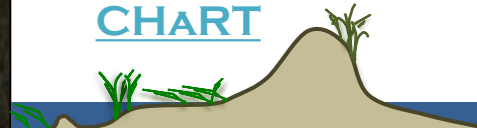


Living Shorelines for New Hampshire



David Burdick, Jackson Estuarine Lab
Tom Ballestero, Civil Engineering,
Gregg Moore, Jackson Estuarine Lab
University of New Hampshire

University of New Hampshire
COASTAL HABITAT
CHART



**University of
New Hampshire**

What are some of the dominant coastal habitats?

Salt Marshes

Rocky Intertidal Shore

Seagrass Beds

Shellfish Reef

Coral Reefs

Mangrove Swamp

Mudflats

Barrier Beach/Dune Systems

Why?

- 1) Physical forces (wind, tides) interact with internal process to support a negative feedback system.**
- 2) The result is a recognizable ecosystem that has ecological functions and human values.**

The diagram illustrates the relationship between coastal processes and land subsidence. It shows a cross-section of a coastal area with vegetation (green grass) on the left and a body of water (blue) on the right. The land surface is divided into a light green 'Root zone' and a brown 'Subsidence' zone. The water is labeled 'Rising sea level'. Key processes are highlighted in yellow boxes: 'Elevation', 'Plant processes', 'Sedimentation', 'Hydrology', 'Soil volume', and 'Subsidence'. Red arrows indicate the flow of influence: 'Plant processes' leads to 'Sedimentation' and 'Soil volume'; 'Sedimentation' leads to 'Elevation' and 'Soil volume'; 'Hydrology' leads to 'Elevation' and 'Soil volume'; 'Rising sea level' leads to 'Hydrology' and 'Subsidence'; 'Subsidence' leads to 'Elevation' and 'Soil volume'; and 'Soil volume' leads to 'Plant processes'.

3

Surface Elevation Tables (SETs) and Marker Horizons Established . . . and Measured



Salt marshes are among our most productive and valuable ecosystems

Plants support food webs

Secondary production

Plant structure for habitat

Support of biodiversity

Protection from flooding

Protection from coastal erosion

Removal of sediments & excess nutrients

Aesthetic, Recreational & Educational values

Self-sustaining ecosystems

Long term carbon storage



The Case for Building Salt Marshes into Living Shorelines

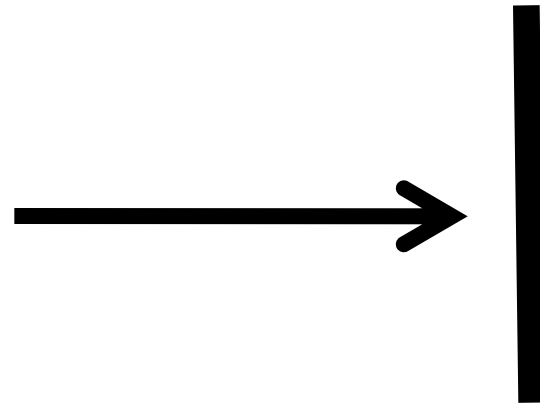
- Loss of 30% of historical salt marshes
- Future for marshes is not bright - SLR/CC
- Salt marshes and peat develop slowly as sea levels rise – most marshes are over 1,000 years old
- Created marshes erode EVEN if shoreline protected
 - 1993 salt marsh creation lost 20% of area in five years in North Mill Pond
- Salt marshes protect, survive and heal following storms
 - Gittman et al. 2014

THE SALT MARSH SQUEEZE



From Kirsten Howard, NHCP

**Marsh migration
+
Shoreline stabilization
=
salt marsh squeeze**



Local Living Shoreline Projects

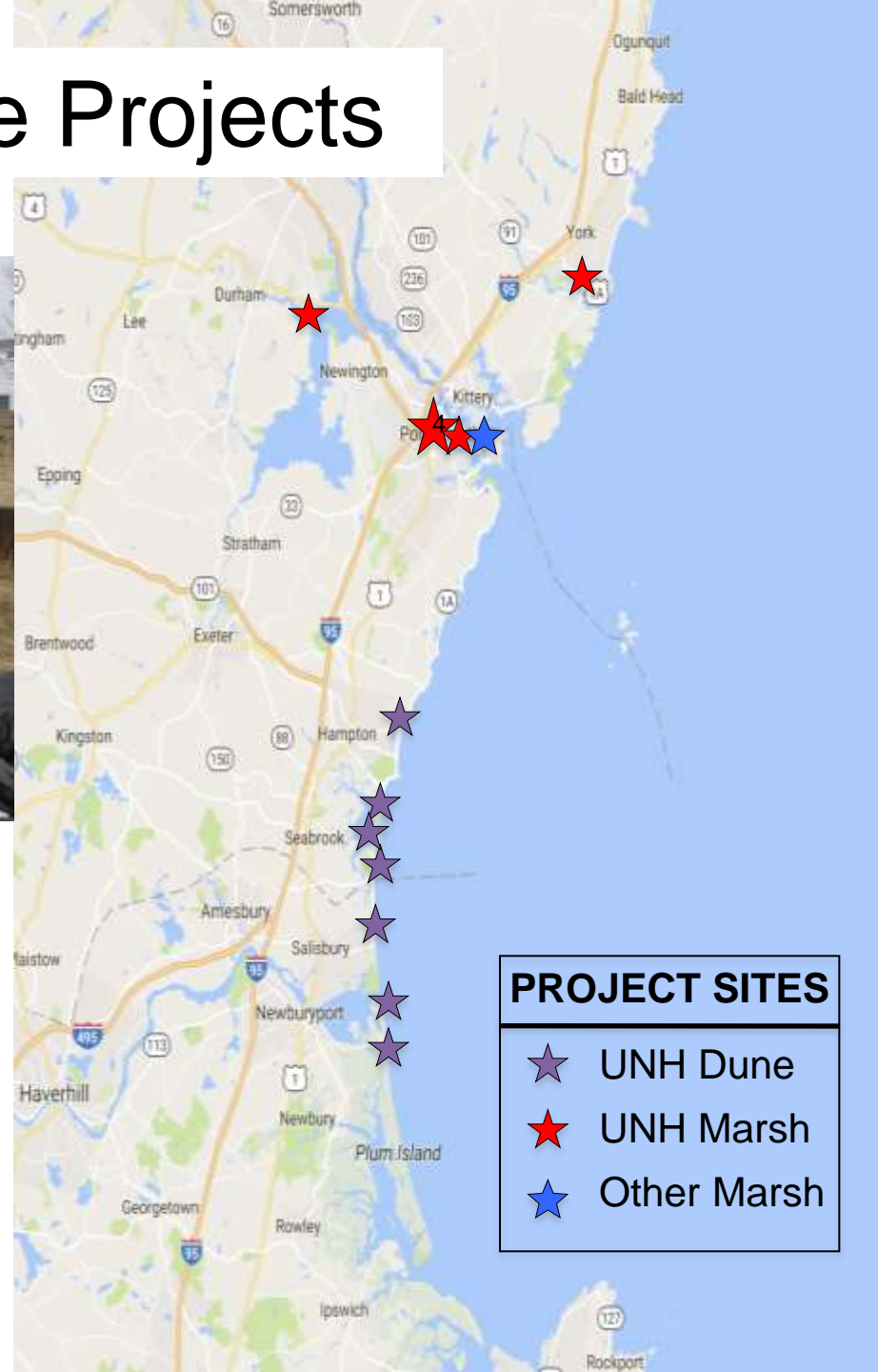
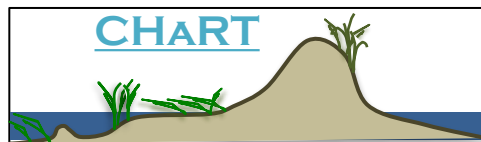


