CIRCULAR NO. 18-6

Title: Going Green - Furthering Living Shorelines in Maine Workshop Proceedings

Author: Peter A. Slovinsky (editor)

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Going Green – Furthering Living Shorelines in Maine

**Audience:** Engineers, landscape architects, consultants, designers interested in incorporating green infrastructure and living shoreline stabilization techniques into projects around coastal Maine.

Planning and Engineer credits will be available

**Date:** April 6, 2018  **Time:** 8:30 AM – 3:30 PM

**Location:** Great Portland Council of Governments Conference Room, 970 Baxter Boulevard, Portland, ME

**Objectives:**
1. Learn about living shoreline approaches for erosion control and habitat restoration and enhancement.
2. Learn about local and regional living shoreline project efforts.
3. Identify challenges, opportunities, lessons learned, and next steps for encouraging permitting, design and implementation of living shoreline projects on public and private properties.
4. Provide updates on regulatory aspects of getting living shorelines in the ground.
5. Obtain tools and strategies for executing a successful living shoreline project.
6. Create a community of practitioners interested in living shoreline design in coastal Maine and the region.

**Agenda**

**8:15-8:30**  Sign in, Networking and Continental Breakfast

**8:30-9:00**  Welcome, objectives, introductions, background on project/workshop, agenda (Chris Feurt, WNERR; Kathleen Leyden, MCP; Peter Slovinsky, MGS)

**9:00-10:30**  Mackworth Island Field Trip (Peter Slovinsky, MGS; Troy Barry, Headwaters Hydro)

Mackworth Island site visit - coastal bluff environment with erosion and upland hydrology issues; assess issues using different decision support tools. Include case study information on property, assessment information. Field trip sets the stage for discussion of potential LS solutions. Summarize site issues and factors influencing noted during site visit.

**10:30-11:00**  Return to GPCOG, restroom break and snacks

**11:00-12:00**  Small Group Debrief on Mackworth Field Trip

11:00-11:30 – Convene in 3 to 4 small breakouts with large aerials of site. What else did you notice at the site? What would you do here for a solution? Why? Each group digs into project site and develops options for mitigating shoreline erosion.

11:30-12:00 – ReConvene as large group to report out on concepts and designs.

**12:00-12:45**  Lunch Provided, networking and discussion

**12:45-1:00**  Review of state and federal permitting requirements and challenges (Marybeth Richardson, MEDEP; Jay Clement, USACE)

**1:00-2:00**  NOAA Living Shorelines 2.0 Project Updates

1:00-1:30 – NOAA Living Shorelines Maine Project Update (Peter Slovinsky, MGS; Curtis Bohlen, CBEP)
1:30-2:00 – NOAA Living Shorelines NH Project Update (Tom Ballestero, UNH)

2:00-2:45  **Living Shoreline Panel**
Analysis by practitioners and engineers on challenges, opportunities, lessons learned as it relates to living shorelines projects in Maine. Participants: MDOT, Troy Barry, Headwaters Hydro; Barney Baker, Baker Design Consultants; and Jon Edgerton, Wright Pierce.

2:45-3:15  **Facilitated Group Discussion**
What were common themes, challenges and lessons learned? How do we further living shorelines in Maine? How do we best engage other consultants and engineers? Property owners? Develop a list of next steps and where we go from here.

3:15-3:30  **Conclusion and Workshop Evaluation**

3:30  **Adjourn and Networking**
On Friday, April 6, approximately 50 stakeholders from around Maine gathered at the Greater Portland Council of Governments office in Portland, ME to learn and share information on “living shorelines” in Maine. The workshop, funded by NOAA and organized by the Maine Coastal Program (MCP), Maine Geological Survey (MGS), Maine Department of Transportation (MDOT), and Wells National Estuarine Research Reserve (WNERR), included a variety of participants, including consulting geologists, engineers, and landscape architects, state and federal regulators and scientists, municipal planners and engineers, and coastal property owners.

After an introduction and orientation to the workshop by MCP Director Kathleen Leyden and WNERR Director of Coastal Training Christine Feurt and participant introductions, the day kicked off with a field trip to visit unstable bluffs at Mackworth Island. MGS Marine Geologist and field trip coleader Peter Slovinsky provided several background slides before participants boarded vans to head in the field. Field trip leaders Troy Barry of Headwaters Hydro 5, LLC (formerly of Cumberland County Soil and Water Conservation District) and Peter Slovinsky of MGS led participants through cold, windy, and icy conditions to observe several failing bluffs, learn about factors causing erosion, and ways to assess instability. Participants completed an instability assessment rating form developed by Cumberland County Soil and Water Conservation District and adapted by Headwaters Hydro. The field trip set the stage for group discussions on evaluating potential living shoreline solutions once we returned to a warm office!

After returning, attendees broke out into four different working groups, each evenly comprised of engineers, architects, scientists and regulators, to work on discussing what they saw in the field and develop potential living shoreline solutions at one of the observed sites at Mackworth Island. Each group then presented its results to all participants and an open discussion on potential techniques followed. Troy Barry ended the session presenting proposed engineering designs at Mackworth Island using living shoreline techniques.

After lunch, Marybeth Richardson of Maine DEP and Jay Clement of the US Army Corps of Engineers discussed with the audience the latest issues related to permitting of living shoreline techniques. Afterwards, Peter Slovinsky of MGS and Curtis Bohlen of the Casco Bay Estuary Partnership provided presentations on an ongoing NOAA-funded northeast regional project geared
towards furthering living shorelines in New England. This was followed by a presentation by Joel Ballestero of the University of New Hampshire providing updates on NH’s efforts on the same project.

Next, living shoreline practitioners provided updates on their experiences with living shorelines in Maine, challenges encountered, and lessons learned. Presenters included Charlie Hebson of Maine DOT, Barney Baker of Baker Design Consultants, Jon Edgerton of Wright-Pierce, and Troy Barry of Headwaters Hydro. This was followed by an “expert panel” in which the audience and presenters from the entire day had an open discussion on common themes, challenges, and logical next steps for living shorelines in Maine. The day ended with an evaluation of the workshop. Minutes from the overall workshop are available here, thanks to excellent notetaking by the WNERR’s Emily Greene. Thanks to all who attended and see you at the next workshop!

This workshop was made possible through a NOAA Grant, “Advancing Green Infrastructure and Living Shorelines Applications in the Northeast,” supporting coastal resilience and living shorelines work in northeastern states from Connecticut to Maine.
Going Green – Furthering Living Shorelines in Maine

Workshop support and planning:

With funding from:
Workshop Objectives:

1. Learn about **living shoreline approaches** for erosion control and habitat restoration and enhancement.
2. Learn about **local and regional** living shoreline project efforts.
3. Identify challenges, opportunities, lessons learned, and **next steps** for encouraging permitting, design and implementation of living shoreline projects on public and private properties.
4. Provide **updates on regulatory aspects** of getting living shorelines in the ground.
5. Obtain **tools and strategies** for executing a successful living shoreline project.
6. Create a **community of practitioners** interested in living shoreline design in coastal Maine and the region.
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)**
Workshop Abbreviated Agenda:

8:15-8:30 - Sign in, Networking and Continental Breakfast
8:30-9:00 - Welcome, objectives, introductions, background on project/workshop, agenda
9:00-10:30 - Mackworth Island Field Trip
10:30-11:00 - Return to GPCOG, restroom break and snacks
11:00-12:00 - Small Group Debrief on Mackworth Island Field Trip
   11:00-11:30 – Small group breakouts
   11:30-12:00 – Reconvene, report out on concepts and designs
12:00-12:45 – Lunch, networking and discussion
12:45-1:00 - Review of state and federal permitting requirements and challenges
1:00-2:00 – NOAA Living Shorelines 2.0 Project Updates
   1:00-1:30 – Living Shorelines Maine Project Update
   1:30-2:00 – Living Shorelines NH Project Update
2:00-2:45 – Living Shoreline Practitioner’s Panel
2:45-3:15 – Facilitated Group Discussion with Panel
3:15-3:30 – Conclusion and Workshop Evaluation
3:30 – Adjourn and Networking
What’s a “Living Shoreline”? 

Living shoreline is a broad term that encompasses a range of shoreline stabilization techniques along estuarine coasts, bays, sheltered coastlines, and tributaries. A living shoreline:

- has a footprint that is made up **mostly of native material**.
- **incorporates vegetation** or other living, natural “soft” elements **alone or in combination with** some type of harder shoreline structure (e.g. oyster reefs or rock sills) for added stability.
- **maintains continuity of the natural land–water interface** and reduce **erosion** while providing **habitat value** and enhancing **coastal resilience**.

