Living Shorelines as a Potential Method to Reduce Impacts of Sea Level Rise on Coastal Farms

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Sea level rise spells salty future for coastal farms

By Carolyn Beeler , Carolyn Beeler · September 25, 2014

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Gulf of Mexico saltwater threatens rice, crawfish farmers

By The Associated Press
on November 29, 2011 at 11:00 PM

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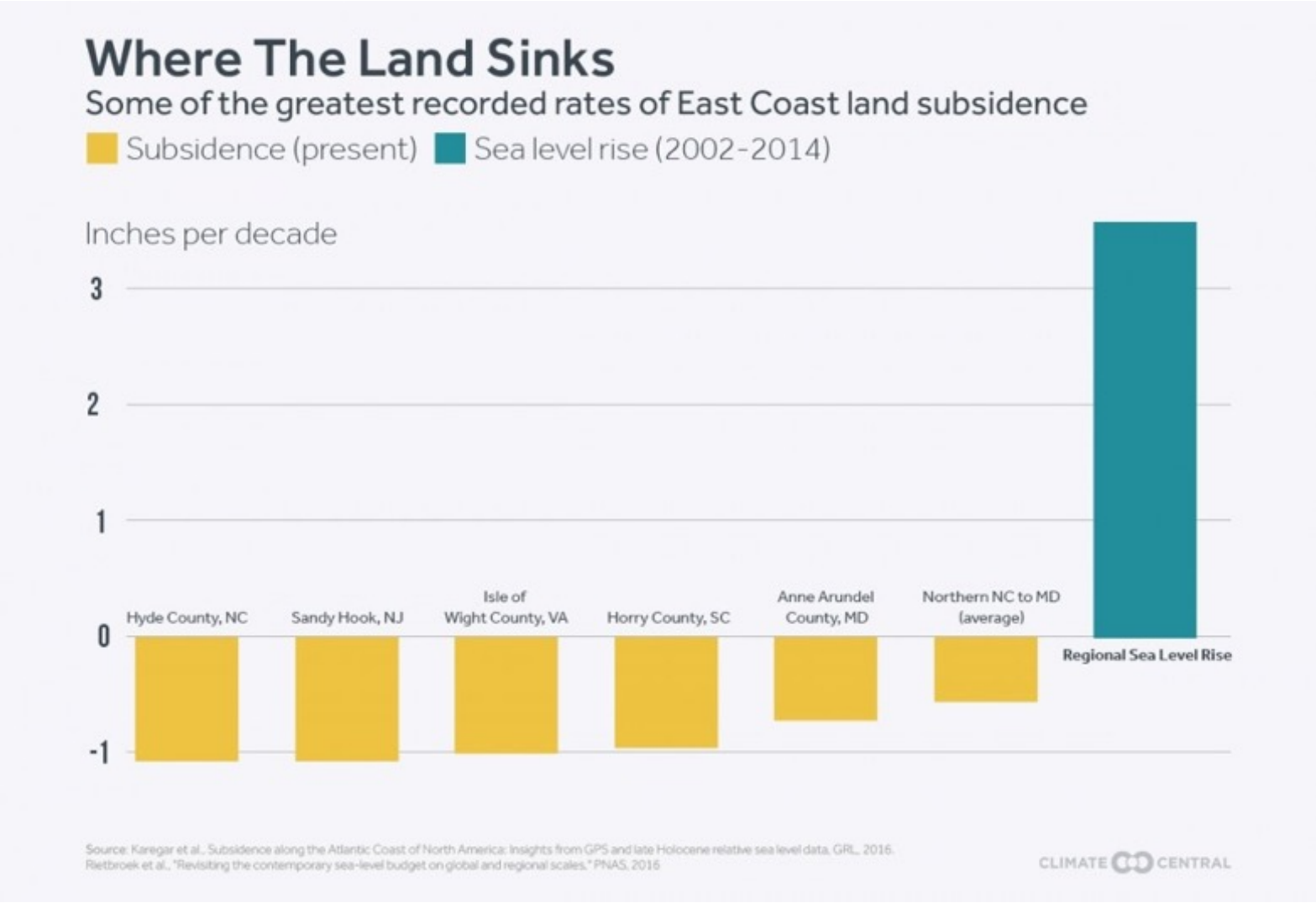
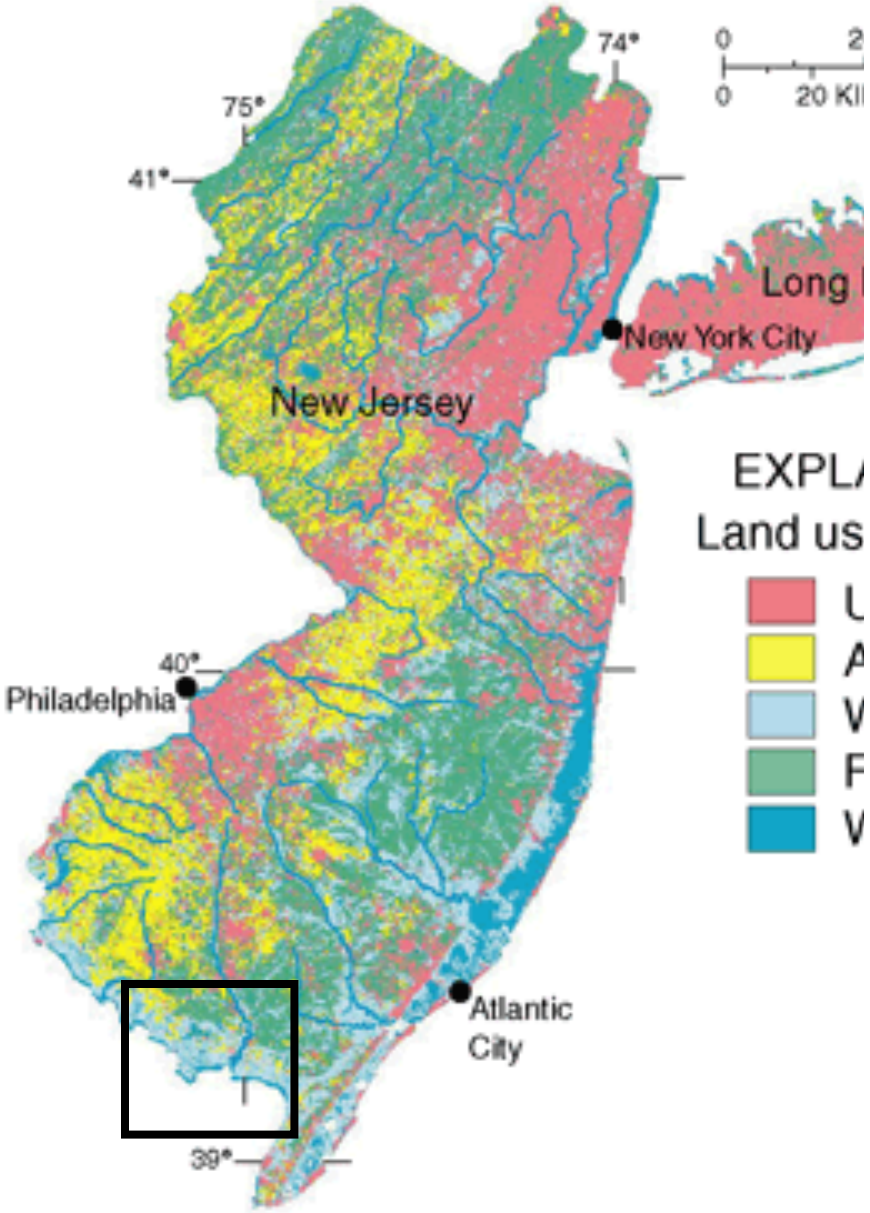
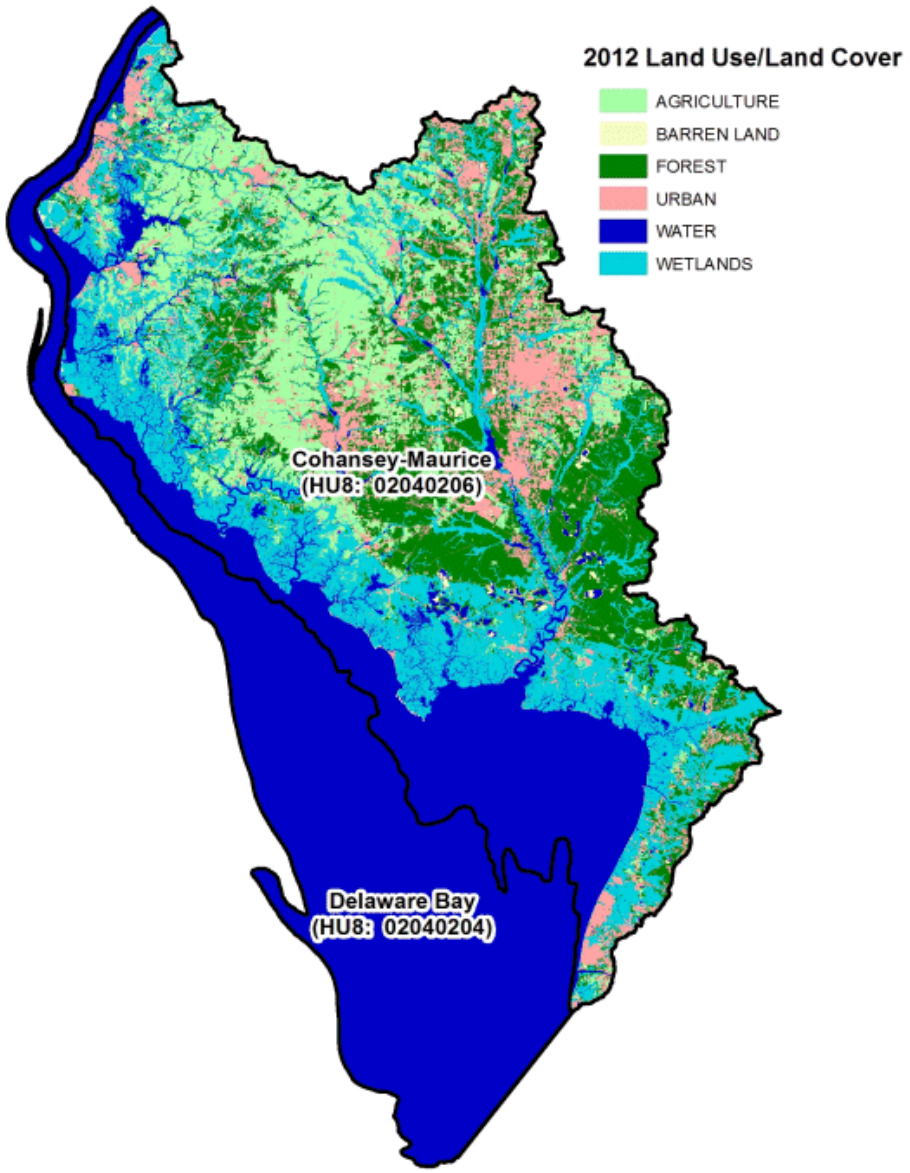
A rice and crawfish farming region on the low-lying southwest Louisiana coast has declared a state of emergency because a large freshwater basin that farmers rely on for irrigation is being spoiled by salt water from the Gulf of Mexico. On Monday, Vermilion Parish declared an emergency and pleaded for help from state and federal officials to prevent the salt water from fouling the Mermentau River basin, a 700-square-mile area of mostly freshwater marsh.