Coastal Habitat Restoration Team:
Burdick, Moore, Grizzle,
Eberhardt, Ashcraft, Ballestero
and Technicians
and Students

University of New Hampshire

COASTAL HABITAT

CHART



Challenges of northern shoreline projects

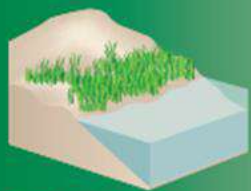
- Low light
- Short growing season
- Large tidal range
- Ice

Ranges of Options

GREEN - SOFTER TECHNIQUES

GRAY - HARDER TECHNIQUES

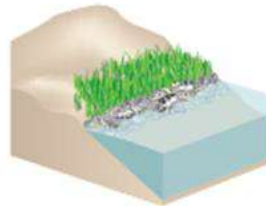
Living Shorelines



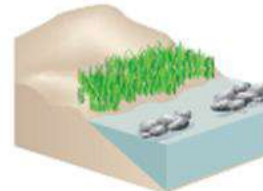
VEGETATION ONLY -
Provides a buffer to upland areas and breaks small waves. Suitable for low wave energy environments.



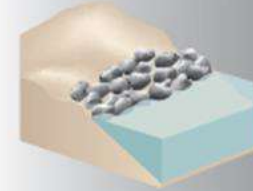
EDGING -
Added structure holds the toe of existing or vegetated slope in place. Suitable for most areas except high wave energy environments.



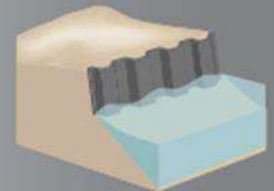
SILLS -
Parallel to vegetated shoreline, reduces wave energy, and prevents erosion. Suitable for most areas except high wave energy environments.



BREAKWATER -
(vegetation optional) - Offshore structures intended to break waves, reducing the force of wave action, and encourage sediment accretion. Suitable for most areas.