Adapted from NOAA’s Guidance for Considering the Use of Living Shorelines (2015)
Most of Maine’s experience with “living shorelines” has been related to dune restoration, construction and beach nourishment along the open coast sand dune system. This comprises only about 2% of Maine’s coastline.
About 48% of our coastline is comprised of unconsolidated bluff. Eroding bluffs have traditionally been “stabilized” using rip-rap placed above the highest annual tide.
Mackworth Island, Falmouth Field Trip
COASTAL INSTABILITY ASSESSMENT RATING DATA SHEET

Shoreline:                        Rating: 
Bluff/Tidal Marsh/Mud Flat/Low Bank:                          
Date: 
Photo(s): 

Overall Bluff Condition                Good <16 Fair >16<25 Poor >25

BANK ASSESSMENT

<table>
<thead>
<tr>
<th>Category / Parameter / Measurement Method</th>
<th>Good (1)</th>
<th>Fair (2)</th>
<th>Poor (3)</th>
<th>Rating (1/2/3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Hydrology / Runoff / Ponding</td>
<td>No alteration of upland drainage</td>
<td>Minimal overland drainage changes above shoreline site. Does not adversely affect hydrology or result in concentrated flow (point discharge)</td>
<td>Surface drainage is reporting to the study site and has an adverse affect on bank site. Water is ponded above the bank. Seepage may be present.</td>
<td></td>
</tr>
<tr>
<td>2 Hydrology / Runoff / Concentrated Flow</td>
<td>No apparent concentrated flow or channelized flow from adjacent land use</td>
<td>Some concentrated flow/channelizing directed to site, however, measures are in place to protect resources</td>
<td>Concentrated flow/channelization to bank site and no treatments are in place</td>
<td></td>
</tr>
<tr>
<td>3 Hydrology / Runoff / Land Use Change</td>
<td>Upland area is primarily native vegetated (&gt;70%) mix of shrubbery and trees. Trees larger than 12&quot; diameter are a minimum of 20' from top of bank.</td>
<td>Land development occurring or active agricultural practices occurring in upland area, vegetated area 20 - 70%. 12&quot; diameter trees 5-20' from top of bank.</td>
<td>Land use is urban or primarily active agricultural practices (&gt; 70%), vegetated area &lt;20%. 12&quot; diameter trees 5' or less to top of bank, roots may be exposed.</td>
<td></td>
</tr>
<tr>
<td>4 Hydrology / Runoff / Distance to Roads</td>
<td>No roads in or adjacent to site (20' or closer). No proposed roads in or adjacent to site in 10 year plan.</td>
<td>No roads in or adjacent to site (20' or closer). No more than one major road proposed in 10 year plan.</td>
<td>Roads located in or adjacent to site boundary (5-20') and/or roads proposed.</td>
<td></td>
</tr>
<tr>
<td>5 Hydrology / Runoff / Seepage</td>
<td>Upland runoff as a result of rainfall patterns, geology, and soils does not result in seepage in bank.</td>
<td>Upland runoff as a result of rainfall patterns, geology, and soils results in seepage in &lt;10% of the bank</td>
<td>Upland runoff as a result of rainfall patterns, geology, and soils results in seepage from &gt;10% of the bank.</td>
<td></td>
</tr>
<tr>
<td>6 Geomorphology / Riparian Vegetation</td>
<td>&gt;80% of contributing shoreline length has &gt;25 ft corridor width - dense vegetation</td>
<td>50 - 80% of contributing shoreline length has &gt;25 ft corridor width - average vegetation</td>
<td>&lt;50% of contributing shoreline length has &gt;25 ft corridor width - low density vegetation</td>
<td></td>
</tr>
<tr>
<td>7 Geomorphology / Sediment Supply</td>
<td>Low soil erosion - bank erosion shows no recent change or loss. There are few runnels/gulleys present on the bank face.</td>
<td>Moderate soil erosion. Bank erosion is occurring, visual change and loss. There are several runnels/gulleys on the bank face &lt;0.5' deep.</td>
<td>High soil erosion - bank erosion is occurring, change is measurable. There are numerous runnels/gulleys &gt;0.5' deep.</td>
<td></td>
</tr>
<tr>
<td>8 Bank Slopes</td>
<td>Slopes range from 3 to 8%.</td>
<td>Slopes 8 to 20%. Toe erosion beginning</td>
<td>Slopes 20% and greater or undercut toe.</td>
<td></td>
</tr>
<tr>
<td>9 Bank Height vs. High Tide Elevation</td>
<td>High Tide Elevation is at or near Top of Bank</td>
<td>High Tide Elevation is 1/3 below Top of Bank</td>
<td>High Tide Elevation &gt; 1/3 below Top of Bank</td>
<td></td>
</tr>
<tr>
<td>10 Soil Properties: Particle Size / Stratification</td>
<td>Bedrock and boulders make up the bank. Or, cohesive soil types (sand/gravel mix) mixed evenly.</td>
<td>No bedrock or boulders, cohesive soils (sand/gravel mix) are dominant and mixed equally. Clay to very stony sandy loam.</td>
<td>Soils are non-cohesive and/or highly stratified. Sand/gravel mix with larger percentage of sand, sandy loam, silt,</td>
<td></td>
</tr>
<tr>
<td>11 Density of Roots / Bank Surface Protection of Total Bank Height with Roots</td>
<td>Surface Protection = 80-100%. Root Density in Bank = 80-100%. Root depth/Bank Height = 1.0-0.9</td>
<td>Surface Protection = 55-79%. Root Density = 55-79%. Root depth/Bank Height = 0.5-0.89</td>
<td>Surface Protection &lt; 55%. Root Density &lt; 55%. Root depth/Bank Height &lt; 0.5</td>
<td></td>
</tr>
<tr>
<td>12 Biology / Landscape Connectivity</td>
<td>Shoreline of project and adjacent area to project area has native bank and vegetation materials. No rip-rap of hardened structures installed.</td>
<td>Shoreline of project and adjacent area has native vegetation and bank materials but is impaired by invasives and/or rip-rap and/or hardened armoring installed.</td>
<td>Shoreline of project and/or adjacent area is hardened by a concrete headwall, or rip-rap or other structure. Limited vegetation present.</td>
<td></td>
</tr>
</tbody>
</table>

This Instability Rating Form was developed to the Maine Coastal Program/Maine Department of Agriculture, Conservation and Forestry by the Cumberland County Soil and Water Conservation District. This work was supported by the National Oceanic and Atmospheric Administration (NOAA) Coastal Zone Management Cooperative Agreement #NA14NOS4190047 pursuant to the Coastal Zone Management Act of 1972 as amended. Note that the assessment form was further adapted for an April 6, 2018 workshop by Headwaters Hydro, LLC. For more information about the Maine Geologic Survey, contact mgsg@maine.gov or 207-387-3801. For more information about the MCP, visit www.mainecoastalprogram.org or 207-287-2051.
COASTAL INSTABILITY ASSESSMENT RATING DATA SHEET

MLW – Mean Low Water  UB – Upper Bank  T- Toe
HAT – Highest Avg Tide  LB – Lower Bank  ^^^ - Seepage Line  - >6”Tree  - <6”Tree
C–Clay  BR–Bedrock  S-Sand  Si-Silt  L-Loam  B-Boulder  Co-Cobble  G-Gravel

Bank Sketch

Site Sketch
<table>
<thead>
<tr>
<th>Group Number</th>
<th>Comments/Questions</th>
<th>Strategies and Solutions</th>
</tr>
</thead>
</table>
| **Group 1**  | Justification for purpose:  
- Overall bank assessment – poor.  
- Costs to relocate path  
- Low costs  
- Movement of sediment and toe  
- Understanding of hydrology and infiltration | • Move path back.  
- Infiltration? Water seeping out.  
- Cut off drain  
- Movement of water above: control seepage, vegetative buffer at upland, bank upslope improvement, coir logs with plantings, oyster bags and aquaculture, willow, speckled alder, low growing sumac.  
- American beach grass: substrate improvement. |
| **Group 2**  | Questions:  
- What are the future conditions? Due to SLR and climate change.  
- What exactly are the shoreland zone regulations? | • Add a large aggregate rock, but allow seepage and water flow without taking sediment with it.  
- Floating attenuator (logs), stakes with rope ties  
- Filter fabric, coir blankets  
- Ice, ice, ice  
- Logs braced by trees to slow water  
- Bedrock location, is it shallow to bedrock? Insufficient to establish plants.  
- Correct profile at HAT  
- Friable soils, surface runoff  
- Rhizomes  
- Bedrock anchors  
- Increase complexity of entering wave: wave attenuation builds up energy  
- Establish temporary stage  
- Cutting trees = more sun.  
- Ground water on slope |
| **Group 3**  | NA | • Boulders to attenuate waves  
- Cut vulnerable trees but leave root balls to avoid future soil loss.  
- Lay tree across the sites  
- Groundwater discharge at toe of slope  
- Top of bank – encourage more of buffer and logs to catch material, organic component to interrupt slope side  
- Terracing like Pocket Beach  
- Need to get into intertidal zone or it will become subtidal. |
| **Group 4**  | Constraints and opportunities:  
- Use of path  
- Water runoff  
- No vegetative buffers  
- Fetch  
- Seepage  
- Positioning of ledge  
- Poor soil stability  
- Type of vegetation (understudy)  
- Expose toe of slope | • First define what is the mechanism for engineering specific structures.  
- Plant material.  
- Water diversion using vegetative buffers.  
- Changing type of foot path.  
- Slope: plant natives that are native to the upper part of slope, also get plants that are salt water tolerant to ocean spray.  
- Use big rocks, “natural” distribution boulders that are big enough to keep toe down.  
- Combination of big rocks, coir logs, logs, root wads.  
- Salt marsh plugs maybe, if the environment is marsh. |
Going Green
Living Shorelines Maine
Using a Instability Rating and Decision Tree
For Living Shoreline & Stabilization Alternatives
Shoreline Management Assessment (SMA)