Sinking Atlantic Coastline Meets Rapidly Rising Seas





Ayers *et al*., 2000 (USGS)



For purposes of this display, the land use data have been generalized from over 86 detailed Level III/IV categories to 6 Level I categories. The actual data set does contain all of the generalized categories and delineations.

Photo Credit: Aaron Maffei, Rutgers

Conventional Shoreline Stabilization Techniques

Erosion control; but minimal habitat or coastal processes benefits

What is a “living shoreline”?

Incorporates natural features to reduce erosion and create habitat

Two complementary goals:

1. Stem erosion that can lead to rapid loss of marsh surface
2. Accelerate sediment accretion to assist the marsh in keeping pace with SLR and thus reduce flooding

Integrates ecological principles into engineering design

LIVING SHORELINES SUPPORT RESILIENT COMMUNITIES

Living shorelines use plants or other natural elements—sometimes in combination with harder shoreline structures—to stabilize estuarine coasts, bays, and tributaries.

One square mile of salt marsh stores the carbon equivalent of **76,000 gal of gas** annually.

Marshes trap sediments from tidal waters, allowing them to **grow in elevation** as sea level rises.

Living shorelines improve **water quality**, provide fisheries **habitat**, increase **biodiversity**, and promote **recreation**.

Marshes and oyster reefs act as natural **barriers** to waves. **15 ft** of marsh can **absorb 50%** of incoming wave energy.

Living shorelines are **more resilient** against storms than bulkheads.

33% of shorelines in the U.S. will be **hardened** by **2100**, decreasing fisheries habitat and biodiversity.

Hard shoreline structures like **bulkheads** prevent natural marsh migration and may create seaward **erosion**.

The National Centers for Coastal Ocean Science | coastalscience.noaa.gov

Some graphics courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/symbols/)