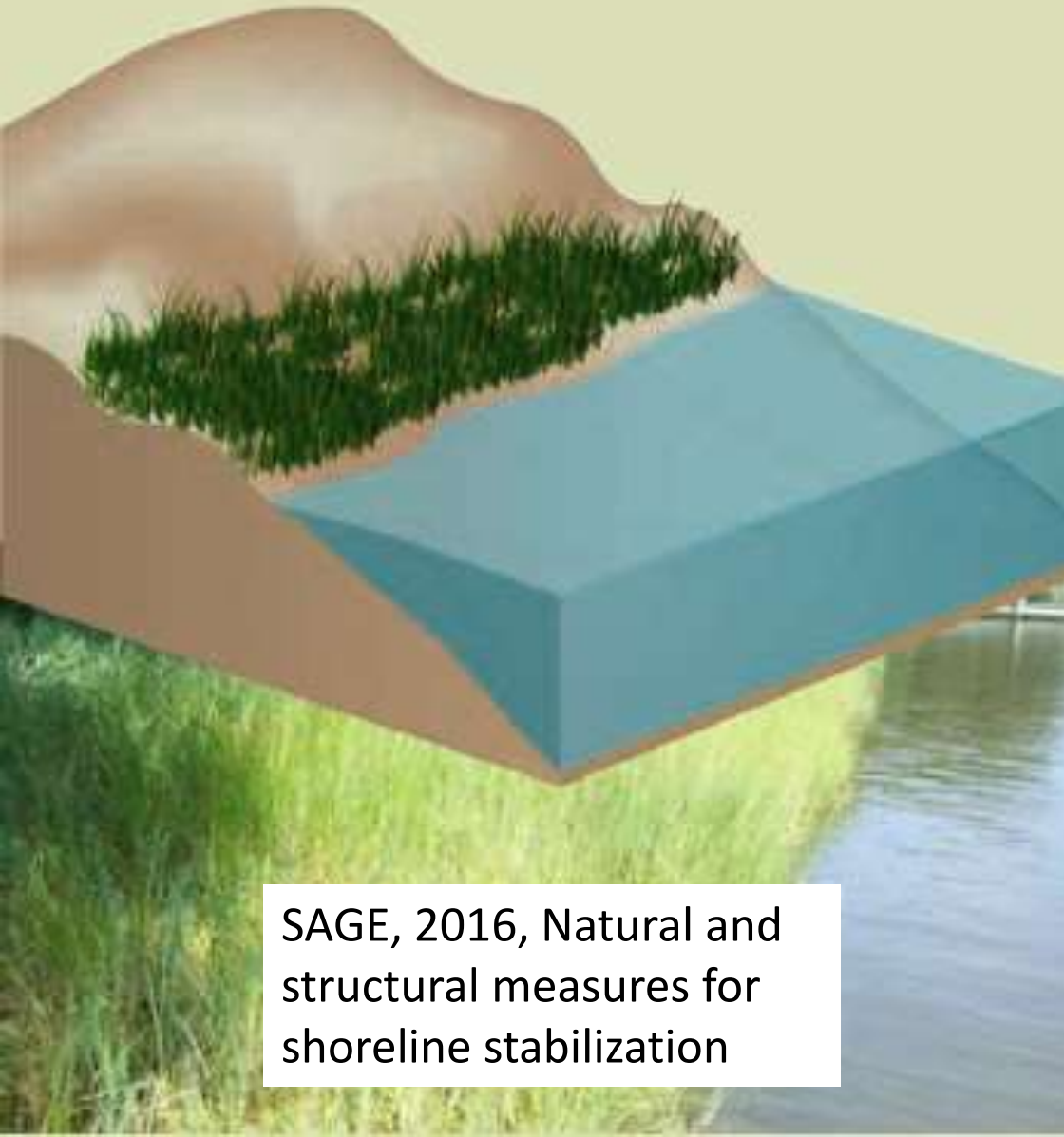


REVETMENT -
Lays over the slope of the shoreline and protects it from erosion and waves. Suitable for sites with existing hardened shoreline structures.



BULKHEAD -
Vertical wall parallel to the shoreline intended to hold soil in place. Suitable for high energy settings and sites with existing hard shoreline structures.

VEGETATION ONLY

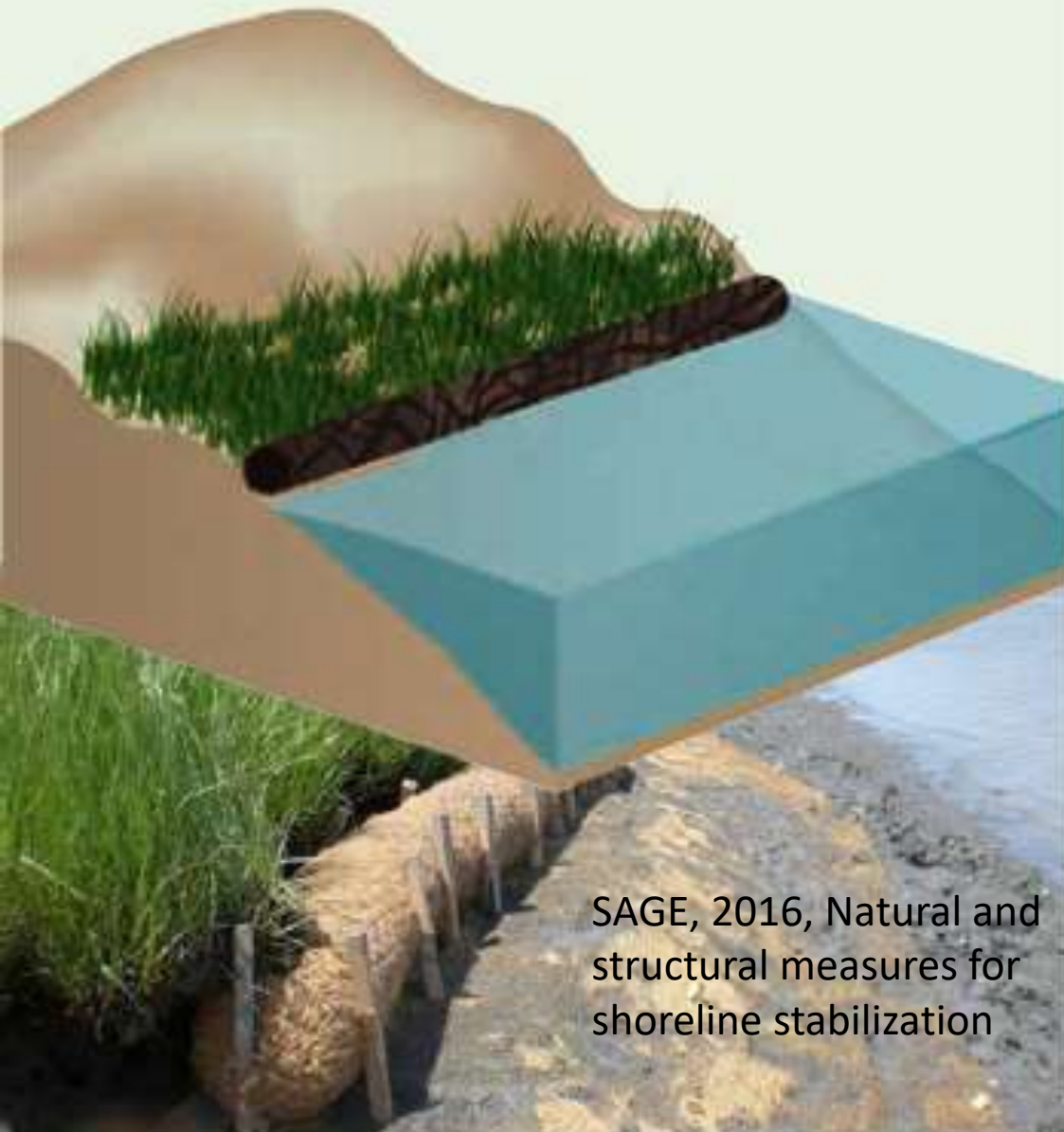


SAGE, 2016, Natural and structural measures for shoreline stabilization



Mill Pond Way berm removal,
North Mill Pond, Portsmouth, NH¹¹

EDGING



SAGE, 2016, Natural and structural measures for shoreline stabilization



Brewster Street Mitigation on North Mill Pond (Stantec)