- Reconnaissance Level Assessment (RLA)
- Prediction Level Assessment (PLA)
- Design Level Assessment (DLA)

Developed by Troy Barry
Reconnaissance Level Assessment (RLA)

1. Compile Existing Data
2. Review Landscape History
   - Historical Aerials, USGS Quads, Post Land Use, and landscape modifications
3. Identify activities potentially affecting sediment supply and bluff stability
   - Current land use, structures, vegetation, upland hydrology
4. Identify Specific Process Relationships
   - Instability Assessment Rating
Instability Assessment Rating (Step 2 of RLA)

- 12 Parameters
- Good (1): 1-15
- Fair (2): 16-27
- Poor (3): 28-36

Refer to your handout
Prediction Level Assessment (PLA)

Develop Prediction Level Assessment (PLA)
Use GIS based suitability analysis to create an initial desktop ranking, to be applied in greater detail to focus areas as follows

- Inventory Mass Erosion
  - Symptomatic (vegetation, infrastructure, etc.)

- Inventory Surface Erosion
  - 2074 Planning Areas, Retaliatory charts, etc.

- Inventory Hillside Processes
  - Visual Assessment

- Assess Hydrologic Processes
  - HydroCAD
    - Surface & Groundwater
    - Hydraulic, Soil Properties
    - Soil Stability
    - Soil Assessment
      - Soil Permeability
      - Soil organic class
      - Available Water Capacity (AWC)

- Analyze Shoreline Processes
  - Analysis, etc.

- Identify/Inventory Shoreline Changes
  - Detection

- Inventory Direct Impacts to Shoreline and Bluff Form
  - Stream/river structures

RLA/PLA Verification

Place, Process, and Sources
Mackworth Island Site #4 (RLA)
Design Level Assessment (DLA)

Design Level Assessment (DLA)
Recommendations for Shoreline Stability

Nearshore/Intertidal Zone
- Select Areas, Bluffs for further Assessment, Develop Bluff Management Plan(s)

Concepts
- Rootwad
- Breakwater
- Log Roll
- Vegetation Plan
- Mud Flat
- Salt Marsh

Upland/Riparian Zone
- Eliminate Area, where elevated, and/or Buff areas that do not contribute to the embankment

Concepts
- Raingarden
- Infiltration
- Rainfall Diversion
- Disconnect Stormwater infrastructure
- Reduce Impervious Cover
- Vegetation Plan
- Reduce runoff velocity with cascade stop pool design
Living Shoreline Concepts

- Coir Roll & Live Staking
- Rootwads & Woody Planting
- Vegetation Dissipation
- Oyster Shell Bags
Conceptual DLA on Mackworth Island

Mackworth Island, Falmouth, ME Site 4 Topography (2006 LiDAR)
Conceptual DLA on Mackworth Island
Conceptual DLA on Mackworth Island

Site 4 Topography

Typical Single Log Free Body Diagram

Log Orientation (Plan View)
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

GEOLOGY
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

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Outcomes:

State of the Practice Report

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

A detailed profile page was created for each of the eight living shorelines 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 Shorelines Introduction

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 site unique conditions, a site specific, 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 specific site 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 section 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 climatic and tidal challenges.

Acronyms and Definitions

**Cubic yards; one cubic yard equal 27 cubic feet.**

- **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.

Outcomes: Living Shoreline Profile Pages

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

Overview of Regulatory and Review Agencies Table

Use and Applicability of Profile Pages

Explanation Key for Siting Characteristics and Design Considerations

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

Building Resiliency Along Maine’s Bluff Coastline

Technical Manual

for use of the

Shoreline Management Assessment Decision Tree

Finalized October 2017
Revised November 27, 2017

COASTAL PLANTING GUIDE

Planting for Slope Stabilization on Maine’s Coastal Bluffs

Coastal Bluffs—defined as a steep shoreline slope formed in sediments (boulder material such as clay, sand, and gravel) that drops three feet or more of vertical elevation just above the high tide line—(Maine Geological Survey)—make up about 30% of Maine’s coastline. Unstable bluffs can erode slowly or suddenly collapse, forming landslides. Some amount of bluff erosion is expected, and is beneficial to the replacement of beaches and other shoreline areas. However, because of significant risks to life and property, landowners and shoreline managers may wish to temper the speed of bluff erosion and reduce the risk of sudden collapse.

The stability of a coastal bluff is influenced by interactions with both the land and sea. This guide includes information for one of the most critical factors affecting bluff erosion rates and overall stability: vegetation. When selecting plant varieties for slope stabilization, there are many factors to be considered, including salt tolerance, soil depth, and water availability. This guide recommends native Maine plants that can be used to stabilize coastal shorelines and that have been determined to be suitable for restoration that uses a living, natural shoreline instead of armor (such as with rip rap). Plant species are organized by whether they are classified as woody or herbaceous and whether they are recommended for shallow soil (<18") or deep soil (>18").

Not all bluff shorelines are suitable for living shorelines. Prior to planting a living shoreline, see the Suitability Table (Table 1) to determine if your site is suitable. If a shoreline is not a suitable option for stabilization, alternatives to traditional hard armoring should be considered. For example, woody debris can be placed on or anchored to shorelines. In some cases, “root wads” (also known as live wood), as shown in Figure 1, may be used as an alternative. Woody structures can help protect and armor exposed soil, particularly in areas that receive large waves, by absorbing the wave energy.

Figure 1. Root wads inserted into unstable banks can help protect bare soil from erosion, from a project in coastal Oregon. In areas not suitable for living shorelines, root wads can be an effective alternative to providing stabilizing habitats. Image source: BlueEngineering Associates, http://blueengineering.com/inside/

Cumberland County Soil & Water Conservation District  |  207-827-4786  |  www.cumberlandwcd.org

Building Resiliency Along Maine’s Bluff Coastline

Cumberland County Soil & Water Conservation District

Case Study: Mackworth Island | Falmouth, ME

Building Resiliency Along Maine’s Bluff Coastline

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Building Resiliency Along Maine’s Bluff Coastline

Cumberland County Soil & Water Conservation District

Case Study: Mackworth Island | Falmouth, ME
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.**
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.**
Maine Direct Project Partners

State

- Maine DOT
- Maine Department of Agriculture, Conservation, and Forestry

NGO

- Casco Bay Estuary Partnership
- The Nature Conservancy
- Maine Coast Heritage Trust

Municipal/NGO

- Town of Brunswick, Maine
- Brunswick-Topsham Land Trust

With participation from:

- Maine Department of Environmental Protection
- Maine State Marine Resources
- Maine State Department of Environmental Protection
- NOAA
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
Maquoit Launch, Wharton Point (Brunswick)
Marsh toe
Lanes Island, Yarmouth
Bluff and/or marsh
Unstable bluff

beach

Lanes Island, Yarmouth
Bluff and/or marsh

Stable bluff
beach

Fringe marsh
Highly unstable bluffs
Mackworth Island, Falmouth Bluff
Ledge
Cobble/gravel
Initial Demonstration Treatment Concepts for Living Shoreline Sites in Casco Bay
How can we beneficially reuse naturally occurring materials, to the maximum extent practicable, to mitigate marsh, beach, mudflat and bluff toe erosion?
Tires? (Just kidding...)
How can we beneficially reuse fallen trees?
Potential beneficial re-use of fallen trees (toe of bluff)

Tree-wad(s) driven into toe of bluff in order to limit toe erosion, above HAT

Tree-trunks lashed parallel to toe of bluff in order to limit toe erosion, above HAT
Potential beneficial re-use of fallen trees
(marsh, beach or mudflat)

Tree-wad(s) driven at toe of eroding marsh or into mudflat approx. 30 feet from toe of slope, below HAT

Tree-trunks lashed and staked parallel to toe of eroding marsh or on beach or mudflat approx. 30 feet from toe of slope, below HAT
How can we beneficially reuse oyster and/or clam shell?
Potential beneficial re-use of shell material