Living Shoreline
Traditional Design

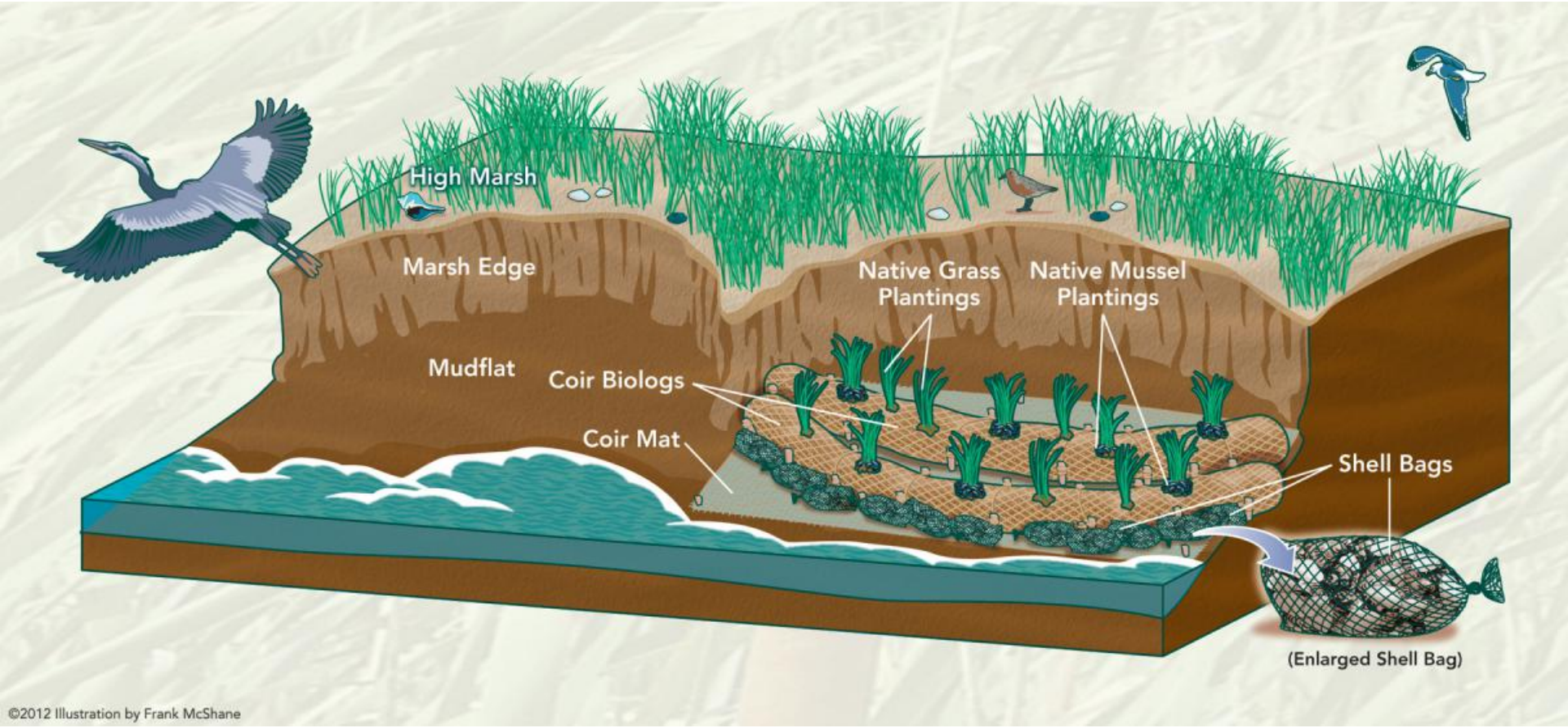


Image credit: The Partnership for the Delaware Estuary

Matt's Landing Living Shoreline, Heislerville NJ
Installed 2010

Photo credits: David Bushek, Rutgers

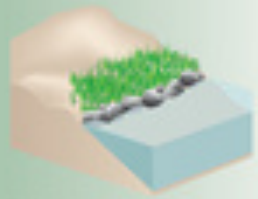
HOW GREEN OR GRAY SHOULD YOUR SHORELINE SOLUTION BE?

GREEN - SOFTER TECHNIQUES ← → **GRAY - HARDER TECHNIQUES**

Living Shorelines

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

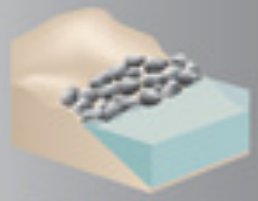
EDGING - Added structure holds the toe of existing or vegetated slope in place.



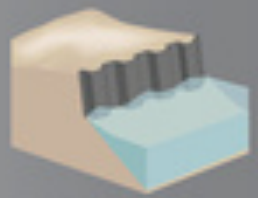
SILLS - Parallel to existing or vegetated shoreline, reduces wave energy, and prevents erosion. Suitable for most areas except high wave energy environments.

Coastal Structures

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 pre-existing hardened shoreline structures.



BULKHEAD - Vertical wall parallel to the shoreline intended to hold soil in place. Suitable for areas highly vulnerable to storm surge and wave forces.

Graphic: NOAA, Natural and Structural Measures for Shoreline Stabilization

Living Reef Breakwaters

Living reef breakwaters function similarly to constructed breakwaters, but are built to provide habitat for baby oysters, mussels and other reef species to settle upon. Reef balls, oyster castles, bagged shell and other reef structures provide a durable and heavily-weighted substrate. Over time, large reef structures can form that not only serve as a natural breakwater, but also provide critical aquatic habitat.