North Mill Pond at Brewster St. Mitigation 2016

Pre-existing



Fill to Designs Grades



Plant With Plugs



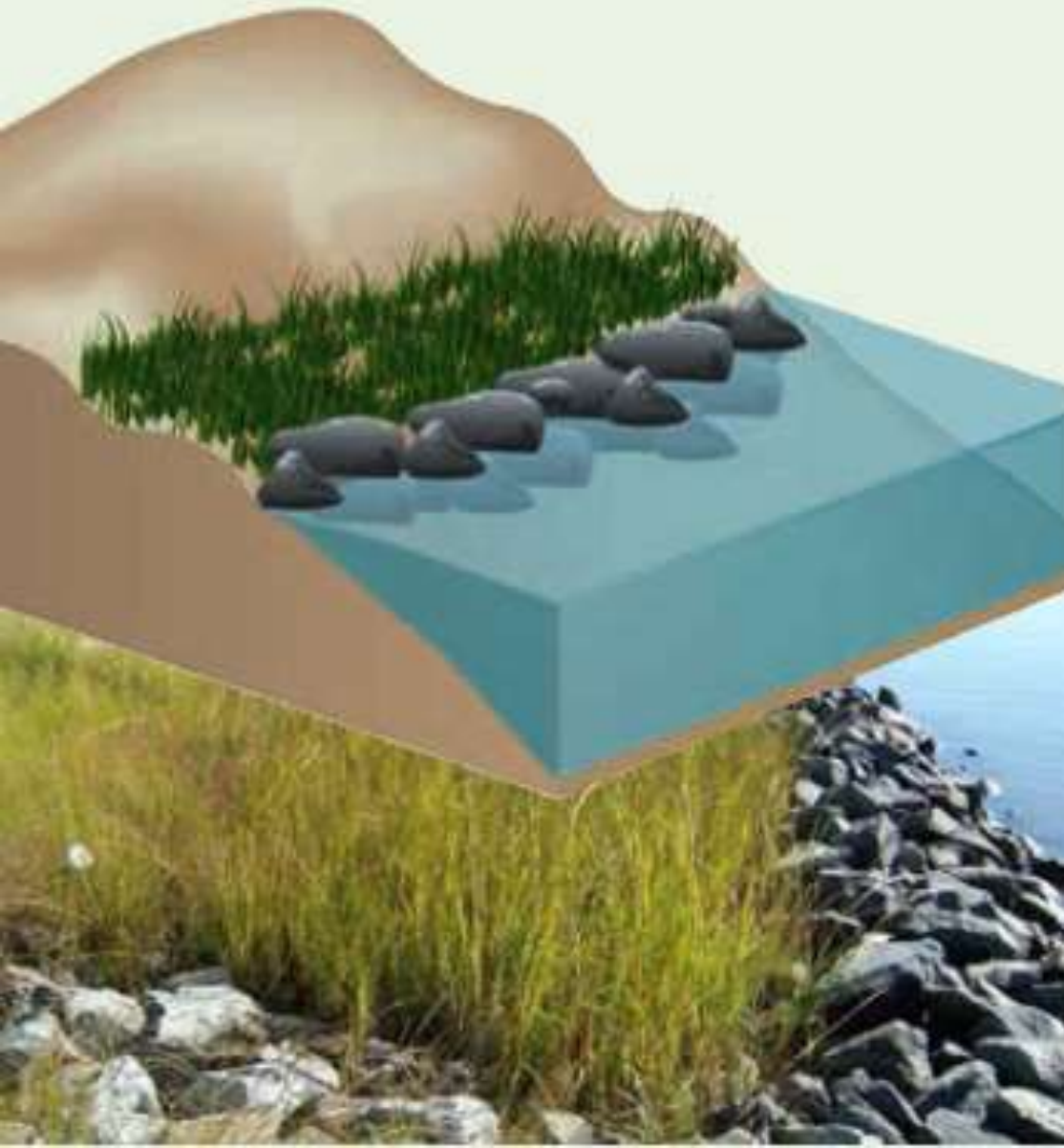
Final Product



Winter Can Be Cruel



SILLS



Marsh built in South Mill Pond 2001, Portsmouth, in front of seawall and behind sill constructed from existing rocks on site.

SAGE, 2016, Natural and structural measures for shoreline stabilization

Two Case Studies:

Living Shoreline Marshes with Sills

1) Cutts Cove, Portsmouth

- Designed as restoration of salt marsh
- Approach is to partially remove rip-rap wall
- Sill provides a 'climate ready' feature for 2060

2) Wagon Hill Farm, Durham

- Designed to stop erosion
- Also restores damaged salt marsh
- Sill provides erosion resistant edge and 'climate ready' feature; TBZ allows for marsh migration