Bagged shell placed at toe of bluff and lashed/staked in place to help prevent toe erosion, **above HAT**

Bagged shell lashed and staked parallel to toe of eroding marsh or on beach or mudflat approx. 30 feet from toe of slope, **below HAT**

draft - for discussion only; final designs determined by engineer
Example Demonstration Treatment Site (toe of bluff – above HAT)

- Eroding bluff (approximately 150 feet in length)
  - Fallen trees (or coir logs)
  - Tree wads
  - Bagged shell
  - Natural control

- Beach, marsh or mudflat

Approximate 20-25 foot demonstration treatments with 10-15 foot spacing in between treatments, 3 treatments per site with a natural control. Above HAT.
Example Demonstration Treatment Site
(on beach or mudflat, or toe of marsh – below HAT)

<table>
<thead>
<tr>
<th>Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>(approximately 150 feet in length)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site Components</th>
<th>Approximate Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eroding beach, marsh or mudflat</td>
<td>~20 feet</td>
</tr>
<tr>
<td>Fallen trees (or coir logs)</td>
<td>~20 feet</td>
</tr>
<tr>
<td>Tree wads</td>
<td>~20 feet</td>
</tr>
<tr>
<td>Bagged shell</td>
<td></td>
</tr>
<tr>
<td>Natural control</td>
<td></td>
</tr>
</tbody>
</table>

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.*
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?
MONITORING LIVING SHORELINE PROJECTS IN MAINE
New England Tides
Conceptual Framework

- National models based on multilayered systems
- Proposed designs in Maine somewhat simpler
- Monitoring should reflect that

Source: VIMS Center for Coastal Resources Management
http://ccrm.vims.edu/wetlands/livingshoreline_intro.html
Conceptual Shoreline Cross Section

- Upland
- Bluff
- Transition
- High Marsh
- Low Marsh

Questions:
- Oyster?
- Softshell Clam?
- Eelgrass?
Considerations

• Monitoring framework that works across states and sites
  • NOT identical, but comparable

• How will information be used?
  • Target audience? D

• Discussion with other states:
  • What questions need to be answered?
  • Are there core METRICS that apply everywhere?

• Controlling costs and level of effort
Case Studies

- Few sites in each of the New England States

- Focus on performance at each site

- Generalization to future projects is based on
  - (1) Sites representative of future projects (“Case Studies”)
  - (2) A generalized exposure gradient
  - (3) “Post stratifying” sites based on site-level characteristics
Monitoring Themes and Questions

• Context
  • What are the surroundings like and how might that affect project performance?

• Do LS / GI technologies “work”?
  • Stable structures
  • Reduced shoreline erosion
  • Sediment accumulation
  • Marsh persistence

• Do they have positive ecosystem benefits?
  • Shellfish
  • Salt marsh vegetation
  • Use by fish, birds, wildlife

• Do they negative impacts?
  • Scour
  • Non-native species
Monitoring Phases

• Pre-project data
  • Site characterization
    • Examples: fetch; tidal elevations; proximity of infrastructure
  • Pre-project topography and cross sections
  • Living resources assessment

• As built documentation
  • Baseline for site evolution and change

• Performance monitoring

• End of study intensive data collection (?)
Bluff Edge Treatment

- Erosion at toe of bluff
- Migration of construction materials
- Sediment accretion and characteristics
- Bluff Toe Treatment

- Colonization by salt marsh veg
- Colonization by invasives
- Intertidal Treatment
- Migration of construction materials
- Colonization by shellfish
Monitoring Concept

- Monitoring at two levels:
  - Site
    - Wave energy
    - Fetch
    - Living resources
    - Bathymetry
  - Treatment
    - Erosion and deposition
    - Soil/sediment characteristics
    - Living resources
Method Selection

- Does metric answer the questions?
- Does method address multiple metrics? Cost? Volunteers?
- Data quality

Metrics

- Method 1
- Method 2
- Method 3
- Method 4

Parameters

Questions

- Is the shoreline eroding?
- Elevation change
- Drone overflights
- Photo stations
- Optical level
- Erosion pins
Questions

• What questions or information will be most important to regulatory agencies to support future permitting decisions?
• What kind of data quality objectives need to be met to make resulting data of value to regulatory agencies?
Not many Regional Examples....

- How’s Maine different?
  - Meso to macrotidal
  - Winter ice

From https://www.habitatblueprint.noaa.gov/storymap/ls/index.html
New Hampshire Experiences with Living Shorelines for Fringing Salt Marshes

Joel Ballestero, Tom Ballestero, David Burdick, Gregg Moore, Kirsten Howard, Cat Ashcraft
Salt marshes are among our most productive and valuable ecosystems

<table>
<thead>
<tr>
<th>Plants support food webs</th>
<th>Removal of sediments &amp; excess nutrients</th>
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</thead>
<tbody>
<tr>
<td>Secondary production</td>
<td>Aesthetic, Recreational &amp; Educational values</td>
</tr>
<tr>
<td>Plant structure for habitat</td>
<td>Self-sustaining ecosystems</td>
</tr>
<tr>
<td>Support of biodiversity</td>
<td>Long term carbon storage</td>
</tr>
<tr>
<td>Protection from flooding</td>
<td></td>
</tr>
<tr>
<td>Protection from coastal erosion</td>
<td></td>
</tr>
</tbody>
</table>
The Case for Building Salt Marshes into Living Shorelines

- Loss of 30% of historical salt marshes in NH
- Future for marshes is not bright – sea level rise and climate change at faster rates
- Salt marshes and peat develop slowly as sea levels rise – most marshes are over 1,000 years old
- Created marshes erode EVEN if LOW physical exposure
  - 1993 salt marsh creation lost 20% of area in five years in North Mill Pond
- Salt marshes protect, survive and can heal following storms
  - Gittman et al. 2014
Global Sea Level Rise Measurements (Church & White 2011) Reflected in Salt Marsh Responses Found in Great Bay

Portsmouth Tide Gauge: 1.76 mm/yr 1927-2001

Sediment Elevation Table
Great Bay Elevation change
1.7 mm/yr 95-97
4.3 mm/yr 00-11

SHORELINE TOMORROW

SEA-LEVEL RISE

PROJECTIONS

- 0.6 – 2.0 ft. by 2050
- 1.6 – 6.6 ft. by 2100

HOW TO PREPARE

1. Select time period
2. Commit to manage intermediate high
3. Adjust if necessary

Example: If the design time period is 2050-2100, commit to manage 3.9 ft. of sea-level rise, but be prepared to manage and adapt to 6.6 ft. if necessary.

www.nhcrhc.org
95 percent of existing salt marsh could be lost with 6.6 feet of sea-level rise
THE SALT MARSH SQUEEZE

marsh migration + stabilization = salt marsh squeeze
SHORELINE TODAY

12% Total Armored
70% Atlantic Coast
5% Great Bay

Blondin & Howard 2014
SHORELINE TODAY

Blondin & Howard 2014
The Case for Building Salt Marshes into Living Shorelines

• What functions and values are lost?
  • Plant productivity, food web support, secondary production, biodiversity
  • Nutrient and sediment removal from water
  • Ability to grow with sea level rise
  • Ability to reduce wave energy
  • Ability to heal following storms
  • Carbon storage
  • Aesthetic value
Atlantic silversides spawn in Spartina

Eggs Collected

- Salt Marsh
- Phragmites
- Rip-rap
- Rip-Rap-Sill
- Bulkhead
- Beach

From Balouskus & Targett 2012
Tidal Marsh Ecosystem Services
Value per Annum per Hectare

Value per Annum per Hectare
• Costanza et al. 1987: $9,900
• In 2008 $ (Gedan et al. 2009): $14,400

New Services:
• Carbon sequestration (European market): $135
• Denitrification (Piehler and Smyth 2011): $6,128

Future Services: . . . ?
Definition

• Living shorelines maintain continuity of the natural land–water interface and reduce erosion while providing habitat value and enhancing coastal resilience. (NOAA, Guidance for Considering the Use of Living Shorelines, 2015)

• Living shorelines maintain the continuity of natural land-water interface and provide ecological benefits which hard bank stabilization structures do not, such as improved water quality, resilience to storms, and habitat for fish and wildlife. (COE NWP, 2016) – Focus is EROSION
Critical Living Shoreline Components

• Continuity of shoreline water-sediment characteristics/interaction

• Habitat
  – Aquatic
  – Riparian

Does not necessarily include plants, but “Living shorelines must have a substantial biological component...” (COE, NWP, 2016)
What Is Not “Living” Shoreline?

