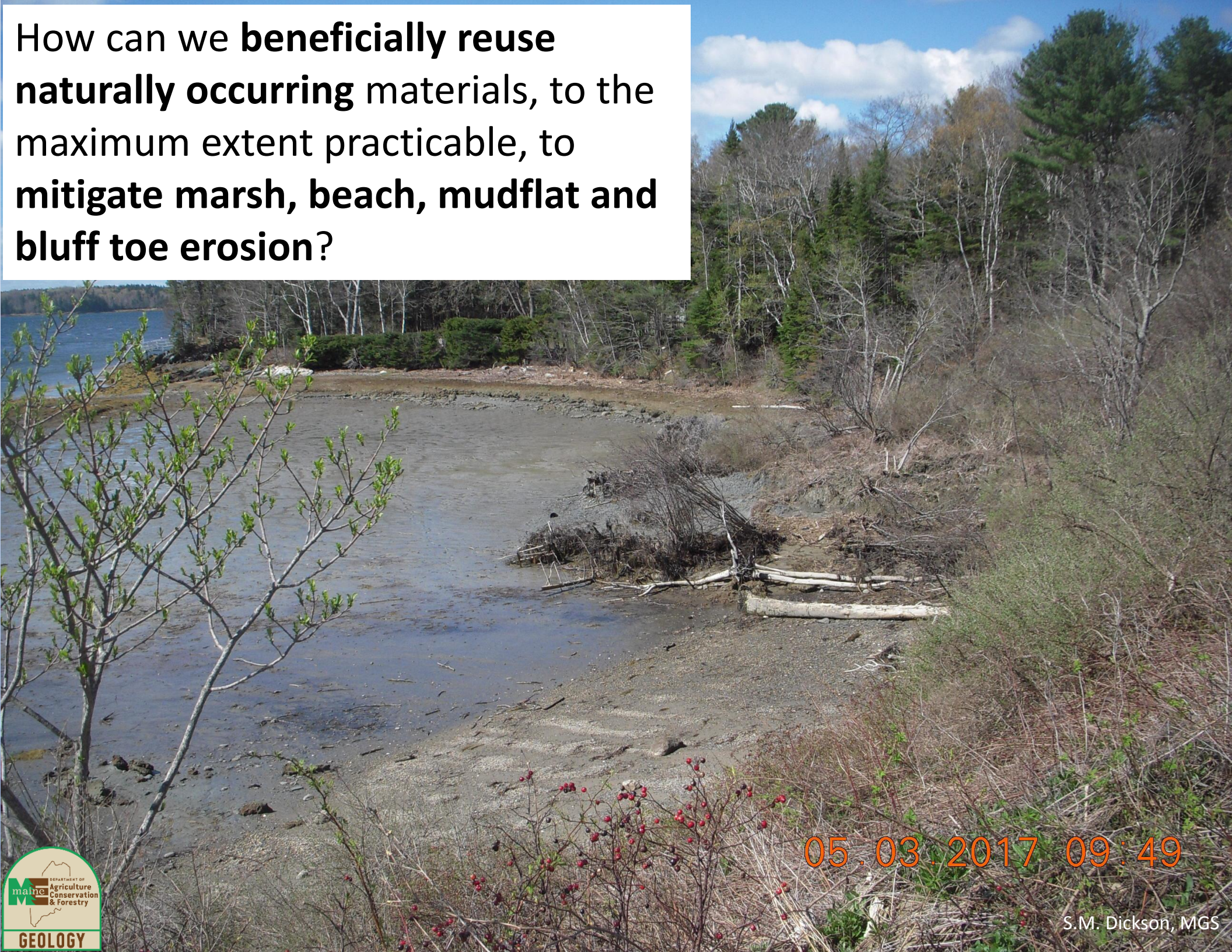
P.A. Slovinsky, MGS

How can we **beneficially reuse naturally occurring** materials, to the maximum extent practicable, to **mitigate marsh, beach, mudflat and bluff toe erosion**?