Cutts Cove



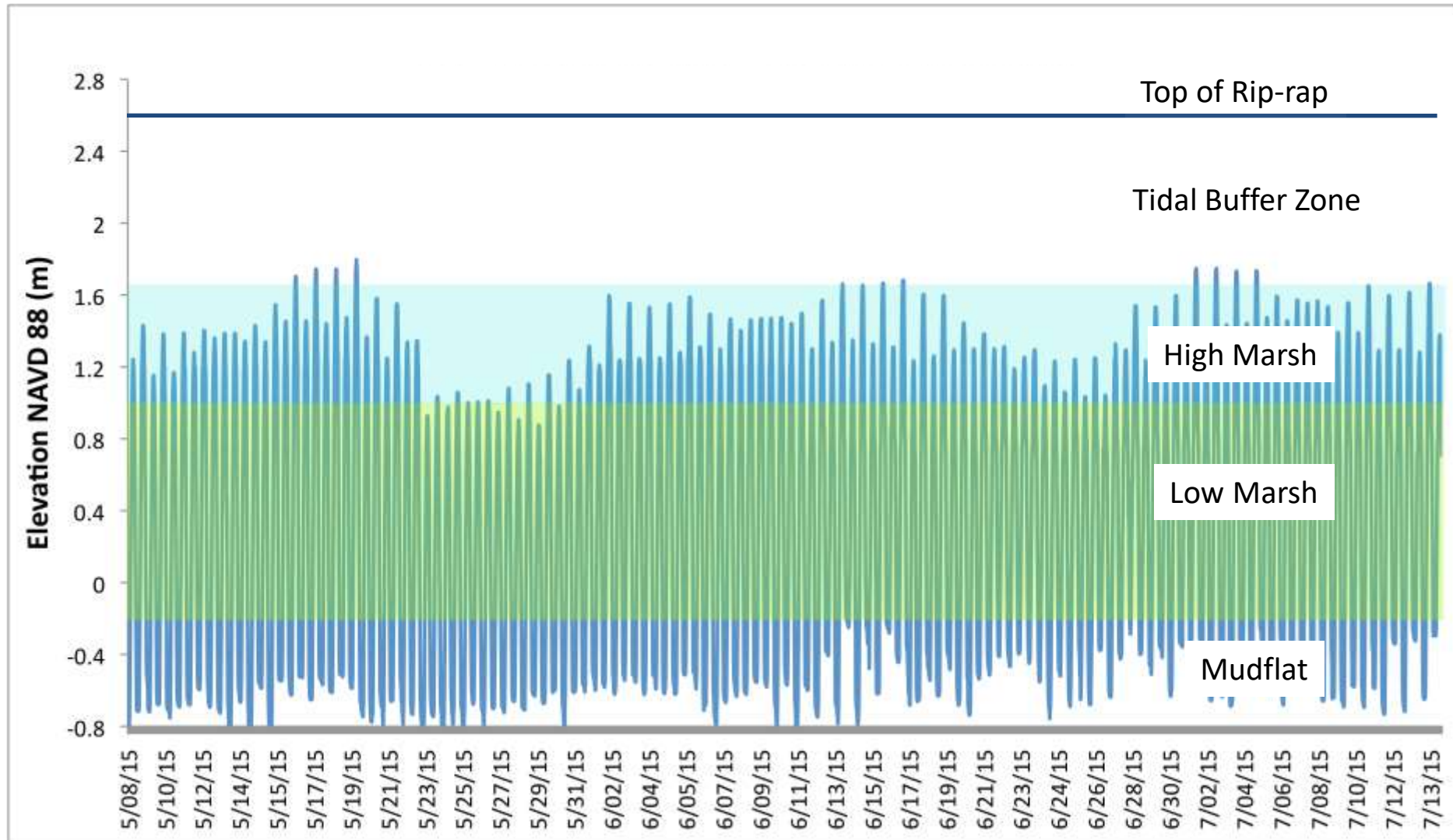
Rip Rap Armor at Cutts Cove



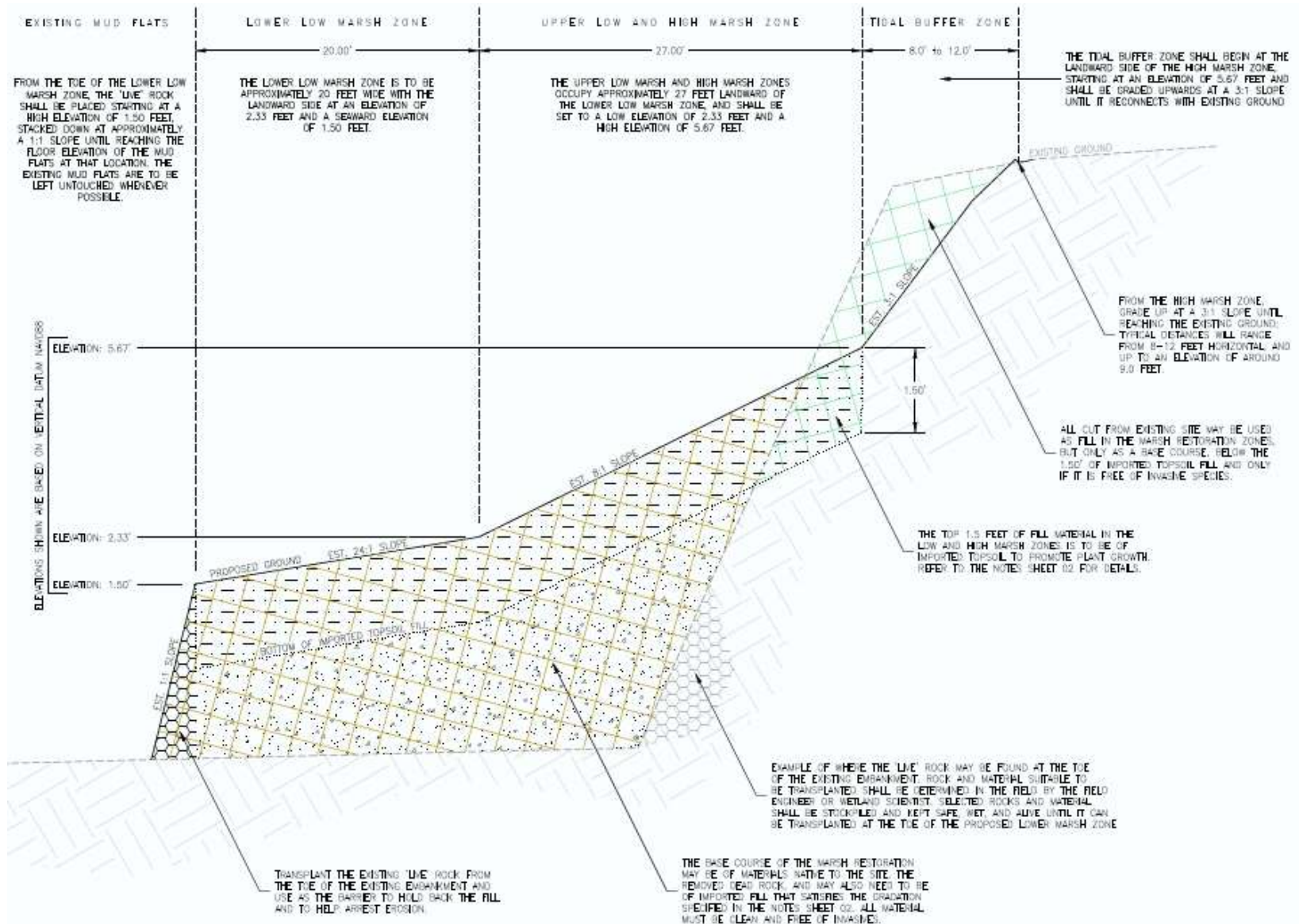
Sarah Mildred Long Bridge Replacement Mitigation Plan January 2014