- Bulkhead
- Seawall
- Revetment
- Groins
- Breakwater
- Sills
- Composite

However some may be components of living shoreline systems.
Shoreline Issues Addressed by Living Shoreline Solutions

• Erosion (from waves, currents—longshore drift, ice)
• Habitat loss (historic and recent losses of oyster reefs, salt marshes, tidal buffer zone)
• Sea level rise (salt marshes build with sea level rise – up to a point)
• Infrastructure protection (bridge abutments, roads, pipelines, sewers, etc.)
What Elevation Range Do We Find Salt Marsh?
Fig. 2. The elevational range of growth of *Spartina alterniflora* relative to mean tide range (MTR) at selected locations along the Atlantic and Gulf coasts (arranged in order of increasing tidal amplitude). The half tide level (HTL) is the plane midway between mean high water (MHW) and mean low water (MLW).
Salt Marsh Vegetation

• Low Marsh:
  – *Spartina alterniflora* (smooth cordgrass)

• High Marsh:
  – *Spartina patens* (salt hay)
  – *Puccinellia americana* (alkali grass)
  – *Distichlis spicata* (spike grass)
  – *Juncus gerardii* (black grass)

• Tidal Buffer Zone:
  – *Panicum virgatum* (switchgrass)
  – *Solidago sempervirens* (seaside goldenrod)
Ecozones

• Low Marsh - Near the MSL; (McKee and Patrick 1988). *Spartina alterniflora* is the only important plant.

• High Marsh - Begins at MHW and extends up to high tide line – A reasonable lower limit for a built/planted marsh might be 10 cm higher than that. Practically, it is best to plant *S. alterniflora* as much as 25 cm above MHW – it will do fine at these elevations; high marsh plants should be planted too and may replace *S. alterniflora*.

• Tidal Buffer Zone - Begins at or above the spring high tide but certainly below the highest observable tide (HOT) and extends as much as two feet higher, depending on exposure. - A transition from the highest of the high marsh plants (like seaside goldenrod and high tide bush) to quackgrass and then shrubs at even higher levels (beach plum, shad bush, bayberry, etc.)
The Zones

Tidal Buffer
High Marsh
Low Marsh

2017 Tides at Dover Point, NH

- Spring High
- MHHW
- Mean High
- MLHW
- Lowest High

- Mean

- Highest Low
- MHLW
- Mean Low
- MLLW
- Lowest
Challenges of Living Shorelines In General

- Causes of impairment or loss (wind/wave, climate, etc.)
- Geomorphic setting
- Permitting
- Access
- Vegetation survival
- Tidal range
- Water quality
- Sea level and sea level rise
- Run-on and drainage
- Orientation (sun exposure, wind)
Challenges of northern shoreline projects

• Low light
• Short growing season
• Large tidal range
• Ice
But, How to “Restore” or “Rebuild”

• Define or measure “impairment”
• What are the appropriate geometric and hydrologic metrics for restoration (analogy to streams)?
  – Use analytical methods at each site
  – Employ geomorphic characteristics of reference sites
• What is “success”? 
Change from 1992 to 2015

- Relatively stable marsh
- Up to 30 feet of erosion in places
Observed Erosion Most Tidal Cycles
Erosion Pins Monitored Quarterly
The Groundwater Well Installed in 2000

Former topography in 2000
Erosion Pins

upper
# Erosion Rates

<table>
<thead>
<tr>
<th></th>
<th>upper</th>
<th>lower</th>
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</thead>
<tbody>
<tr>
<td>Average (ft/yr)</td>
<td>0.208</td>
<td>0.148</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Median</td>
<td>0.129</td>
<td>0.054</td>
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<tr>
<td>Maximum</td>
<td>0.875</td>
<td>0.930</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>upper</th>
<th>lower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average (mm/yr)</td>
<td>66.7</td>
<td>47.5</td>
</tr>
<tr>
<td>Minimum</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Median</td>
<td>41.4</td>
<td>20.7</td>
</tr>
<tr>
<td>Maximum</td>
<td>266.8</td>
<td>283.3</td>
</tr>
</tbody>
</table>
Erosion Pin Readings

Erosion (mm)

142 days
267 days
353 days

upper
Lower
upper
Lower
upper
Lower

30-Oct-16
30-Oct-16
4-Mar-17
4-Mar-17
29-May-17
29-May-17

- Q1
- minimum
- Median
- Maximum
- Q3
Erosion Pin Readings (log scale)

- Q1
- minimum
- Median
- Maximum
- Q3

<table>
<thead>
<tr>
<th>Erosion (mm)</th>
<th>142 days</th>
<th>267 days</th>
<th>353 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>upper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-Oct-16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-Oct-16</td>
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<tr>
<td>4-Mar-17</td>
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<tr>
<td>4-Mar-17</td>
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<tr>
<td>29-May-17</td>
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<tr>
<td>29-May-17</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Energy spectra indicates majority of energy is the tide.
Sunlight Effect on Stability
2016 pre-trimming – note light meter on stake at center of image
Light Reaching Marsh Surface Before and After Limbing

<table>
<thead>
<tr>
<th>Location</th>
<th>Light Before</th>
<th>Light After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gundalow Pier</td>
<td>13,000</td>
<td>12,000</td>
</tr>
<tr>
<td>Mudflat (Oak)</td>
<td>11,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Low Marsh (Oak)</td>
<td>6,000</td>
<td>5,000</td>
</tr>
<tr>
<td>High Marsh (Oak)</td>
<td>3,000</td>
<td>2,000</td>
</tr>
<tr>
<td>High Marsh (Pine)</td>
<td>1,000</td>
<td>1,000</td>
</tr>
</tbody>
</table>
Foot Traffic
Get out!
Stormwater Runoff
"Softer" Edge

Can extend the sediment to avoid hard edge, but cannot grow anything over most of the fill. Would most likely erode.
Potential First Phase - Plan

- Anchored logs
- Root wads
- Crib wall
- Rock
- Coir logs

Location of approximately 1 heavy untreated large tree to be cut down. Banks will be cleared back at high water to help stabilize the bank and promote coves and shrub growth.

The map shows the placement of the various elements of the proposed first phase plan.
Profile Type 1 – Coir Log
Profile Type 2 – Root wads
Profile Type 3 – Crib wall
Profile Type 4 - Rock
Test Structure Mock up
Completed Test Structure – 6 June 2017
Postcard View
Coir Logs and Root Wad
STRUCTURE TODAY
Lesson Learned
Test Structure Today

• Most coir failed
• Log was transported after major tide event
  – Likely due to ice
• Lessons learned
  – Need stronger cable/anchor system
  – Coir staking/cabling suspect
Wagon Hill Outlook

• Thinking of salt marsh mats rather than individual plant sets
• Armored (rock) sill most likely candidate
• Possible use of random root wads in rock sill as well as seaward of sill
Stormwater Management Site
Conceptual Stormwater Design
Strong Public Outreach Efforts
Example: Durham Day at Wagon Hill Farm
Cutts Cove
Rip Rap Armor at Cutts Cove
Cutts Cove Concept

Legend:
- Existing Marsh
- New Marsh
- Fill Removal
- Living Shoreline
- Eelgrass Area
- Mudflat Enhancement

Oyster reef
Created salt marsh
Enhanced Mudflat -shell from oyster conservationist and recycling program
Proposed Cutts Profile

**Existing Mud Flats**

**Lower Low Marsh Zone**

From the toe of the Lower Low Marsh Zone, the "blue" rock shall be placed starting at a high elevation of 1.50 feet, stacked down at approximately 1:1 slope until reaching the floor elevation of the mud flats. At this location, the existing mud flats are to be left untouched whenever possible.

The Lower Low Marsh Zone is to be approximately 20 feet wide with a landward toe at an elevation of 2.50 feet and a seaward elevation of 1.50 feet.

**Upper Low and High Marsh Zones**

The Upper Low and High Marsh Zones occupy approximately 27 feet landward of the Lower Low Marsh Zone, and shall be cut to a low elevation of 2.50 feet and a high elevation of 5.67 feet.

**Trial Buffer Zone**

The Trial Buffer Zone shall extend at the landward side of the High Marsh Zone, starting at an elevation of 5.67 feet and shall be graded upwards at a 3:1 slope until it reconnects with existing ground.

---

**Notes:**

- From the High Marsh Zone, grade up at a 3:1 slope until reaching the existing ground.
- Typical cuttings will range from 6-10 feet horizontal, and up to an elevation of around 95 feet.
- All cut from existing site may be used as fill in the Marsh Restoration Zones, cut fill as a base course below the 1.60 feet of imported topsoil and only if it is free of marine species.
- The top 1.5 feet of fill material in the Low and High Marsh Zones is to be used to import topsoil to promote plant growth. Refer to the Notes Sheet 03 for details.

---

**Example of where the blue rock may be found at the toe of the existing connection rock and material:**

If Translated, shall be retained in the fill by the FOX Engineers or another certified leveling and material shall be specified and kept free of water and algae until it can be transplanted at the toe of the proposed Lower Marsh Zone.