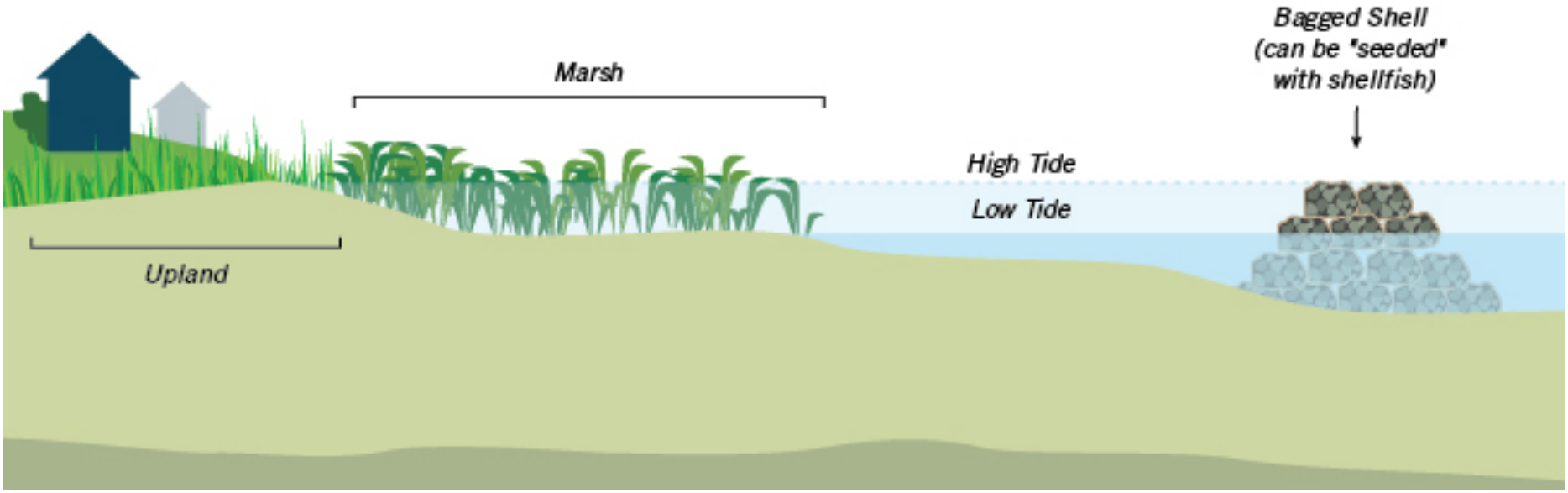


Image credit: The Nature Conservancy

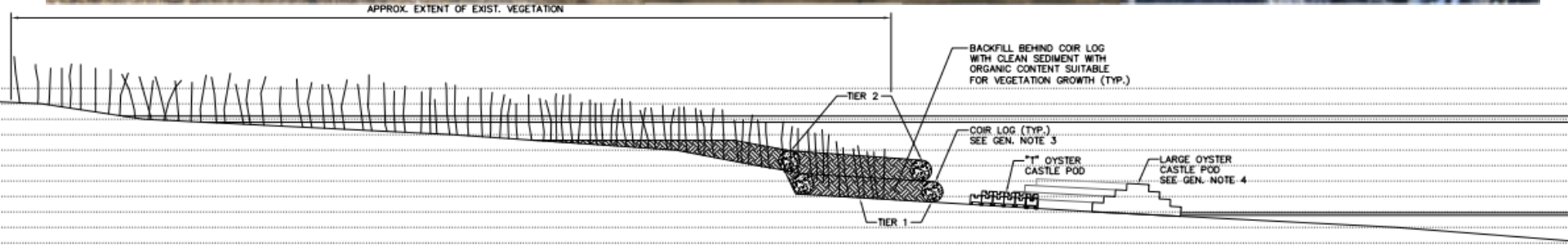


Image credit: The Partnership for the Delaware Estuary


NOAA


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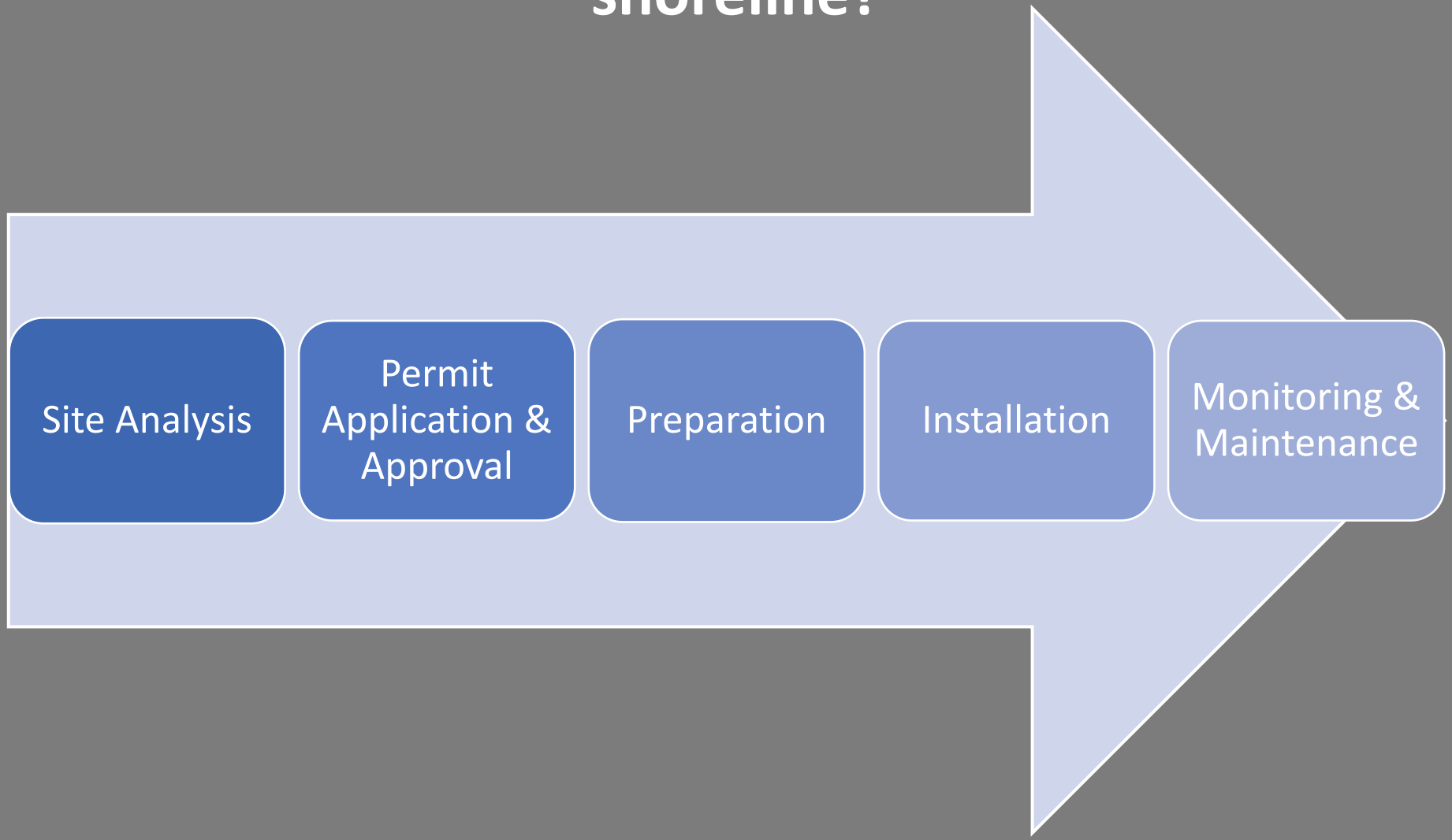
Photo credit: Beth Maynor Young & National Geographic

What are the steps to construct a living shoreline?



Information adapted from NOAA Fisheries

Maintenance & Augmentation

Don’t just set it and forget it!

