Workshop Overview and Related Projects

Rebecca A. French, Ph.D.
CIRCA Director of Community Engagement

Connecticut Living Shorelines: Projects into Practice Workshop
November 20, 2017

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Connecticut Institute for Resilience and Climate Adaptation

CONNECTICUT ENERGY ENVIRONMENT

Morning

10:15 – 11:00

Overview of Connecticut living shoreline permit process –

Tonia Selmeski and John Gaucher, Environmental Analysts
CT DEEP Land and Water Resources Division, SW District

11:00 – 11:10 Break

11:10 – 12:00 Description of two sites and design concepts

Hepburn Dune and Marsh, Fenwick Marilyn Ozols - Land Use Administrator, Borough of Fenwick

East Shore Park, New Haven Giovanni Zinn - City Engineer, City of New Haven

Afternoon Breakouts

12:00 – 1:00 Lunch – In the Branford House

1:00 – 2:00 Mock permit application review for two sites – breakout session

- Tonia Selmeski, Environmental Analyst CT DEEP Land and Water Resources Division, SW District
- John Gaucher, Environmental Analyst CT DEEP Land and Water Resources Division, SW District
- Brian Golembiewski, Supervising Environmental AnalystCT DEEP Land and Water Resources Division, SE District
- Susan Jacobson, Environmental Analyst

  CT DEEP Land and Water Resources Division, N District

Federal Perspective and Closing

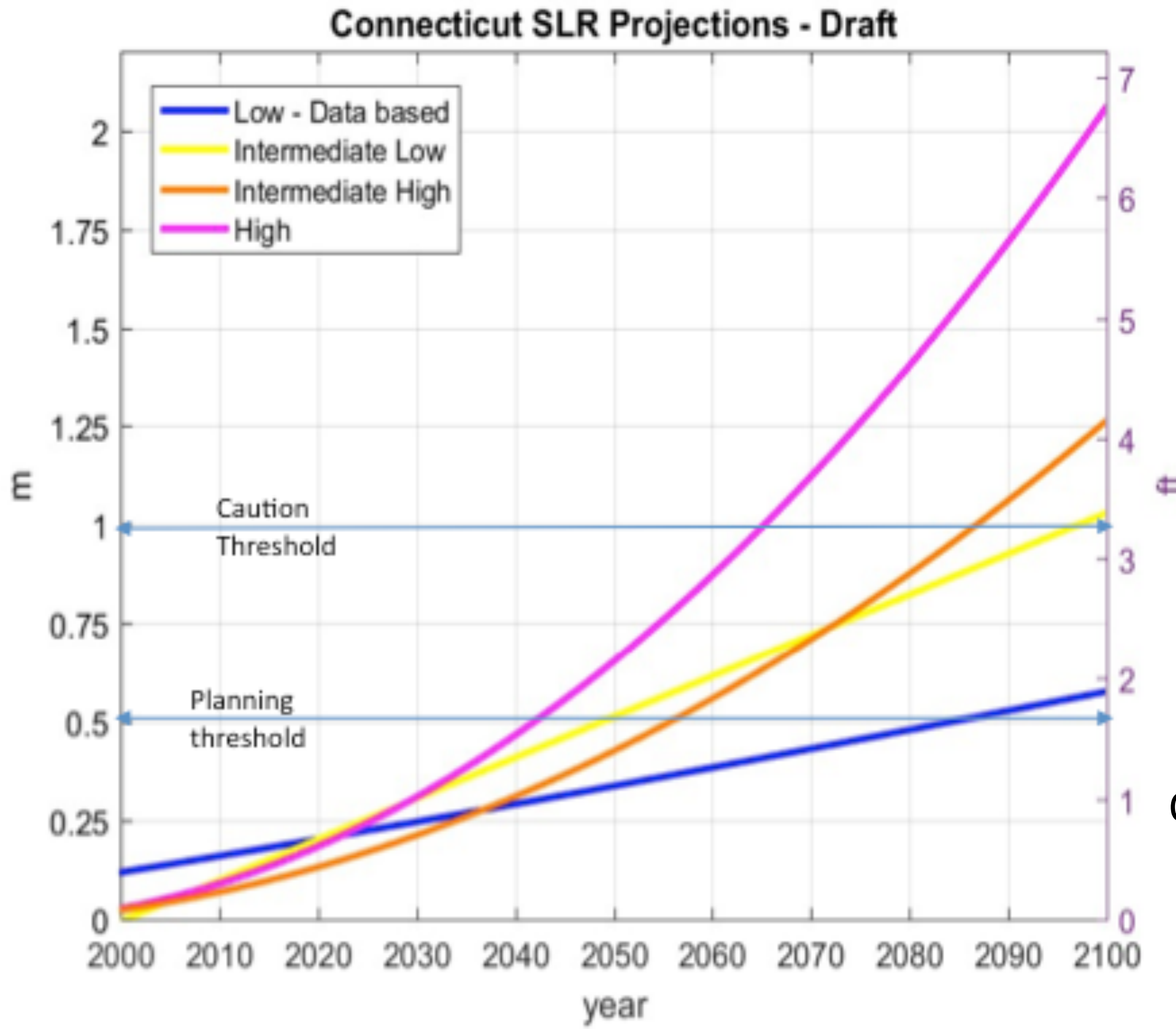
- **2:00 – 3:00** Federal perspective on mock designs and permitting
  - *Cori Rose, Senior Project Manager US Army Corps of Engineers, Regulatory Division*
  - *Alison Verkade, Marine Habitat Resource Specialist National Oceanic and Atmospheric Administration, NMFS*

- **3:00 – 3:30** CT DEEP and federal agency staff panel for Q&A and to re-cap breakout sessions