---

**Note:**

The same course of the Marsh Restoration may be described in the fill. The proposed return rock may also need to be of imported fill that meets the specification specified in the Notes Sheet 03. All material must be clean and free of marine species.
Cutts Profiles and Ecosystems

Elevation NAVD (ft)

Distance from mudflat (ft)

Existing Rip-rap Profile

Tidal Buffer Zone

Upper Low and High Marsh

Rock Sill

Lower Low Marsh
Tides and existing marshes in Cutts Cove

- Rock Sill
- Lower Low Marsh
- Upper Low and High Marsh
- High Marsh
- Low Marsh
- Mudflat

Elevation NAVD (m)

Distance from mudflat (ft)
Measures of Success

• Monitoring
  – Erosion
  – Plant establishment and growth
  – Animal use of habitat

• Maintenance
  – Low to none
Construction
Living Shoreline at Cutts Cove, Portsmouth
Completed Plantings
Winter Can Be Cruel
Upcoming Project

• Locations all around the Great Bay
• Field data collection for geomorphic, physical, and observational metrics
• Additional metadata obtained offline
• Goal is to develop a database of metrics and metadata that describe the spectrum of stable to impaired fringing salt marshes
• Similar to stream restoration using natural channel design
Natural Channel Design - Rosgen

<table>
<thead>
<tr>
<th>Stream TYPE</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>DA</th>
<th>E</th>
<th>F</th>
<th>G</th>
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<tbody>
<tr>
<td>Bedrock</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Gravel</td>
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<td>Sand</td>
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<td>Silt-Clay</td>
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- **Entrachment**: < 1.4 | 1.4 - 2.2 | > 2.2 | n/a | > 4.0 | > 2.2 | < 1.4 | < 1.4
- **W&D Ratio**: < 12 | > 12 | > 12 | > 40 | < 40 | < 12 | > 12 | < 12
- **Sinuosity**: 1 - 1.2 | > 1.2 | > 1.2 | n/a | variable | >1.5 | > 1.2 | > 1.2
- **Slope**: 0.04 - 0.099 | 0.02 - 0.039 | < 0.02 | < 0.04 | < 0.005 | < 0.02 | < 0.02 | 0.02 - 0.039

Field Data Collection

- Geomorphic
  - Elevations
  - Dimensions
  - Slopes (upper, lower, mud flat)
  - Arc/cusp radius, length, depth
  - PSDs

- Physical
  - Topographic survey
  - WSEL during survey
  - Tidal elevations
  - Features (pools, paths, logs)
  - Densities
  - Debris lines, staining

- Observational
  - Species
  - Degradation
  - Shade
  - Use and access
  - Upland setting
Online Metadata

• Wind rose data
• Fetch distances
• Orientation
• Land use
• Tide predictions
• Boat traffic
Baker Design Consultants
Challenges, Opportunities, and Lessons learned

Living Shorelines Workshop
April 6, 2018
Miller Seawall
CHALLENGES

“...a stimulating task or problem....”

1. Retreating Shorelines
2. Sea level Rise Climate Change
3. Client Education
4. Economical Solutions
5. Regulatory Requirements
OPPORTUNITIES

“...a good chance for advancement or progress....”

1. No shortage of Coastal Erosion
2. Developing Expertise
3. New Products
Toe Erosion
Sensitive soils
Steep Slopes
Pipe Discharge on Slope
Retreating Slopes
Trees on Unstable Slopes
Trees on Slope
Surficial Slides
Fringe Marsh Health and Contribution
Case Studies
Prouts Neck
Prouts Neck
Hamilton Beach

CONSTRUCTION (TYP).

12" THICK SLOPED MATTRESS

BASE FLOOD ELEVATION 12.0

BROADCAST TOPSOIL TO FILL VOIDS IN STONE, PLANT WITH CONSERVATION MIX (SEE NOTE 1)

SPRING TIDE ELEV. 6.3

TOE STONE PROTECTION (SUITABLE BEACH STONE DISPLACED BY TOE EXCAVATION MAY BE USED)

5.0±

FILL TO BE SUITABLE BACKFILL 6"(-)

TOE EROSION

SUBGRADE STABILIZATION
Hamilton Beach
Hamilton Beach
Hamilton Beach

Top of wall varies with section

Base flood elevation 12.0

Spring tide elev. 6.3

Toe erosion

Toe stone protection (suitable beach stone displaced by toe excavation may be used)

Subgrade stabilization fabric US1540 by US Fabrics or approved equal

18" thick stacked mattresses. Refer to plans for wall limits

5.0±
Hamilton Beach
Hamilton Beach
Parkill Slope

![Image of Parkill Slope with construction equipment and a house in the background]
Fringe Marsh Reconstruction
Fringe Marsh Reconstruction
Parkhill slope
Parkhill slope
LESSONS LEARNED
Equipment Access
Working in Tandem
Landslide Access
Landside Access
Access via the Beach
Access via Barge
Temporary Structures to Reduce Impacts

04/08/2011
Build Your way in
Mattress Assembly
Stockpile Ahead
Take advantage of the weather
Complete Sections and then Move on
Vertical Drains
Horizontal drains
Thank you!

Barney Baker, PE
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Baker Design Consultants
7 Spruce Lane
Freeport, ME  04032
207-846-9724
Living Shorelines

Presented by Jonathan Edgerton
April 6, 2018
Living Shorelines

• Desirable where feasible
  • better habitat value
  • less aesthetic impact
• Not feasible everywhere
  • wave energy/currents
  • stability of substrate, terrain
• Determine where and when they make sense
• Often look at “hybrid solutions” – introduce some structural elements to make sure vegetation will thrive
• Understand fluctuating water levels, including SLR
Selection Criteria

• Lower Energy Environments
  • riverine/estuary
  • lakes and ponds
  • oceanfront, including beaches
Selection Criteria (cont’d)

- Soil Substrate and Slope
  - silty/organic
  - sands
  - rocks and gravel
  - flat versus steep
Design and Regulatory Elements

• Obtain topographic/bathymetric survey
• Characterize protected natural resources
• Establish level of structural elements required
• Determine appropriate plant species (salinity, submergence, root structure, planting media)
• Develop drawings and specifications
• Seek regulatory approvals
Riverine/Estuarine Applications

- Falmouth, Freeport, Harpswell
  - bluffs subject to block failures
  - maintain stable toe
  - wave action/SLR
- Madawaska, Brewer, Veazie
  - reconstruct natural shoreline
Lake/Pond Applications

• Greenwood, Coburn Gore
  • directional wave action
  • dams / embankments
  • understand fluctuating water levels
Oceanfront/Beach Applications

- Old Orchard Beach, Wells Beach
  - re-establishing dune vegetation
  - in concert with other work, such as beach nourishment
- Kennebunkport, Bristol
  - more reliance on structural measures where wave energy is highest
Questions/Discussion
Going Green
Living Shorelines Maine
Using a Instability Rating and Decision Tree
For Living Shoreline & Stabilization Alternatives
Living Shoreline Example

- Rootwads & Woody Planting
- Vegetation Dissipation

ROCK & WILLOW LIFTS

3 MONTHS COMPLETION

ROOTWAD – WOODY WILLOW

ERODED CONDITION

ROCK REVETENT ATTEMPT

SCOUR HOLE HABITAT

3 MONTHS - LOW TIDE
Bustins Island Natural “Case Study”
Vegetation vs. Riprap
Conceptual DLA on Bustins Island
Complex Coastal Processes

Key Physical Parameters:
- Coastal Geomorphology
- Wind/Fetch
- Waves
- Tides
- Hydrology
- Upland groundwater
- Vegetation-slope stability
- Soils – horizons/type
- Wood Debris - sediment

Human Activities:
- Infrastructure
- Watershed Changes
- Upland Drainage Patterns
- Upland Vegetation Changes
Rootwad Installation – Bank Habitat
Rootwad Installation – Bank Habitat
A. Welcome and Introduction
Pete Slovinsky – MGS (Maine Geological Survey)

*All presentations from the day will be available online

Why are we researching Living Shorelines (LS)?
- Increase questions for permitting of LS stabilization projects, esp. for coastal bluffs.
- 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 GI and LS approaches in Northeast
- NOAA funded regional project: Increasing resilience and reducing…. 

How you might deal with instability on a coastal bluff. Broad term of LS encompasses a range of shoreline stabilization techniques along estuarine coasts, bays, sheltered coastlines, and tributaries. A LS:
- Has a footprint mostly of native material. Incorporates vegetations or other living, natural elements.
- Maintain natural functions of coastline.
- Traditional response to bluffing is to cut back slopes, plant in front, place some riprap. What this doesn’t account for is minimizing the transfer of soil sediment. Mackworth Island is where we will be looking at gullies, looking at site 4. There are eight erosion sites.