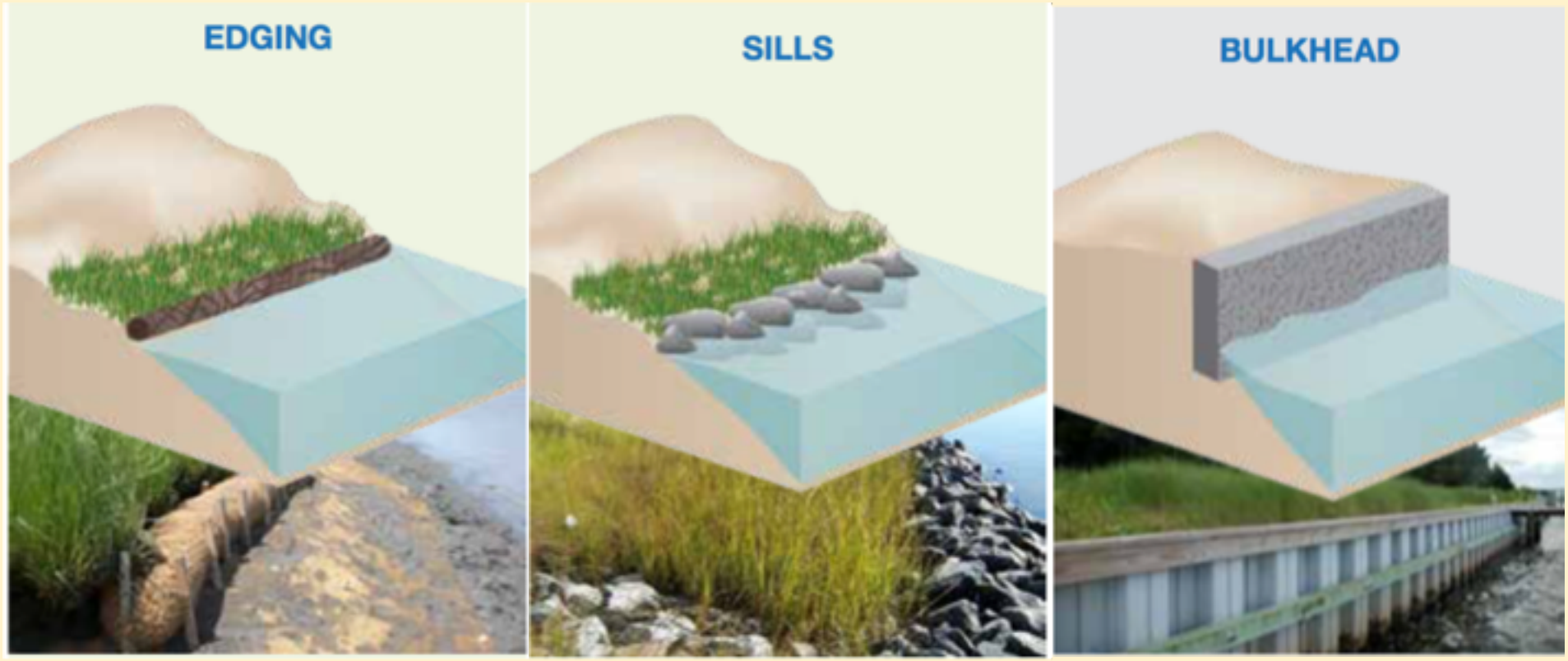
Photo credit: Sarah Bouboulis, Partnership for the Delaware Estuary

Costs

Living shorelines tend to cost less than hard shorelines for both installation and maintenance (NOAA and USACE).

Installation: $1000-$2000 per linear foot — $2000-$5000

Maintenance: <$100 per linear foot — $100-$500



Photos: NOAA, Natural and Structural Measures for Shoreline Stabilization

Evaluating Living Shoreline and Wetland Restoration Projects

Monitoring Metrics

- Marsh elevation
- Sediment accretion
- Plant growth and survival
- Wave attenuation
- Shellfish recruitment

Do they work?

Researchers are actively validating how and where living shorelines may be effective alternatives.

- The combination of established *S. alterniflora* plus live *C. virginica* was the most effective LS treatment and reduced 67 % of the wave energy created by a single recreational boat wake, compared to bare sediment. (Manis *et al*., 2014)
- Sediment accretion rates in the marshes behind the stone sills at two living shoreline sites in N.C. were approximately 1.5 to 2-fold greater than those recorded in the adjacent natural marshes (Currin *et al*., 2008)
- Sediment accretion evidence from 35 sites analyzed along the Chesapeake Bay confirmed that erosion could be reduced using soft stabilization techniques (Berman *et al.,* 2007)

Living shorelines are not a "cure-all". They don't all work all the time! Site-specific conditions may determine the effectiveness and success of a LS project.

Implementation

- Contact your local state governing agency for information on required permitting (e.g. NJDEP in NJ or DNREC in DE)
- The New Jersey Chapter of the Nature Conservancy is offering grants and technical assistance to help communities overcome barriers to implementing living shorelines. Spring 2018 RFP

Partnership for the Delaware Estuary


Questions?