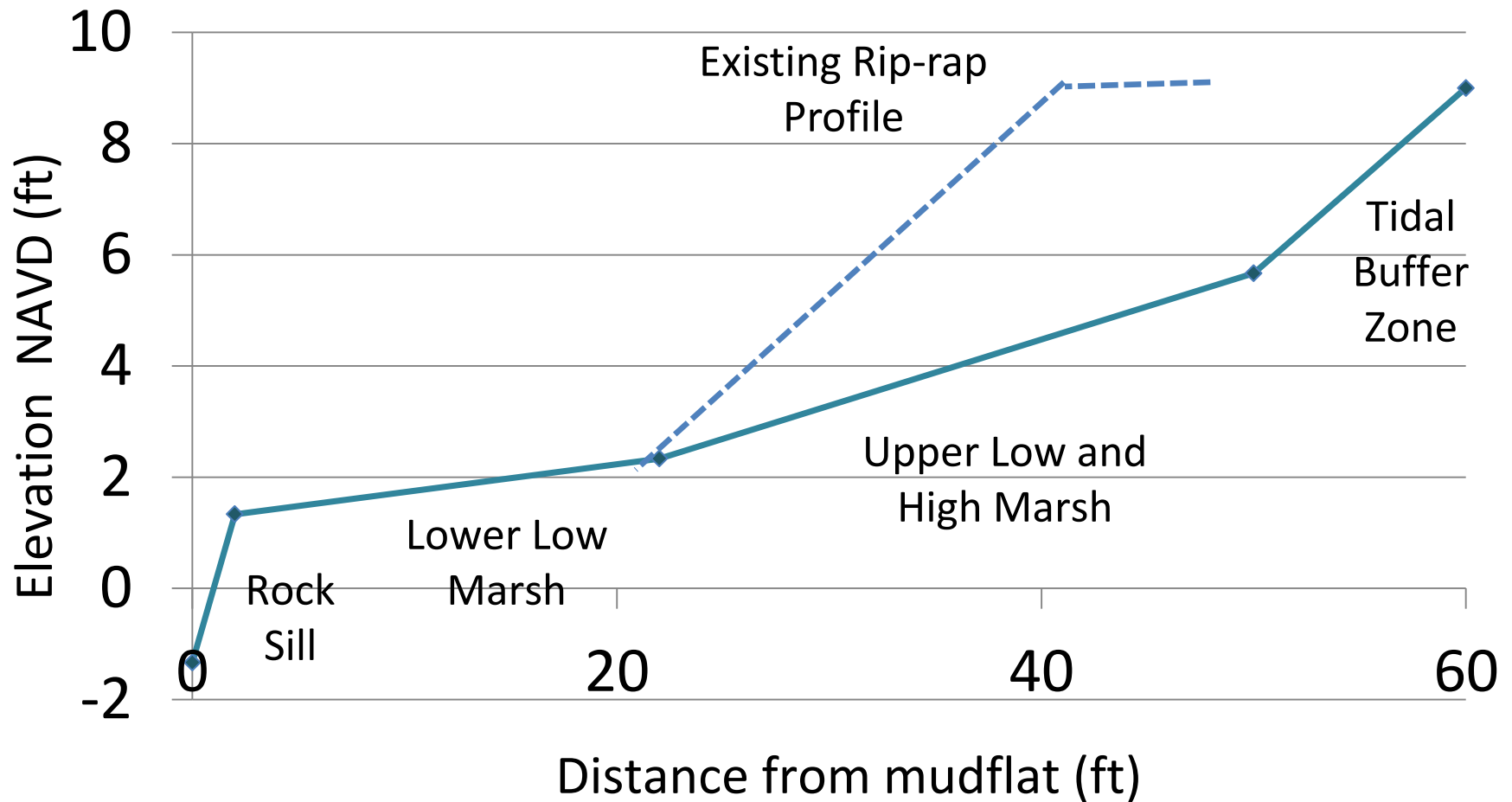
Tides and existing marshes in Cutts Cove