Troy Barry – Headwaters Hydro
Going Green: Living Shorelines Maine

Where this table comes from, looking at bank, bluff erosion and being able to compare it. Data sets from both of those, could judge equally to compare the two. It comes from a reconnaissance level assessment (RLA). Prediction level assessment (PLA) takes time. Design level assessment (DLA), but more conceptual for today when looking at Mackworth Island. But, we will look at the landscape, the history of it, and understanding the geology, bank failures, land slide, and other background information. I want to ID potential issues that have been causing erosion problems. The idea is to take this instability assessment (step 2 of the RLA), and rate using 12 parameters, based on what you see in each box. The key is to be consistent when rating. Parameters are listed on the sheet. Today, we will use the whole form to assess the entire bank. But, usually, I use four different forms for four different zones. Part of this rating form is to decide which areas you might need to focus on. You might need to phase the project and figure out which areas are of highest priority. The PLA is understanding exactly what you might need to focus on as well.
B. Mackworth Island Field Trip – Break out Discussion

Discussing and sharing notes from the field trip and the ratings that we gave them for LS. The goal is to bring people together to stabilize the site (case study in action) on Mackworth Island, Site 4. Each group will report on LS concepts in their break out session. Maybe use the instability rankings to get a hold on things. This rating system, will relate to the upland concepts, and the near shore concepts. This sheet should connect with how you make the decision that you make for your chosen concept.

The idea is to create common language with the use of the RLA, PLA, DLA. This group break out session was to gain some understanding of the concepts and processes that are happening naturally and anthropologically on Site 4. This is a great experiment to begin using your gut instinct rather than using the methods that have been used for decades (armory alone). This field trip that we conducted today is an example of RLA. We are at this level right now figuring out what we need to do for the site. PLA, we are dealing with predictive level. How much soil is coming out of the slopes? Over time, pins that were pounded flush with the ground become exposed from previous storms. Then we get into the conceptual design with SLA. Essentially, this is a level 1, 2, 3 assessments to help you figure out what you might need to do for your site. It is important to think about the scale at which you are working at. The root wads, tree logs, coir logs, etc. all need to be anchored somehow because it is possible for these projects to simply wash away down river or out to sea.

C. Review of State and Federal Permitting Requirements and Challenges

Marybeth Richardson – DEP (Department of Environmental Protection)

This LS concept is really exciting. But, our rules are not structured to be able to permit these projects. Permit by rule – available for some public projects. If the project is being overseen by a conservation org, then you can actually work in the resource below the hat line. Enhancement of wildlife habitat or water quality improvement projects. We know that it will be monitored by a reputable group. If you can give us some assurance that it will fall into one of the two categories, then we can permit it. There is no limit in size, so it’s a very general requirement for the permit. For private projects, any work in the resource or within 75 feet of the hat line, it’s split up basically. The permitting is project-specific. The are set up where it really discourages activity below the hat line. It’s assumed that you have a practical alternative for a few things. One of the things it talks about is creation of artificial reefs or some language to allow alteration in or adjacent to the particular resources, then we might give you a permit. As far as LS goes, I haven’t heard of projects where there is fill being put below the hat line. You have to show that you are proposing the absolute minimal disturbance in the resource as possible. But there are exceptions.

The beneficial use aspect of oyster shells. The chapter 400 rules regulate the beneficial use of waste material. Oyster shells would be one of those things. The way you could do that now is to get a pilot project permit through the …use department.
Jay Clement – USACE (US Army Corps of Engineers)
In many cases of DEP permitting, you need federal permitting. Under section 10 of the Rivers and Harbors Act, navigable waterways are all tidal waterways. “Work” is basically anything. Anything beyond mean high tide water levels, then you need a Corps permit almost always. Permits are also required for temp or permanent dredged discharge or fill material on any adjacent wetlands under section 404 Clean Wetland Act, beyond the high tide line. Regulatory matters and challenges in LS is much like DEPs. We haven’t seen a lot of these LS projects. We don’t collectively have a lot of experience with these. There are a lot of activities that can be done without the USACE. The way that we look at fill projects, is what is the purpose of the fill and what are the alternatives to achieving that purpose while either not filling, or filling as little as possible? We want to know what the purpose of the project is. Then we have a no-bill alternative, which is just doing nothing. We do issue permits for some seaward encroachment. But to go back out to what is used to be however many years ago, that probably won’t happen. The other real challenge is for those proponents of LS in the audience, and we understand the value of LS, but the challenge is not convincing the regulators, but the home owners and contractors of this world. They understand stone structures where there are a lot of models and examples. But for land owners, you are asking them to take a risk, going to survive the long-term. And it’s going to satisfy the issue that they have. These are the challenges that I see. The issue for us is determining what is worth keeping or losing.

Pete Slovinsky
State of the Practice Report/Profile Pages: Profile pages are helpful for looking at how would I approach a problem and what are the questions I need to ask?

Regulatory findings
Maine Geological Survey GIS-based LS suitability DST.
- Shoreline suitability based on red, green and yellow indicators. Green meaning that it would be most suitable to no suitable at all.
- It looks at NOT excluding, but categorizing shoreline suitability.
Site selection: eroding bluff or marsh, ownership, access, possible to high living shoreline suitability, relatively straight, consistent shore type, approx. 150 feet, representative geography, proximity to mapped special habitat types, educational opportunities, proximal previous or additional work on or adjacent to the site.

Actions Needed
Education and outreach, technical support.
Regulatory recommendations for LS in Maine, there are none right now.
We have not implemented any recommendations yet. Trying to get LS easier to get moving on the ground.
Amend Maine GP to incorporate select elements of NWP 54
Develop/adopt common definition of LS projects.
Amend NRPA and DEP chapters.
Amend Land Use Planning Commission zoning standards.
Amend definition of structure for submerged lands leasing.
LS is not a submerged structure.
Initial demonstration treatment concepts for LS in Casco Bay
How can we beneficially reuse naturally occurring fallen trees?
Potentially driving in trees into the slope or vertically into the marsh for intertidal zones?
Bagged shells are widely used in other areas of the country. Drive the tree wads into the mud flats, put bagged shells there, do the same thing above and below the high tide line.

Monitoring LS Projects in Maine
Where there has been a lot of LS projects, are within the z foot tide zone. But in New England, it is very difficult to do when we have 12-foot tides. Conceptual Framework: problem with monitoring, is that I don’t know which components of LS projects are able to be monitored until we do it. National models based on multiplayer systems, proposed designs in Maine somewhat simpler, monitoring should reflect that. Considerations: monitoring framework that works across states and sites, how will information be used, discussion with other states, controlling coasts and level of effort.
Case studies: few sites in each of the NEW states, focus on performance at each site, generalization to future projects is based on other case studies, exposure gradient, post stratifying sites based on site-level characteristics. Monitoring themes and questions: what is the context of the project, do LS/GI technologies work, do they have positive ecosystem benefits, do they have negative impacts? Monitoring phases: pre-project data, as built documentation, performance monitoring, end of study intensive data collection. Monitoring at two levels: site (wave energy, fetch, ling resources, bathymetry) and treatment levels. Method selection, we want to id core questions, and then develop some core metrics. What questions or information will be most important to regulatory agencies to support future permitting decisions? What kind of data quality objective need to be met to make resulting data of value to regulatory agencies?

Joel Ballesteros - New Hampshire experience with Living Shorelines for Fringing Salt Marshes
I’ll tell you about three projects that we have. 
Wagon hill Farm: our first project site. 140 acre parcel. It’s very publicly used. The town of Durham has been very cooperative and excited to do restoration work. About 2,000 feet of bank, that have lost about 60-80 feet over the past 100 years. About 30 feet of erosion since 1992. Part of coming up with a design is to figure out where the impairments are coming from. Understanding where the loss of marsh is important to figuring out what to do to restore them. Erosion pins are monitored quarterly. We see about .2 feet per year of erosion. What we see at the site, most of the energy is from the tide, not the waves or waves made by boats. We have collected data of sunlight effect on stability.

There is a problem at this site with many dogs and human foot traffic. The Town of Durham has been very supportive in wanting to discourage walkers from walking on the salt marsh while it is being restored. The potential first phase, we have used coir logs, anchored logs, root wads, and large rocks. We first wanted to test a mock structure. We did not need a permit because it was all done by hand. We learned that it is extremely labor intensive to create these things. Within one storm, an 800-pound root wad and the entire things was gone. The coir without having weight on top of it, it would rock back and forth with the waves. The motion eroded below it
and then the measures holding it down completely disintegrated it. Wagon Hill outlook: thinking of salt marsh mats rather than individual plant sets. Armored sill most likely candidate. Possible use of random root wads in rock sill as well as seaward of sill.

Cutts Cove: Historically has been a salt marsh. But the railroad and traffic has made it what it looks like today, which is two 600-foot length marshes. We are planning to put oyster reefs. Then we did volunteer plantings of Spartina plugs.