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Tires? (Just kidding…)

S.M. Dickson, MGS

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How can we beneficially reuse fallen trees?

http://gravelbeach.blogspot.com/2016/04/

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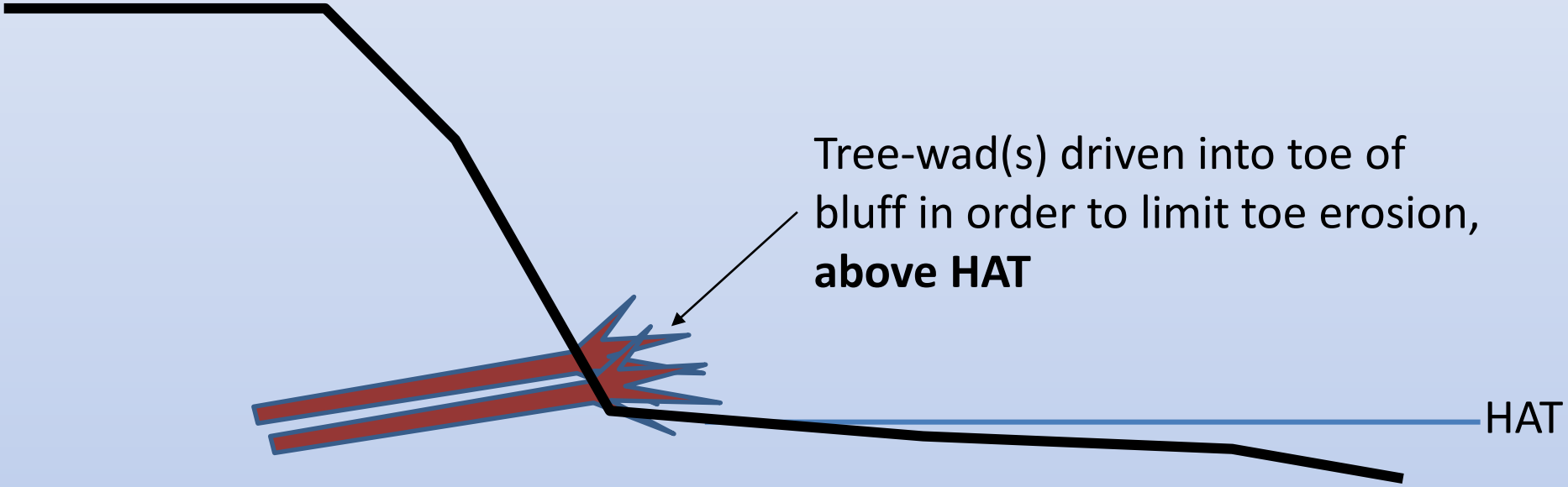
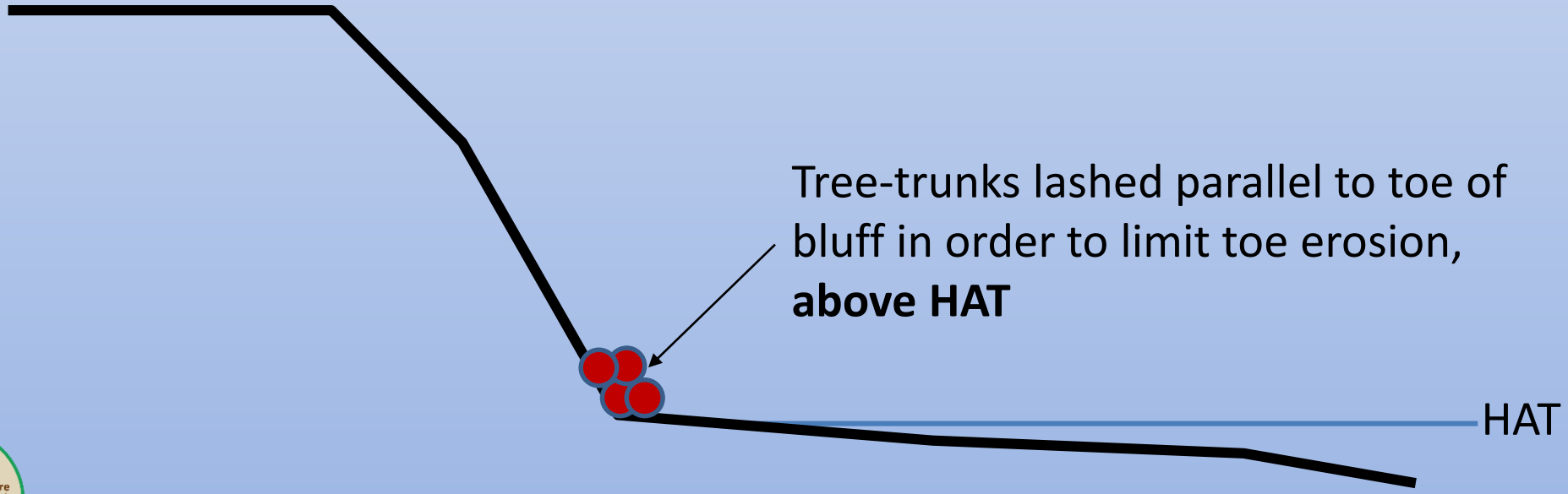
Potential beneficial re-use of fallen trees (toe of bluff)