CIRCA Mission

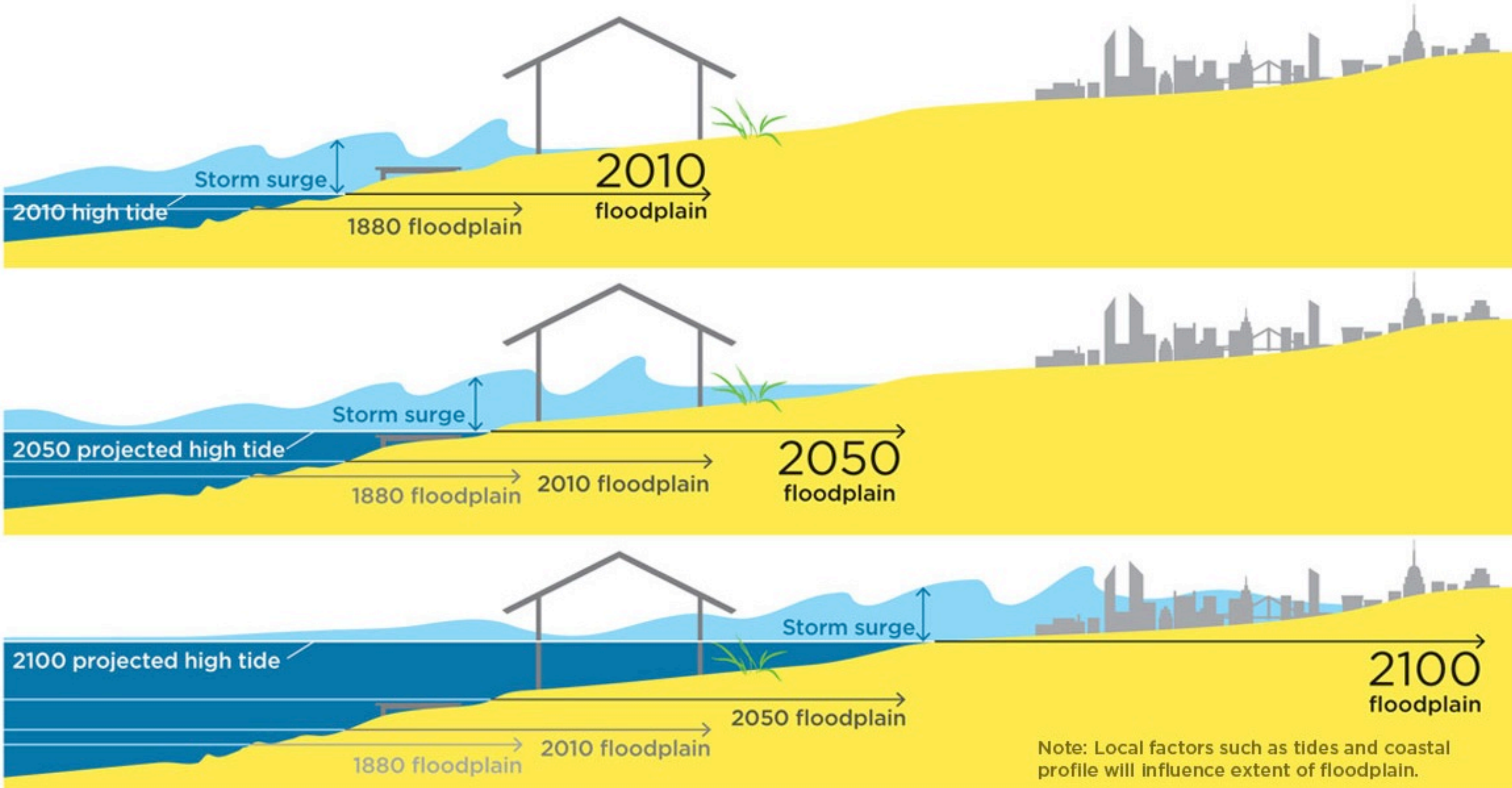
Increase the resilience and sustainability of vulnerable communities in Connecticut's coastal and inland areas to severe storms and the growing impacts of climate change on the natural, built, and human environment in response to critical, identified needs and priorities.

- We recommend that planning anticipates that sea level will be 20 inches (50cm) higher than the national tidal datum in Long Island Sound by 2050.
- It is likely that sea level will continue to increase after 2050.
- We recommend updates every 10 years to ensure that planning be informed by the best available science.



O'Donnell, 2017

Sea Level Rise Increases the Frequency of Flooding from Storms and Tides



Connecticut Coastal Management – alternatives to hard structures

- Public Act (12-101) (2012): An Act Concerning the Coastal Management Act and Shoreline Flood Erosion Control Structures
- "feasible, less environmentally damaging alternative" includes, but is not limited to, relocation of an inhabited structure to a landward location, elevation of an inhabited structure, restoration or creation of a dune or vegetated slope, or living shorelines **techniques utilizing a variety of structural and organic materials, such as tidal wetland plants, submerged aquatic vegetation, coir fiber logs, sand fill and stone to provide shoreline protection and maintain or restore coastal resources and habitat."**

Living Shorelines Connecticut's Working Definition

- The term "living shoreline" refers to a shoreline management practice which restores, enhances, maintains or creates natural coastal or riparian habitat, functions and processes and also functions to mitigate flooding or shoreline erosion through a continuous land-water interface.
  - Coastal and riparian habitats include but are not limited to intertidal flats, tidal marsh, beach/dune systems, and bluffs.
  - Living shorelines may include structural features that are combined with natural components to attenuate wave energy and currents.

State of the Practice
Profile Pages Intro

Living Shorelines Introduction

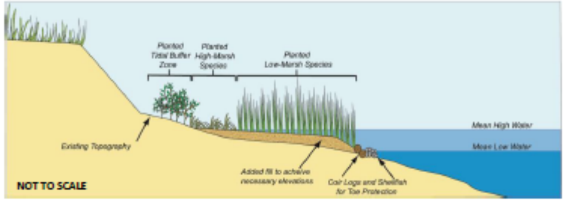
A detailed profile page was created for each of the eight (8) living shoreline types listed below. The purpose of these profile pages is to provide a comprehensive overview of the design recommendations, siting criteria and regulatory topics pertinent to a range of living shorelines designs that practitioners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