Upcoming project is Great Bay: we will collect reference data. Additional metadata obtained offline. The goal is to develop a database of metrics and metadata that describe the spectrum of stable to impaired fringing salt marshes. Similar to stream restoration using natural channel design.

D. Living Shoreline Panel & Facilitated Group Discussion

Charlie – DOT (Department of Transportation)
We did complete in the past year some feasibility studies. We did it with NH DOT. The main project that we looked at was Popham Beach. The stretch of road where it is between the park and the beach. It’s about as different as can be from what we looked at today. My take away was that it is very different geology and processes going on, so we approach things a different way. With some of these resources, you will come across similar and basic settings between here and Popham. Where we ended up, the solution would have been on the hard side. The results from the researchers, said that the sediment supply is a problem here. No chance of stabilization for that kind of dynamic system. So we ended up with a hybrid of hard and soft measures. The most attractive hard measure, was sheet steel and maybe some beach nourishment farther down the beach. But we didn’t expect that to last long term. I don’t see DOT doing a lot of these. I suspect the right place and time will be what does it for us. We want to be confident that what we build will not be a perpetual head ache. My suggestion was to terminate the DOT road at the state park and let the town deal with it.

Troy (continuation of his previous presentation)
For USACE, you do not need a permit to vertically excavate below the HAT line. With DEP, you need a NRPA permit because you are within 25 feet of the HAT line.

Barry Baker – Baker Design Consultants
Challenges in Maine: Retreating shorelines, SLR and climate change, client education, economic solutions, regulatory requirements. Opportunities in ME: no shortage of coastal erosion, developing expertise, new products. Our shoreland zoning is not keeping up with how fast erosion episodes are occurring.

John Edgerton – Wright Pierce
LS are desirable where feasible, but not everywhere. Challenge is where and when they make sense. We look for hybrid solutions. Understanding fluctuating water levels, including SLR. Selection criteria: we look for lower energy environments. When we get into the estuaries, you have riverine/estuary areas, lakes and ponds, and oceanfront including beaches. We also look for soil substrate and slope.
Design and regulatory elements: must understand the topography of the area (bathymetric surveys). Characterize protected natural resources, establish level of structural elements, determine appropriate plant species, develop drawings and specification, and seek regulatory approvals.


Lake/Pond applications: greenwood, Coburn Gore (directional wave action, dams/embankments/understand fluctuating water levels).

Oceanfront/beach applications: Old Orchard Beach, Wells Beach (reestablishing dune vegetation, in concert with other work, such as beach nourishment). Kennebunkport, Bristol (more reliance on structural measures where wave energy is highest).

**Facilitated Group Discussion**

How do we advance LS projects? How to best engage people who are no in the room?

As an estuary person, the reason I came today was because my backyard is in a state of transition on the river inside Marcus Point. We have had discussions about what to do, we have enjoyed our backyard a lot, and we want to know where do we go to start with ideas, and regulations?

- Finding an NGO that stabilization of a project somehow fits within their priorities for undertaking things, my s is that it does. Its up to the landowner to make the initiative and make the investment for whatever it is to jumpstart the project.
- We have also been trying to build a network of practitioners. Those people can look at your site and point you in the direction you need to go in. This workshop is to help point fingers so that the citizen of municipality can at least get at some of the resources to make decision. The best thing to do is pheon some of the regulators and they can always point you in the right direction.
- Projects that are similar have been undertaken in your town.
- Or you come to things like this and the field service and force staff will give you their cards.
- Right now what we are doing, is going out to a site, and looking at the sites. We are exchanging ideas, each group had reps from each perspective, and we ae doing what we need to be doing, talk about the challenges and obstacles, and figure a path forward.
- If you go back to what I said in a general sense, understanding the risk elements of what we monitor, is giving engineers better tools to zero in on what they can better do. We need demonstration projects and give us a better understanding of those risks.
- There is a need for information that is at an intermediate level and answer if LS make any sense at all. There is a screening level of info that is needed as we understand this work more. We do a fair amount of screening level work. But we can look at these assessment tools and say this looks like a great site or no, and at least get a level of conversation started with people.
- The Properties Owner Guide to Erosion Hazards. I would look at that on our website (ME DEP) and it answers those questions for a property owner.

As a practitioner of the Penobscot area, I was speaking to a lot of people on bluffs. I might as well speak to bluff owners and get some people in. Cumberland County Soil and Water Conservation District and I are partnering to have some talks in the region, which will be public events this summer. I’m excited about putting this program together. I encourage all of you to do something like that in your neighborhood.

You need to make sure your name and email is on the sign in sheet. Then we will get ideas of the event and send that info out to everyone.

Barney, the project you showed, was that a collection of houses?
- Yes, that was a total of 7 owners one of which was the town. If you can get your neighbors involved, there is a collective benefit to that.
- Yeah, that was my question. A land owner might do it by themselves, but if their neighbors are not doing it, then it’s a limited benefit.
- Right. It was led by a couple property owners. We got the town involved because we said they didn’t have to pay anything, just help us through the permitting process. There was a property owner who couldn’t pay. So they ended up working out a special financial deal. These families had known each other for 50 years, so they knew each other very well. You should talk to your neighbors.

Regarding keeping the conservation open, I thought if any of you guys have given presentations to universities. That’s a helpful tool.
- So I run the Casco Bay Estuary Partnership, and it is very much a part of making connections. This is a great project for us to be a part of. We have not been working with engineering faculty, they are in other kinds of engineering. We do look for opportunities, but we work with NH folks a lot. Folks down there do a lot of this kind of work. It depends on who your local engineering faculty are. You find the opportunities when you can.
- We work with UMaine folks as well. For Phase 1, there was a track 1 to it, developing wave models, to develop that data, to help with LS design, sighting and more. We continue working with UMaine on that. There is some overlap, but not as much as it should be. But it hasn’t resulted in maps yet. It is resulting in data that is then put out on the internet.
- Those models have lot of potential applications. The models have gone way up. The biggest problem for us, is that they are giant files of data. We need to contract those down to something that is useful for us engineers.

I’ve heard that it takes a really big storm to wake people up to get real action to take place. I wonder if your thoughts are on that and if that is what it will take to get people moving?
- From a geological standpoint, that we have had an influx with phone calls about dunes eroding 30 or 40 feet. But now, many people are creating zigging and zagging permits for the paths to their beaches. We haven’t had a dynamic shift in LS thinking, but there is a higher level of interest because of the erosion problem. Events like this, will put an exclamation point at the end of our long-term erosion problems. My hope is that we don’t allow legislation change just for dumping of rocks. We need to allow for natural transgressional features and creating natural habitats at the same time.
To not forget the urban condition, but I think that cities as a place for experimentation where there isn’t much to lose economically, and where there is an expectation where people have to interact with their environment, there is a lot good reasons to look at urban areas for this LS experimentation.

- NY and NJ have done amazing things after Sandy in terms of furthering concepts of LS. They have done so much work.

To the point of advancing this further, such as the storms we have had, if we had a little cache of funds that could be thrown into PSA, to get the word out, if the regulators are getting calls, that would be the time to pull the trigger to pull something like this for the public. Workshops. Who knows when that will happen. So you have to have that group ready together and ready to go kind of like EMS. It would be an effective way to increase understandings rapidly. Because we have solutions to present to them.

Mine was more of a comment. I was just looking around, we have a ton of riprap projects coming in. You know who is not here, the contractors, that are doing the work and doing the permitting. None of them have hired them to talk about what we are talking about today. We need contractors into this room.

- My experiences was that I just relocated from VA. There is lot of flooding. So, what there were doing, the communities that all had water, developed a “light house” program where people were given tax credits for improving issues with water. As a result, landscapers who got involved, were given regulations from the cities, they were allowed to do “x” things. Grants were also used to fund these projects.

What does it take to make change?

- My colleagues experience after Sandy, was because everyone was panicking. There was no time for preparation for projects like these. But, we have to recognize in terms of thinking a different kind of border between human and oceans, disasters will not move us past how will we form these projects.

- Build on that, if you’re in the sand dune system, there is a whole other regulation area. A lot of our calls at DEP, was that they wanted to maintain their structure because it is grandfathered. Everyone is always interested in maintaining their seawalls. The regulations need to be looked at closer at some point, but I’m not sure where that starts. Some of our regulations could be made more user-friendly towards these greener LS options that don’t get any consideration.

- Some things I know what is going on, is the Coastal Caucus. They have not achieved their primary goal, but they are working on. For the Wells Reserve, we don’t need to be paid more that IS our job. We can organize these meetings and workshops. The symposium later in April will be about salt marshes (special symposium on Thursday the 26th).

Pierson already does willow planting, coir logs, etc. so if you want to reach out to us, we are in Dayton, ME. Please contact us if you want more information.
## Living Shoreline Workshop Attendee List

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<th>First</th>
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