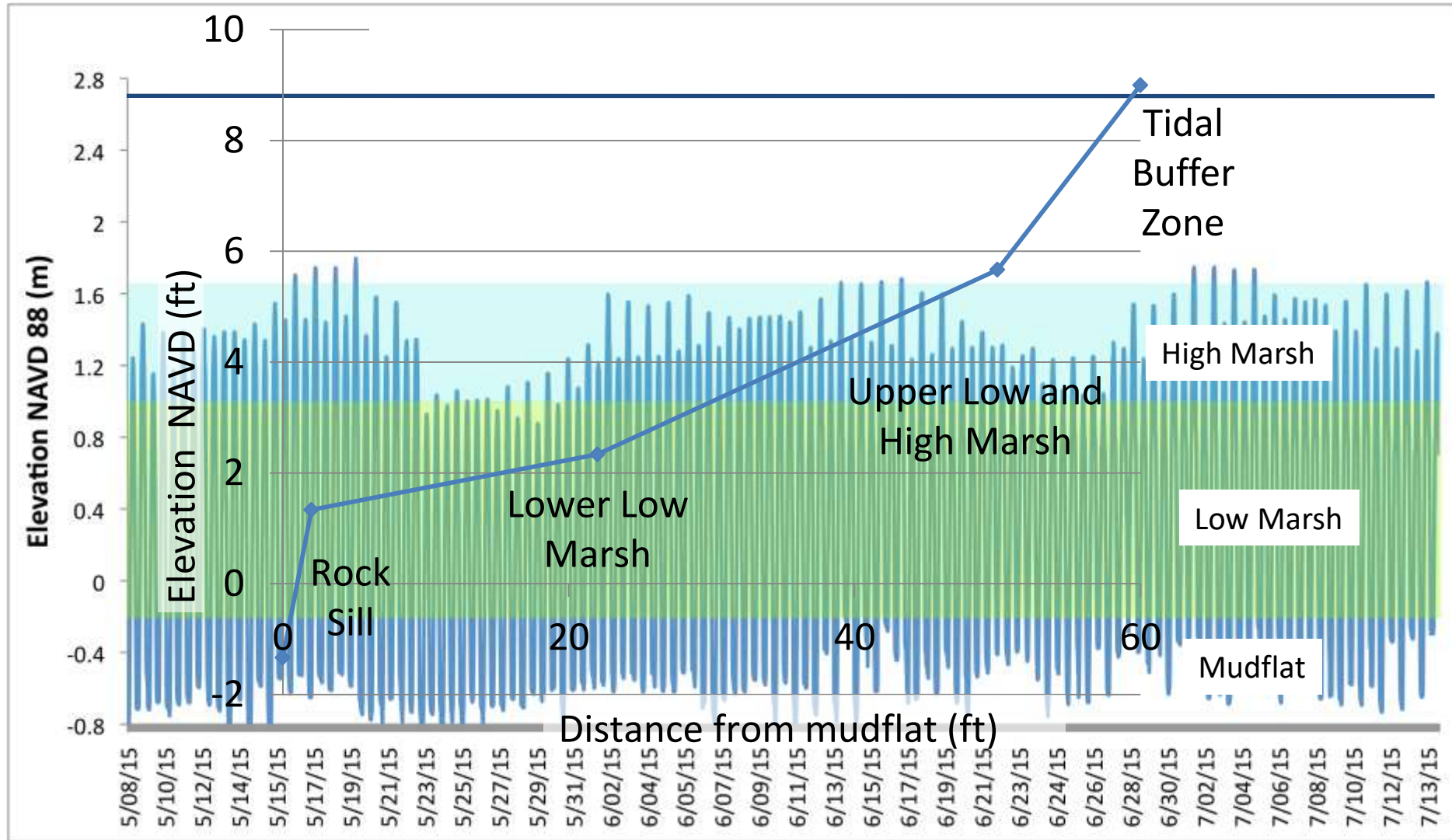
Proposed Cutts Profile



Cutts Profiles and Ecosystems



Tides and existing marshes in Cutts Cove



Construction Sequence

Clear and Grub

Flatten rip-rap wall and build stone edge

Backfill with sandy silt to elevation



Planting and Maintenance



Measures of Success

- Monitoring
 - Erosion
 - Plant establishment and growth
 - Animal use of habitat
- Maintenance

Pre-restoration Fish Sampling



Case Study #2: Wagon Hill Farm



Change from 1992 to 2015



Wagon Hill Farm Issues and Data Collection

Potential Causes of Erosion

- Waves
- Increased foot /pet traffic
- Decreased light
- Increased Sea Level
- Ice Damage
- Plant disease or herbivory
- Lack of Sediment supply
- Eroded shoreline promotes erosion cycle
- Stormwater

Data Collection

[to eliminate potential causes and inform design]

- High intensity water levels
- Wildlife cameras
- Light meters
- Water level recorders
- Wildlife cameras
- Observations
- Trial structure
- Erosion pins