Living Shoreline Types

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

Design Schematics

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



Case Study

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

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

Explanation of Design Overview Tables

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

Acronyms and Definitions

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


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

Connecticut Institute for Resilience and Climate Adaptation

State of the Practice
Profile Pages Intro

Living Shorelines Introduction

Overview of Regulatory and Review Agencies Table

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

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

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

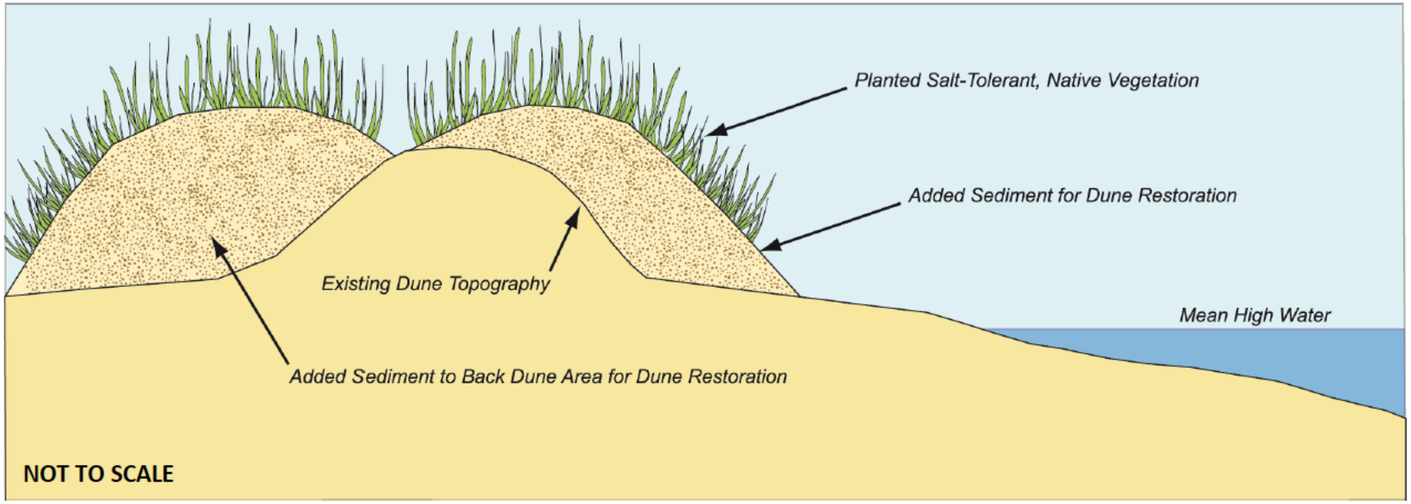
Use and Applicability of Profile Pages

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

Explanation Key for Siting Characteristics and Design Considerations

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

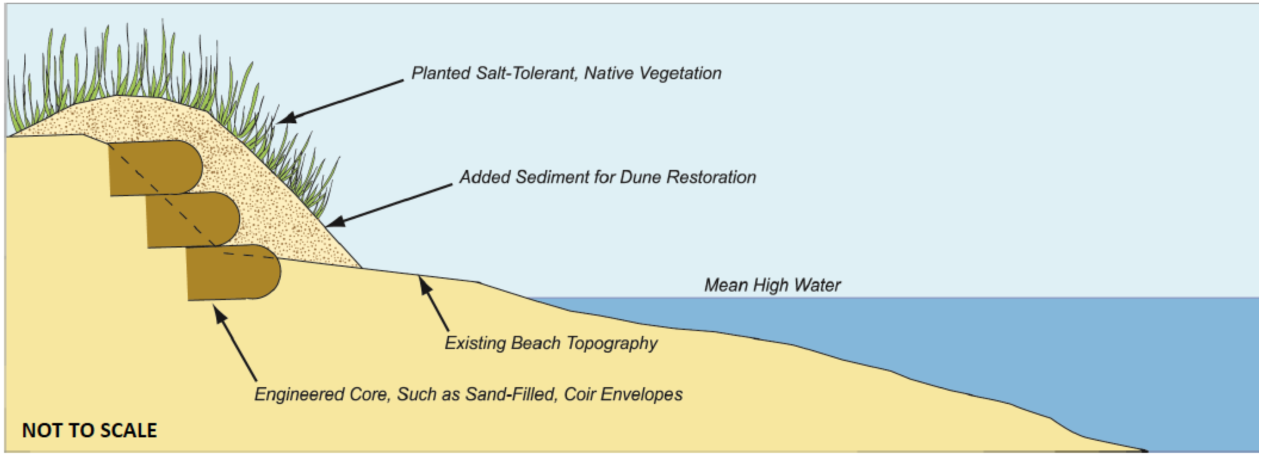
Dune - Natural



Duxbury Beach, Duxbury, MA
Photo courtesy of Woods Hole Group

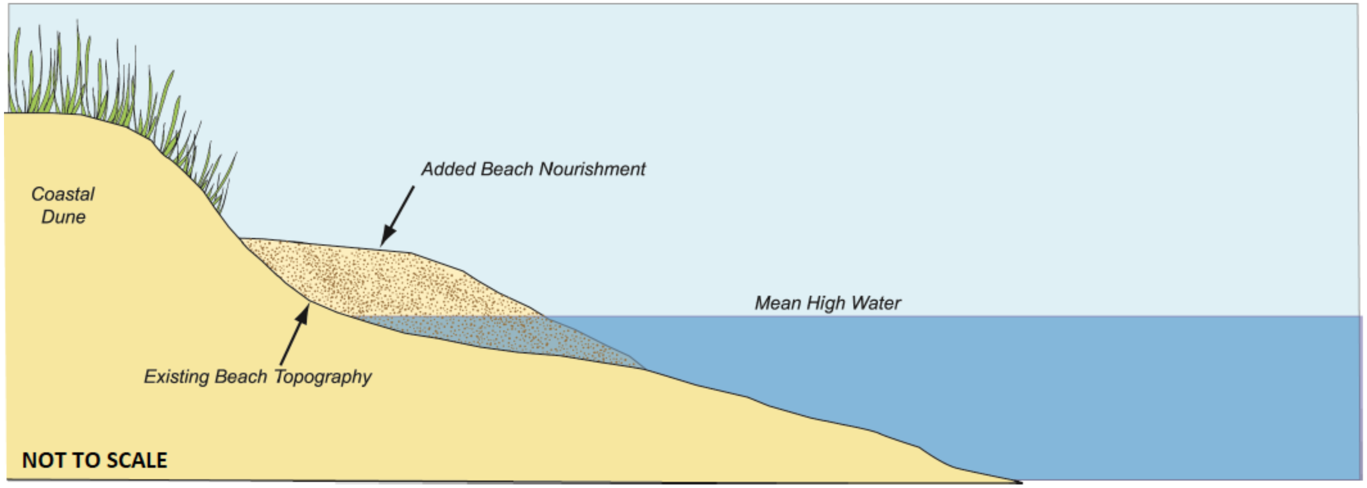
Cow Bay Beach, Martha's Vineyard, MA
Photo courtesy of Woods Hole Group

Dune – Engineered Core

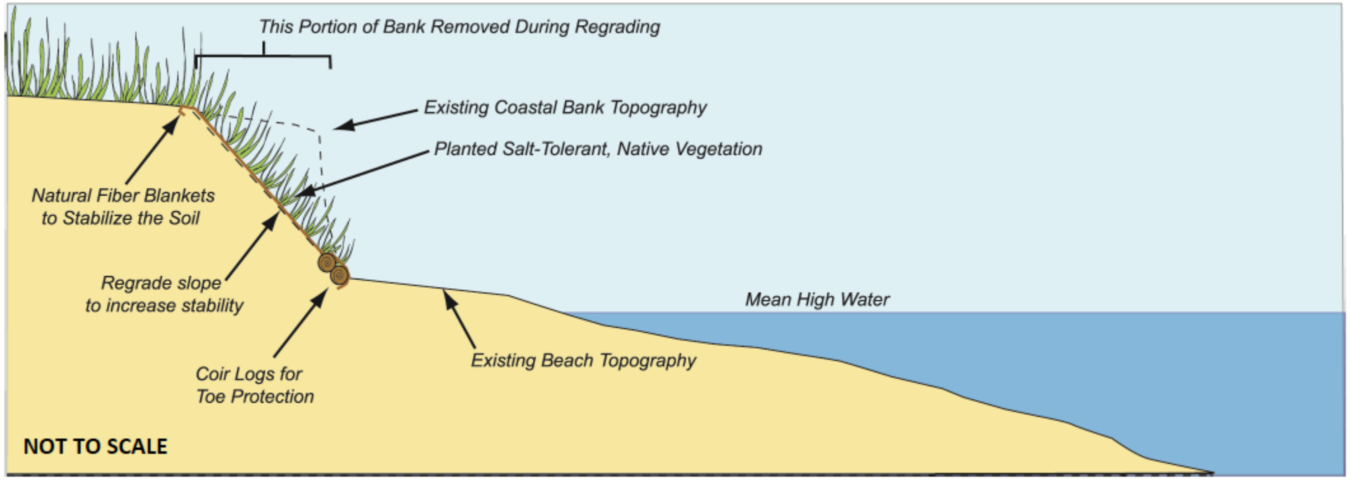


Dune with an engineered core, South Kingstown, RI
Photo courtesy of Janet Freedman