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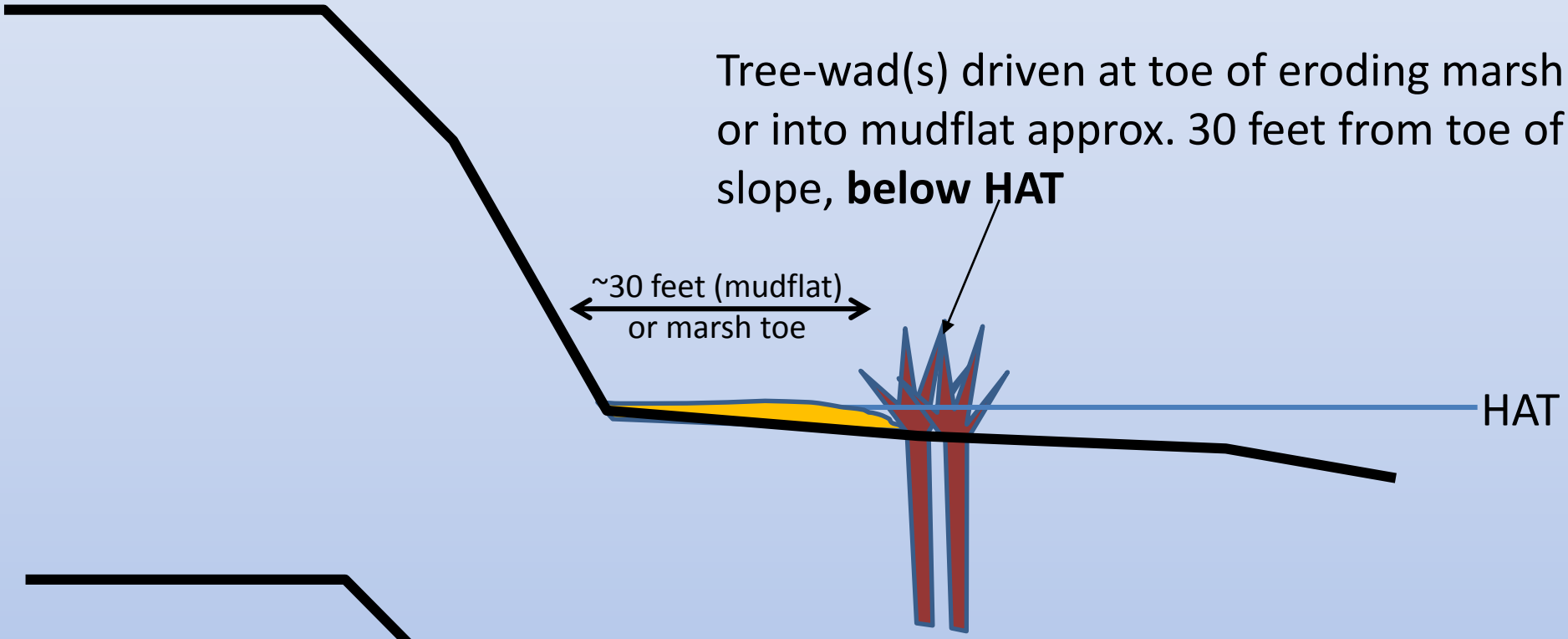
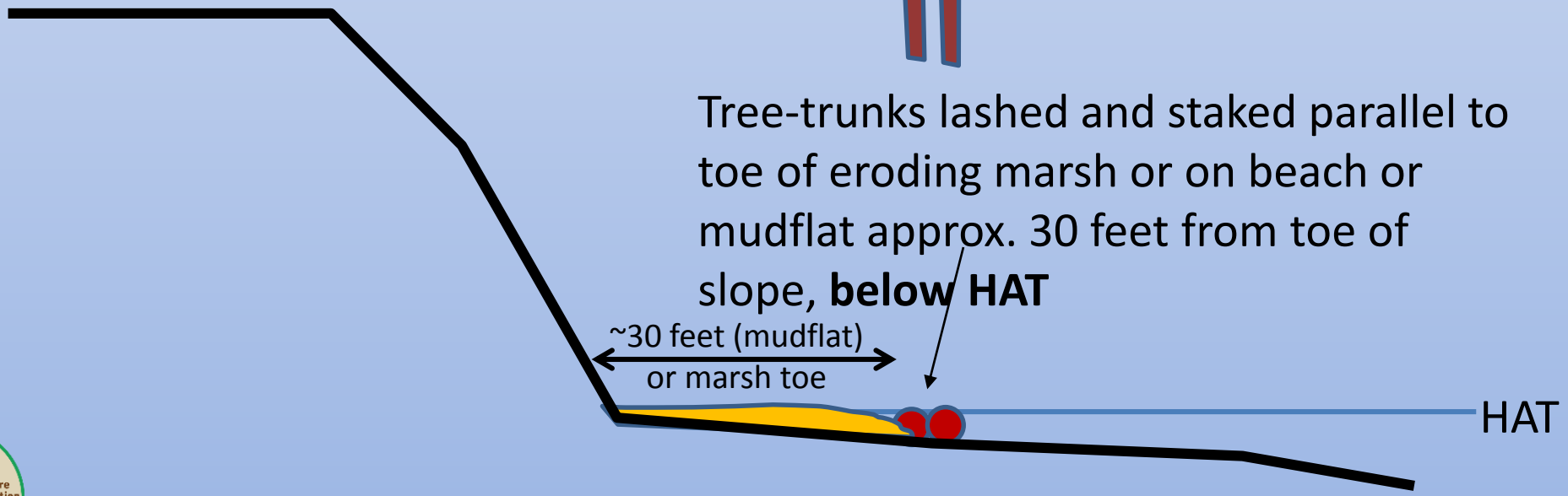
draft - for discussion only; final designs determined by engineer