Setting Erosion Pins



Foot Traffic and Boat Waves





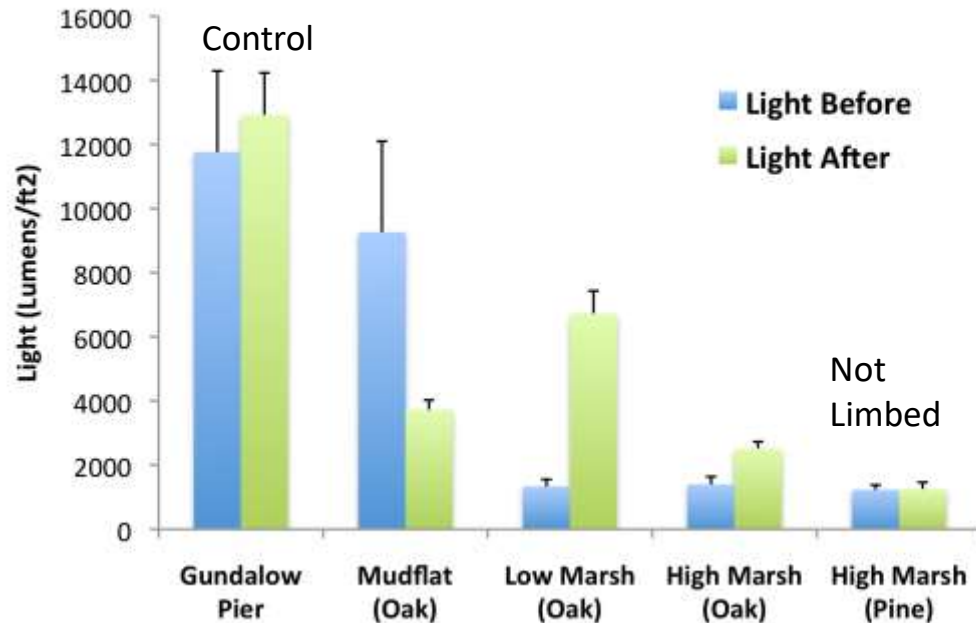
From 2009

Light can be a big issue for plants

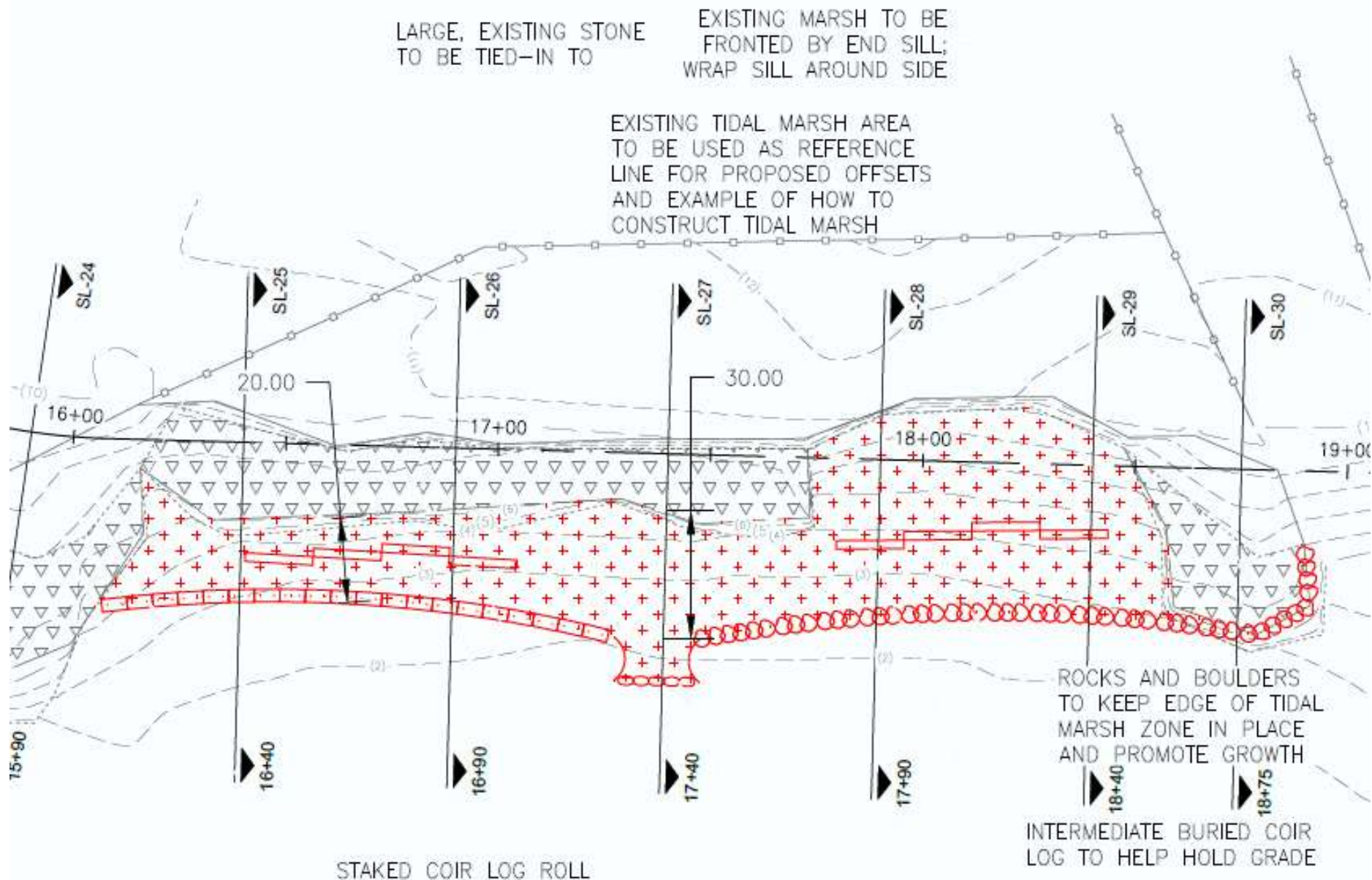


Today

Light Reaching Marsh Surface Before and After Limbing



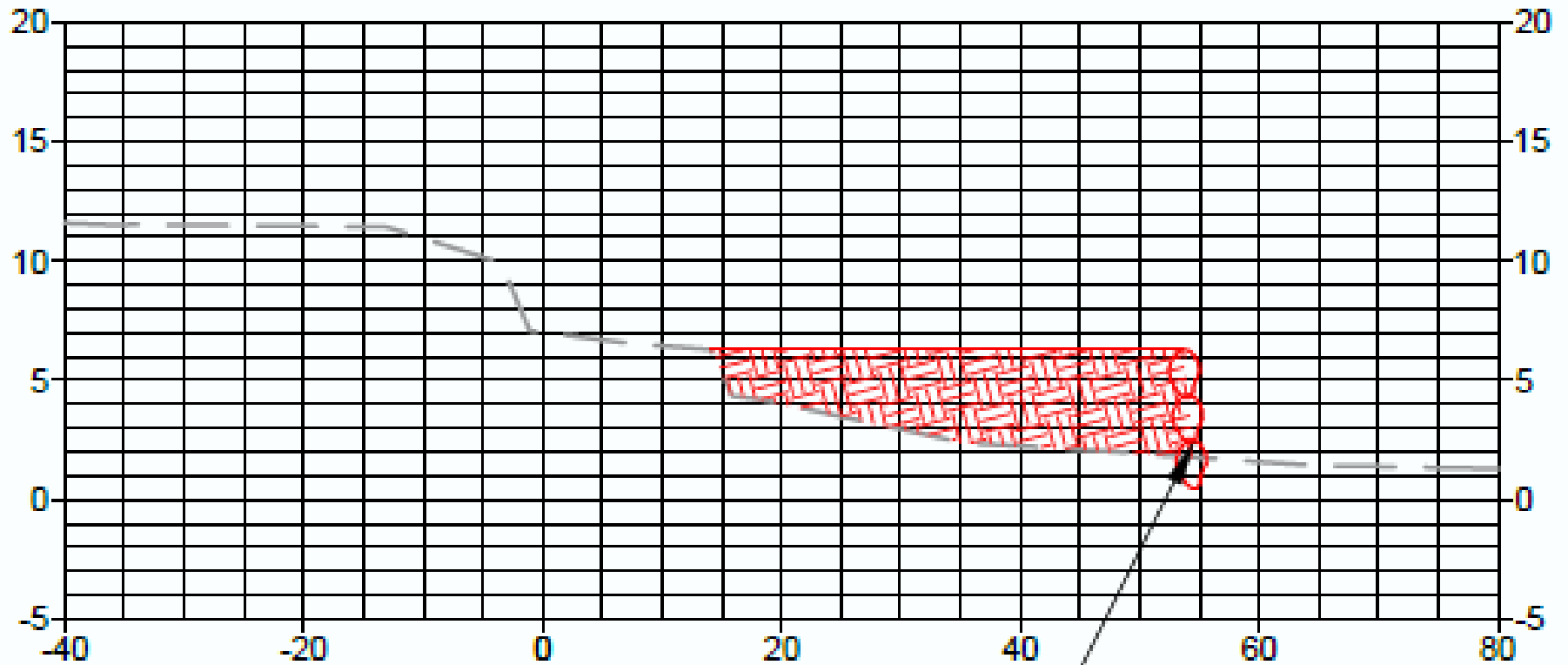
Potential First Phase - Plan



Profile Type 1

SL-27

17+40



LL

LARGE STONE BREAKWATER
TO HELP HOLD GRADES AND
CREATE CUSPATE AREAS

Conclusions

- Recognize limited growing season
- Difficulty increases with tidal range and physical exposure to shear stress from waves and ice
- Be aware of conditions that can reduce success: shade and animals (geese, crabs, snails, people)
- Consider management (including people management) at the landscape scale

Thank You!