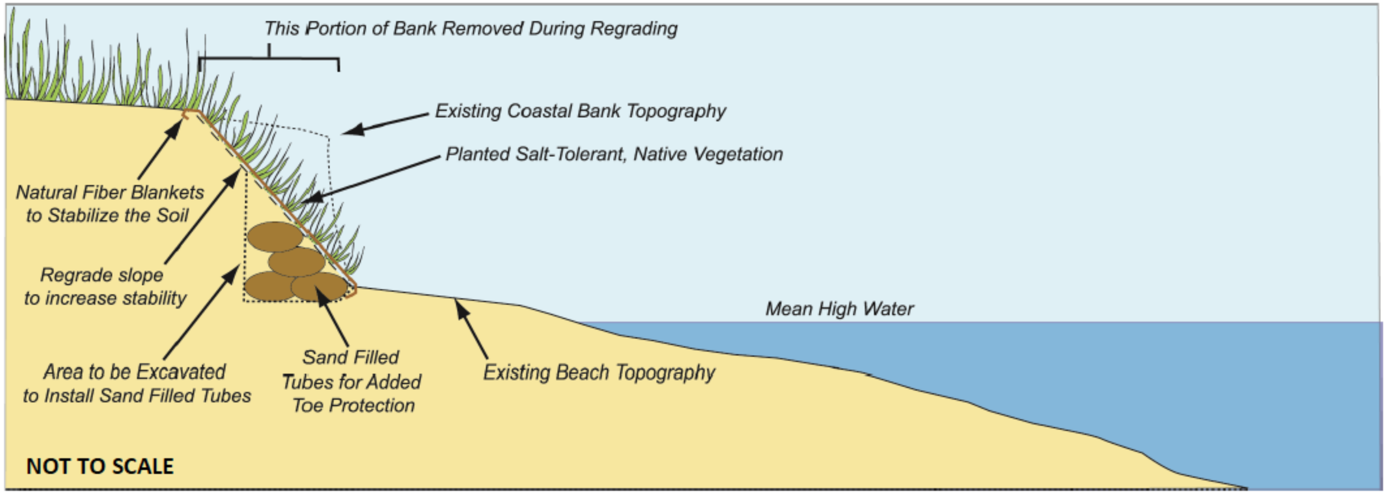
Beach Nourishment



Coastal Bank - Natural



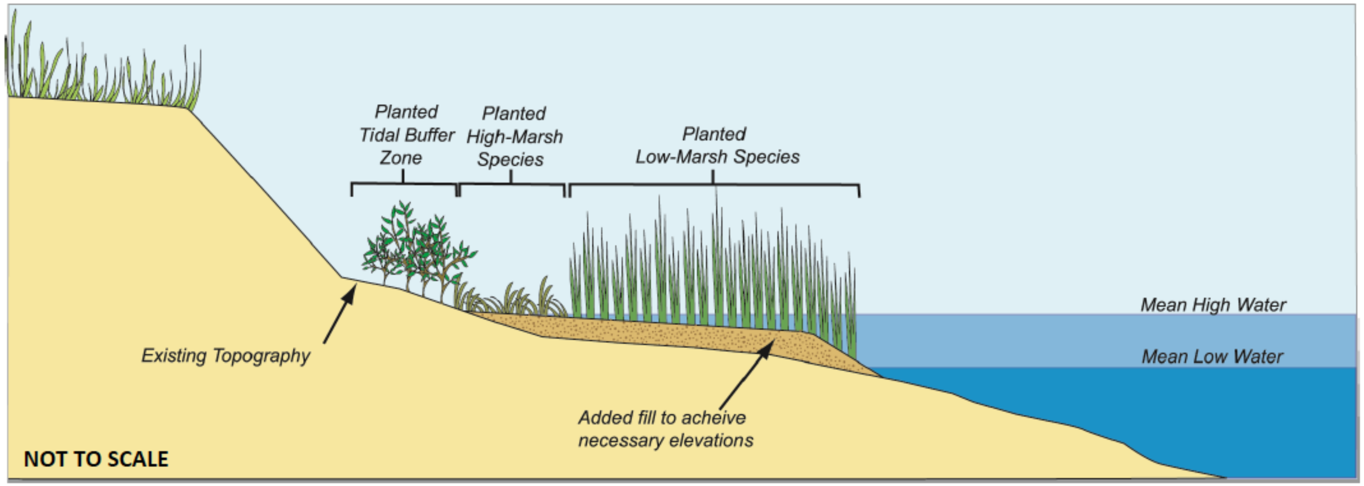
Coastal Bank – Engineered Core



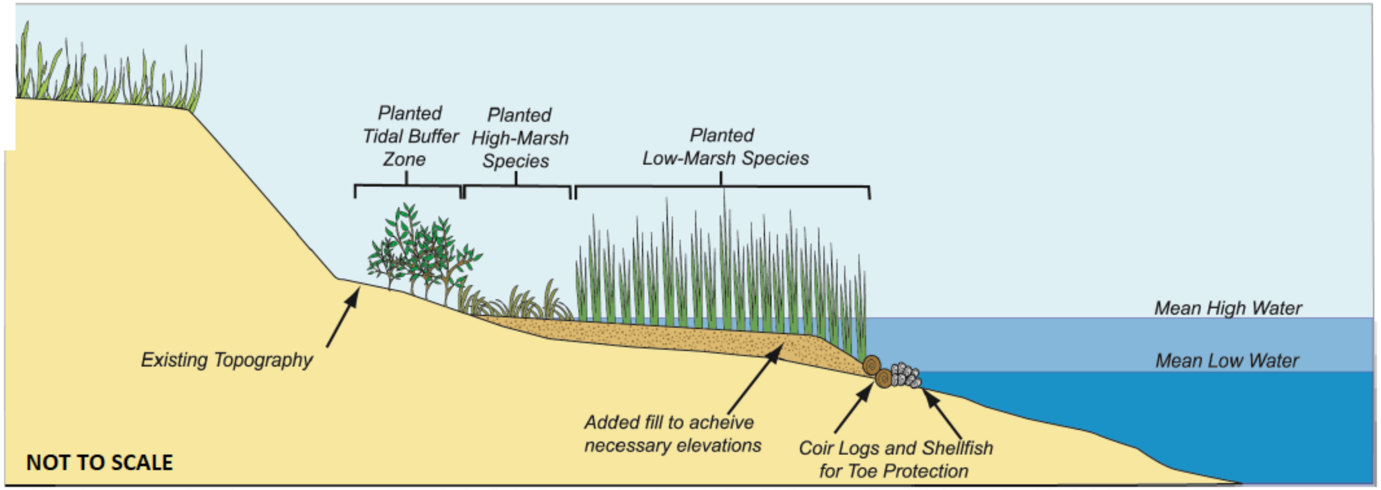
Construction at King's Park, Newport, RI