Potential beneficial re-use of fallen trees (marsh, beach or mudflat)





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How can we beneficially reuse oyster and/or clam shell?

North Carolina Coastal Federation

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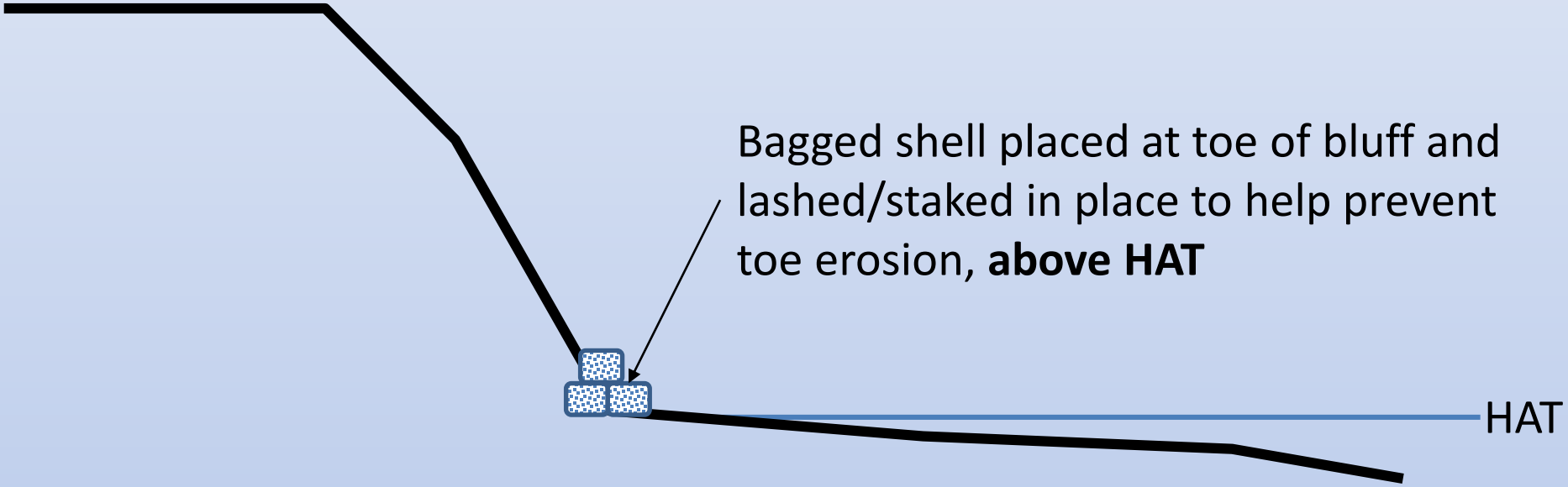