Photos courtesy of Janet Freedman

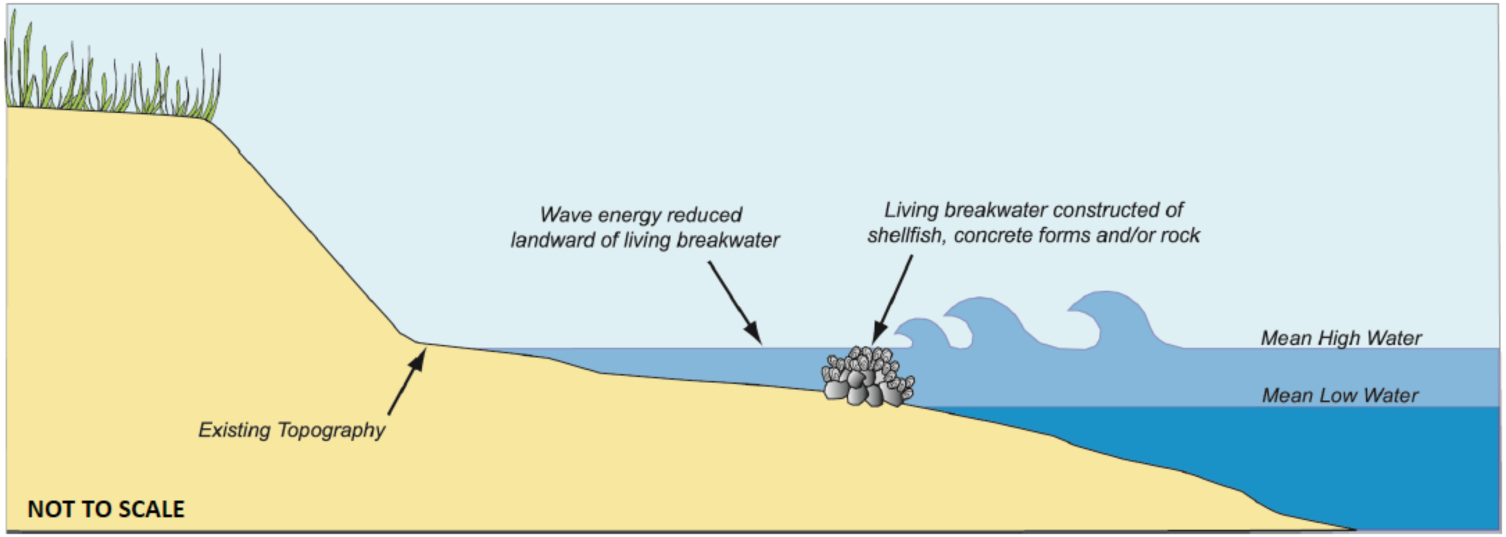
Natural Marsh Creation/Enhancement



Marsh Creation/Enhancement w/Toe Protection



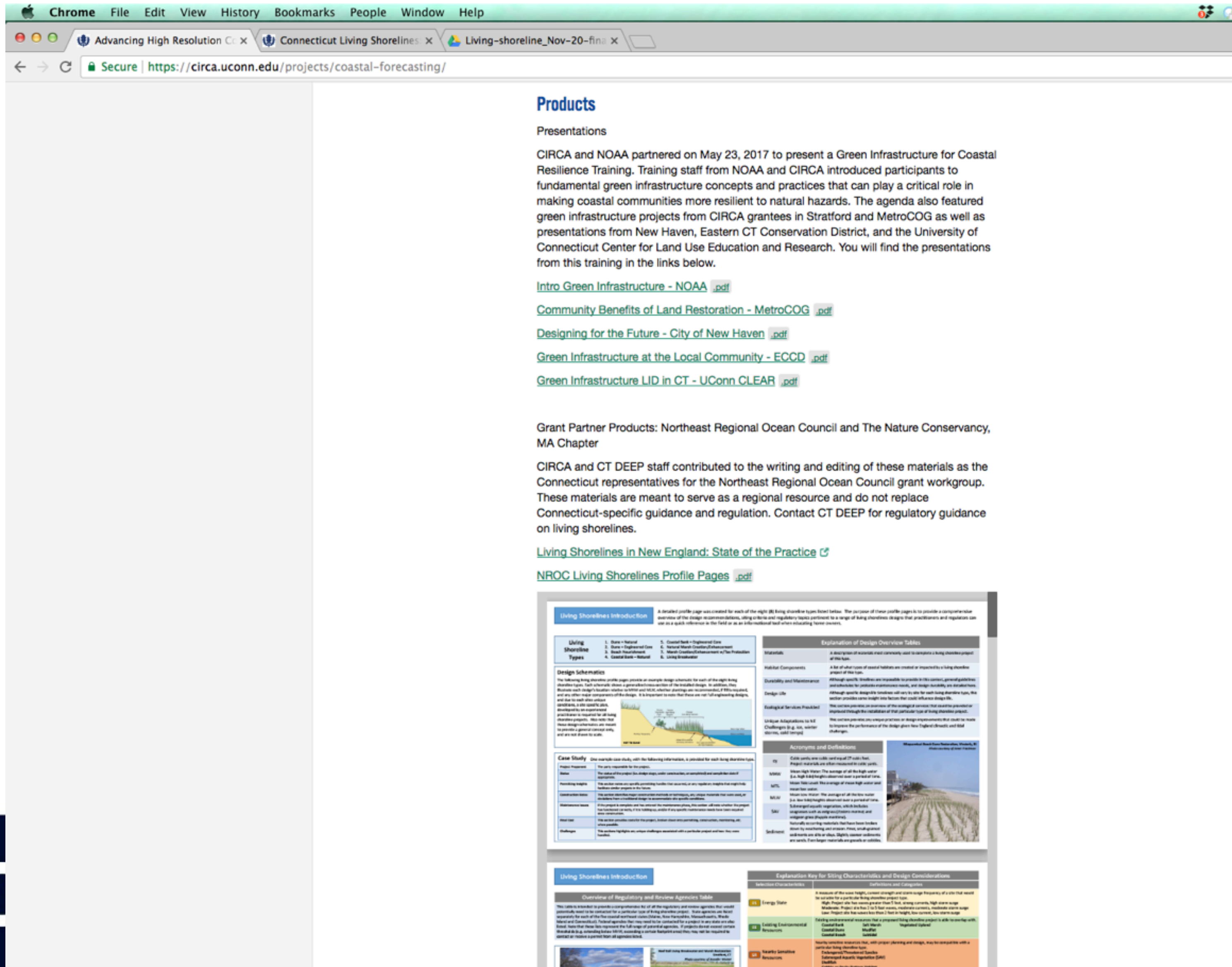
Living Breakwater



Reef Ball Breakwater, Stratford, CT
Photo courtesy of Jennifer Mattei

Oyster castles for a living reef at Gandy's Beach NJ
Photo courtesy of Mary Conti, TNC NJ

- https://circa.uconn.edu/projects/coastal-forecasting/



CIRCA Grantees

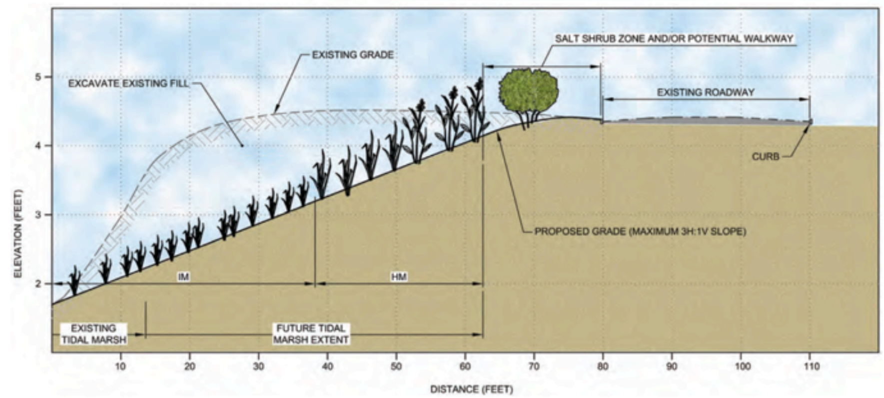
IMPLEMENTING LIVING SHORELINES IN CONNECTICUT

Milford

- Restoring a dune in the Walnut Beach area by removing invasive species and replanting with native species.
- Acts as a living shoreline by buffering waves and serving as a barrier to storm surge while also providing a healthy shoreline habitat.

Connecticut Metropolitan Council of Governments

- *Designing Resilience: Living Shorelines for Bridgeport* will advance engineering and design for a living shoreline along the West Johnson Creek.
- Preliminary conceptual design included creating a gradual vegetated slope that would also allow for marsh migration under sea level rise.



Stratford (through Sacred Heart University)

- *Stratford Point Living Shoreline: Restoring Coastal Habitats to Maintain Resiliency and Function.* CIRCA grant expanded the site to 750 feet of additional shoreline.

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Living Breakwaters – Reef Balls at Stratford Point

Living Breakwaters – Reef Balls at Stratford Point

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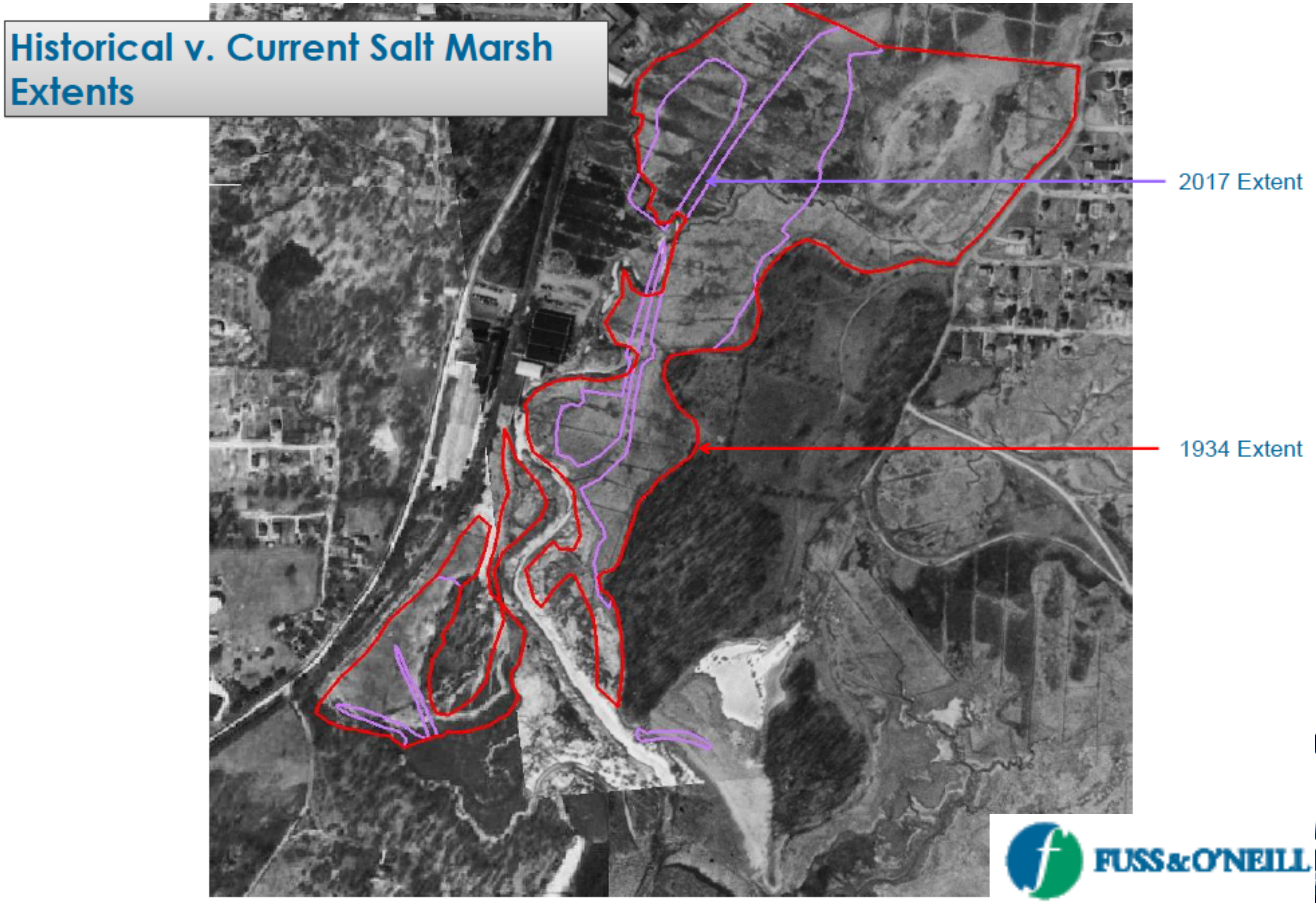
Norwalk (Norwalk Land Trust w/ partner Village Creek Harbor Corporation)

- *The Village Creek Saltmarsh Restoration Demonstration*



Norwalk (Norwalk Land Trust w/ partner Village Creek Harbor Corporation)

- *The Village Creek Saltmarsh Restoration Demonstration.* CIRCA grant matching Long Island Sound Futures Fund to do assessment, design and baseline site monitoring.