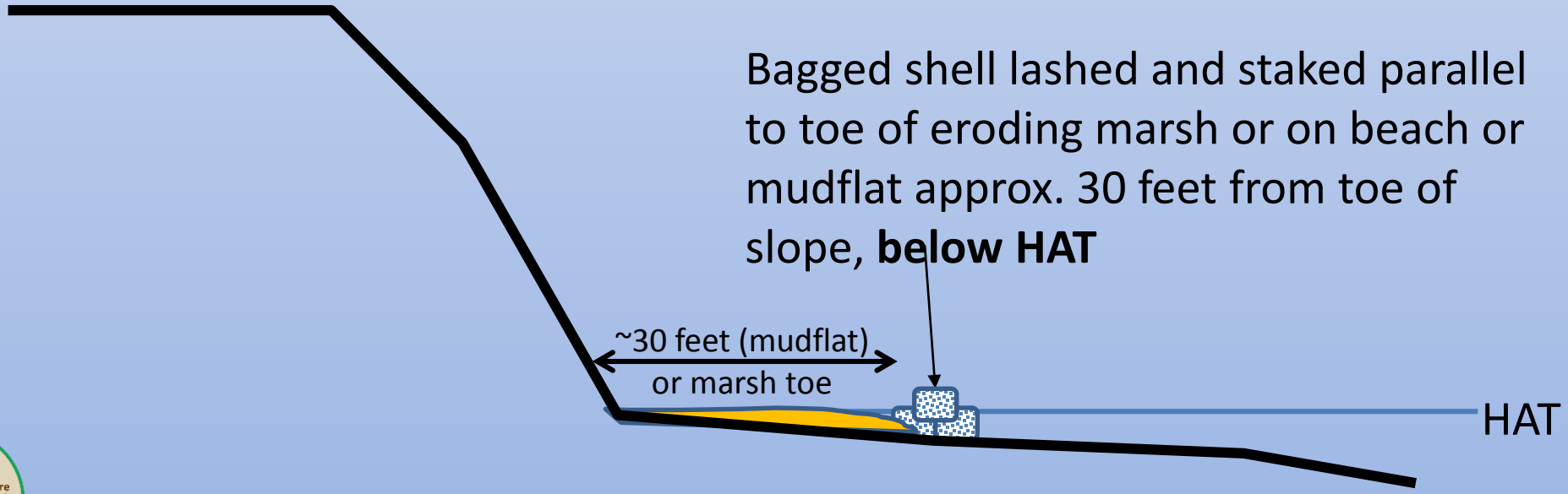
Potential beneficial re-use of shell material





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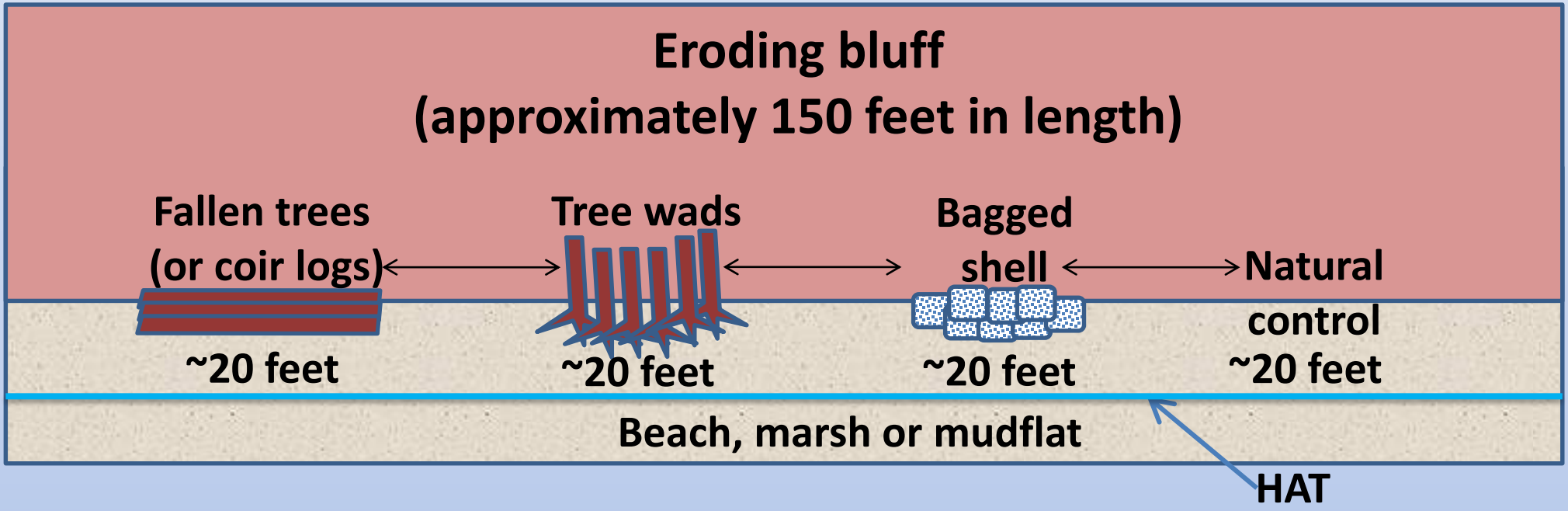
Example Demonstration Treatment Site
(toe of bluff – *above HAT*)