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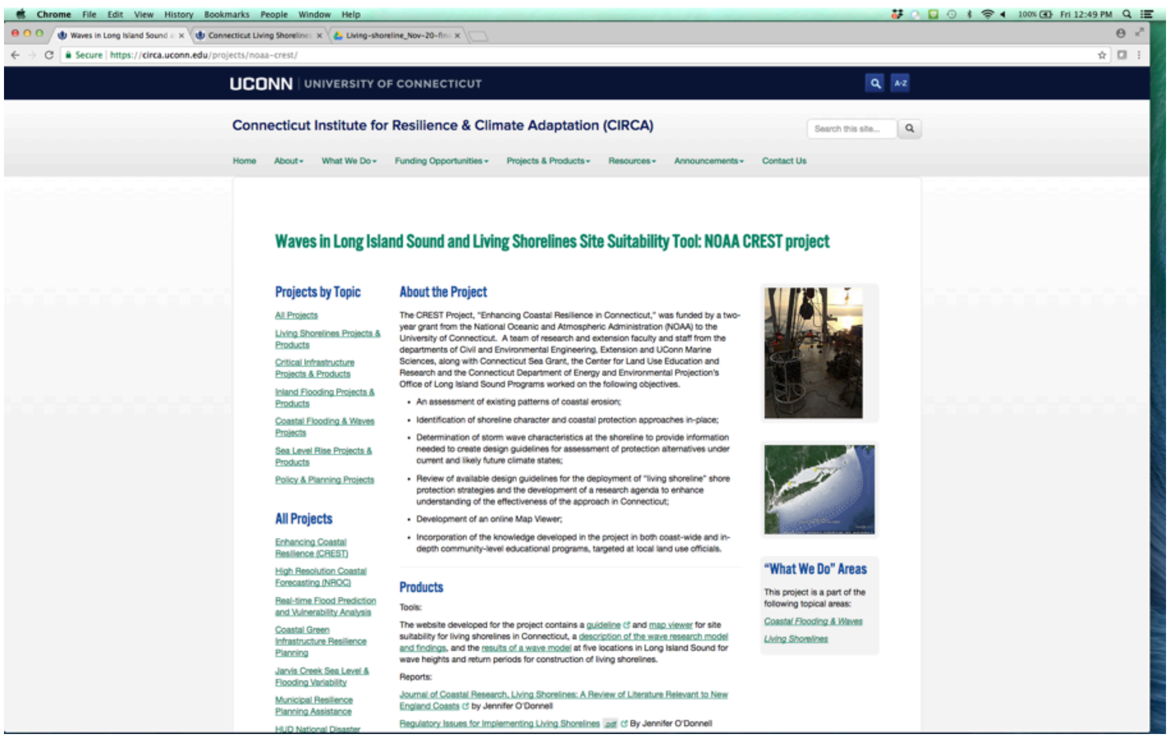
Tools to Design Living Shorelines

- Wave heights at a location are needed to design the appropriate type of living shoreline
  - bigger waves mean design needs to break up waves before they hit the shore
- CIRCA research modeled wave heights for all of Long Island Sound. This information is available to anyone who wishes to use it to inform a design. Information is usually used by an engineer or design firm.
- Contact circa@uconn.edu to get wave data.

CIRCA Resources for Constructing Living Shorelines

https://circa.uconn.edu/projects/noaa-crest/



Waves and Living Shorelines: NOAA CREST Project

- Old Saybrook Study Area and New Haven Study Area
  - Two 4-mile pilot areas
    - Detailed analysis of existing coastal structures,
    - Shoreline photos in high density
- Results Living Shorelines Site Suitability Analysis
  - The Connecticut shore was analyzed for the potential success of four living shoreline methods
  - The CREST Map Viewer contains layers indicating the potential of a particular living shoreline technique

Structure Display

- inland hard
- inland hard natural
- inland medium
- inland medium natural
- inland soft
- inland soft natural
- shore MHW
- shore MHW natural
- shore hard
- shore hard natural
- shore medium natural

- Potential for Marsh with Structures
- Potential for Marsh Enhancement
- Potential for Offshore Breakwaters
- Potential for Beach Enhancement
- Areas Excluded in Analysis

Waves and Living Shorelines: NOAA CREST Project

Map Viewer – Shows potential locations for living shoreline strategies in Connecticut

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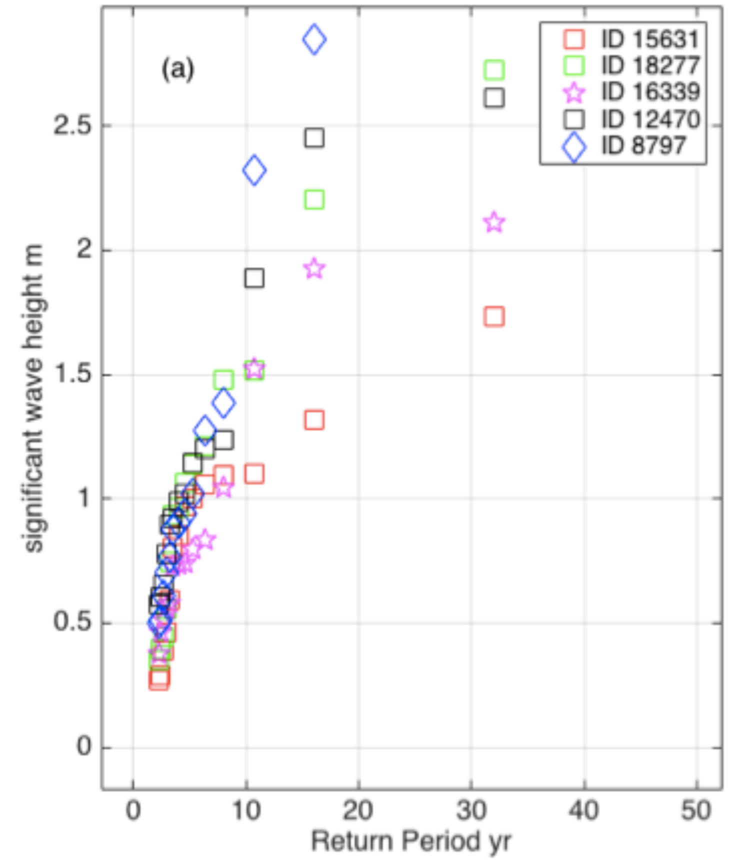
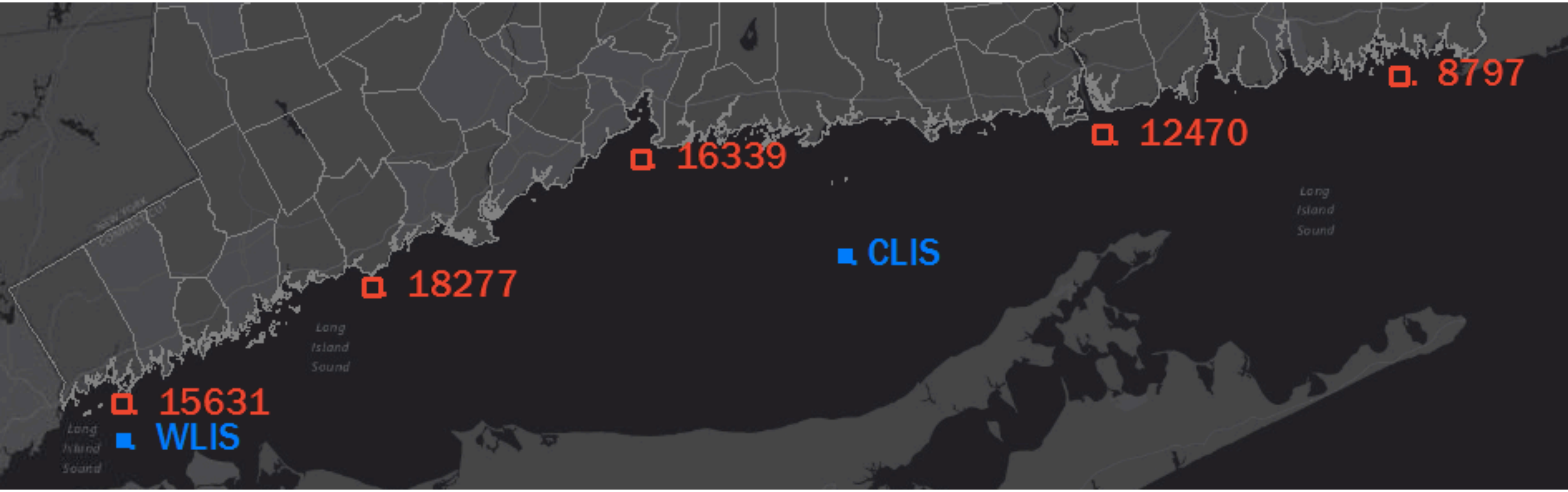
Wave heights for designing site appropriate living shorelines

- Most western location (ID 15631, red squares) the probability of a significant wave height exceeding 1.7 m (5.6 ft) any given year is **1/32**.
- At the eastern end (ID 8797, blue diamond) a 1.5 m (4.9 ft) significant wave height shows a **1/10** probability any given year

Significant Wave Height – Return Period plot



CREST Map Viewer – Wave height statistics for living shoreline designs



CREST Map Viewer

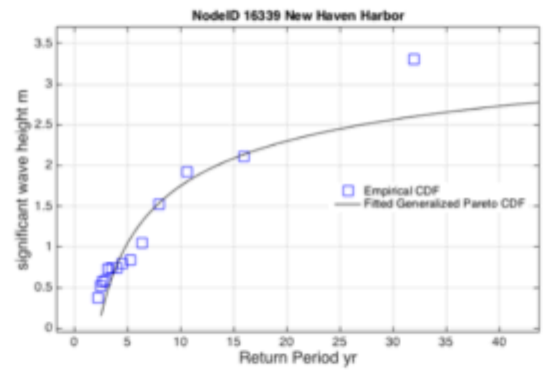
Viewer | Point 16339 | Connecticut In | Point 16339 | Connecticut In | CREST Maps | Connecticut In | Coastal Resilience Networks

Point 16339

New Haven Harbor

Latitude: 41.232
Longitude: -72.918
Depth: 6.244 m

- NOAA CREST Home
- About
- Maps
- Wave Research
- Wave Points



Storm	Date	% U max [m s^-1]	%U mean [m s^-1]	% U dir max	% U dir mean	% z(t) max [m]	% sigH maz [m]	% Tpeak max [s]
Gloria	Sept. 20, 1985	46.955	6.634	259.027	171.137	1.496	6.993	9.675
Sandy	Oct. 25, 2012	26.019	11.065	79.472	96.224	1.65	3.798	8.068
NorEaster	Oct. 30, 2012	35.324	10.176	237.129	90.782	1.53	2.024	6.145
1985	month 9	13.375	5.356	70	152.73	1.366	0.891	4.274
2005	month 9	8.677	5.868	91.492	201.768	1.467	0.774	3.564
2007	month 4	16.141	7.626	104.108	231.735	1.766	0.878	3.903
2008	month 8	20.689	7.807	115.509	220.164	1.409	1.601	5.125
2009	month 8	7.562	4.142	186.805	200.805	1.561	0.539	2.972

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Living Shorelines Publications

National Wetlands Newsletter, Vol. 38, No. 2, Copyright © 2016 Environmental Law Institute ® Washington, D.C., USA

Regulatory Issues for Implementing Living Shorelines

The benefits of living shorelines over traditional man-made structures have been well known for decades, however, obstacles still exists to their widespread use. Regulatory reform, better coordination among regulatory agencies, and improved perception can help remove barriers to living shorelines.

By Jennifer E.D. O'Donnell

As communities begin to adapt to climate change, the initial response is to construct more traditional coastal engineering structures such as seawalls and revetments (Shepard et al. 2011). A few spatially distributed coastal-protection structures should have little effect on coastal habitats; however, shorelines are becoming increasingly hardened, resulting in significant habitat degradation (National Research Council 2007; Currin et al. 2010). In some areas, over 50% of the shoreline is already protected with man-made structures. Over the last few decades, increasing awareness of the potential adverse impacts of traditional, hardened coastal protection structures on coastal processes and nearshore habitats has prompted interest in the development of shoreline stabilization approaches that preserve intertidal habitats, or at least minimize the destructive effects of traditional shoreline protection approaches (e.g., Augustin et al. 2009; Feagin et al. 2009; Gedan et al. 2011; Shepard et al. 2011; Arkema et al. 2013; Bridges et

Figure 1. Non-structural living shorelines: (*Top*) dune restoration; and (*Bottom*) tidal wetlands restoration. Photo credits: Jennifer E.D. O'Donnell

Connecticut Beaches and Dunes: A Hazard Guide for Coastal Property Owners

Adapted by Jennifer O'Donnell[a], and Juliana Barrett[b], from the [Maine Sea Grant Website, Maine Property Owner's Guide to Managing Flooding, Erosion & Other Coastal Hazards] which was based on an original document by Peter Slovinsky[c], ([Slovinsky, 2011]).

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Questions?

Rebecca French
rebecca.french@uconn.edu
860-405-9228

circa.uconn.edu
@UConnCIRCA

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