Approximate *20-25 foot demonstration treatments* with *10-15 foot spacing* in between treatments, 3 treatments per site with a natural control. *Above HAT.*

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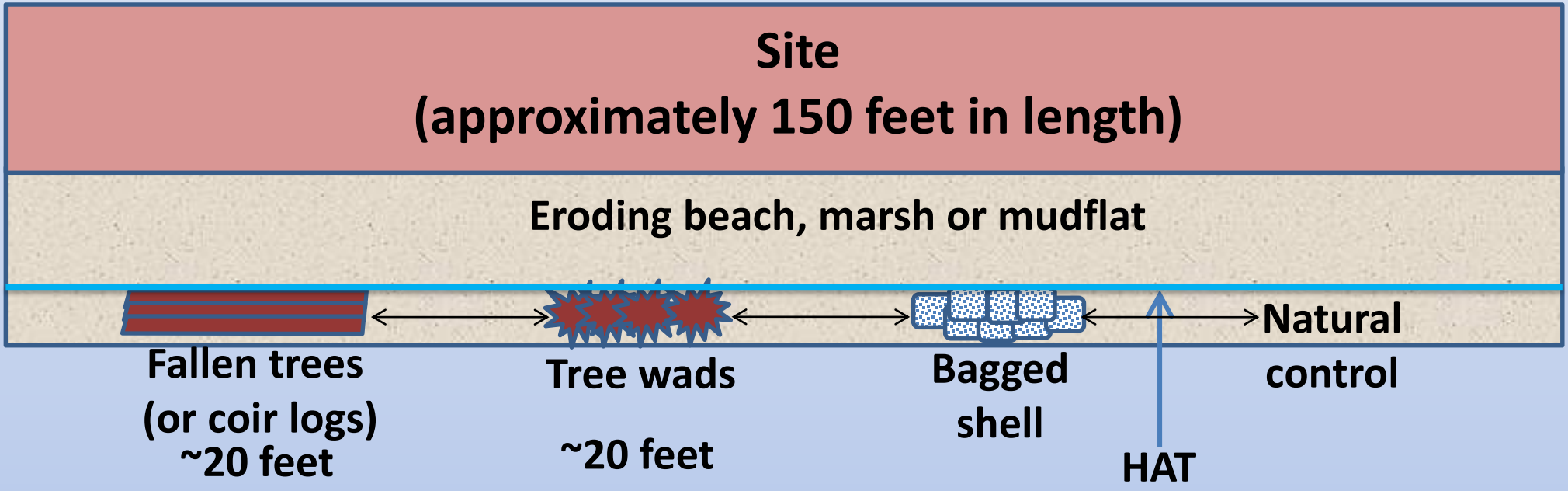
draft - for discussion only; final designs determined by engineer

Example Demonstration Treatment Site
(on beach or mudflat, or toe of marsh – *below HAT*)



Approximate *20-25 foot demonstration toe treatments*, placed approximately *30 feet from bluff (on mudflat or beach) or at fringing marsh toe,* with *10-15 foot spacing* in between treatments, 3 treatments per site with a natural control. *At or below HAT.*

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draft - for discussion only; final designs determined by engineer

Living Shoreline Project Next Steps…

- Regional workshop with **state and federal commenting and review agencies to investigate monitoring protocols**
- **Final engineering design, permitting, and construction** of demonstration treatments at four publicly-owned locations in Casco Bay
- **Implementation of monitoring protocol(s)** (Spring and Fall) at treatments. Volunteers?

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