Estuarine Shoreline Stabilization Design & Techniques

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Dr. Mariko Polk *Coastal Processes Specialist*

What is North Carolina Sea Grant
https://www.youtube.com/watch?v=gI-_GtUpMV8

NC Sea Grant

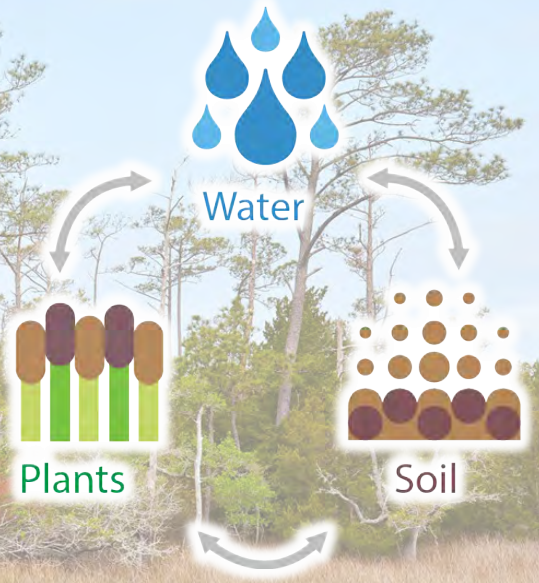
Research, Education, and Outreach

Focus on:

- Resilient communities and economies
- Sustainable fisheries and aquaculture
- Healthy coastal ecosystems
- Enhance environmental education
- Foster workforce development

Wetlands in North Carolina

Learn more IDing wetlands



- Wetlands are areas of land that are saturated with water
- They are defined by their unique plants, soils, and hydrology
- Wetlands are everywhere

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(USGS; NCDWR)

Forested Wetlands

Visit a public wetland

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(USGS; NCDWR)

Forested Wetlands

Fun Fact: We have some of the oldest trees in the world +2,600 yo

Visit a public wetland

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Marshes

Learn more
About SASMI

SOUTH ATLANTIC SALT MARSH INITIATIVE

Fun Fact: SASMI is a coalition of 300 federal and state entities, scientists, and practioners informing needs on salt marshes

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Marshes

Learn more
About SASMI

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Seagrass

Learn more
UNCW Jarvis

(Procaccini)

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Seagrass

Learn more
UNCW Jarvis

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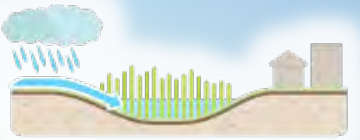
(NPS)

Why Do Wetlands Matter?

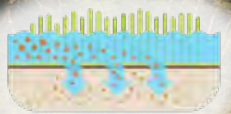
MIGRATION
REST AREA

FUN



FLOOD & EROSION
CONTROL

HABITAT



CLEAN WATER

FOOD

WATER SUPPLY

JOBS

(adapted from NCDWR)

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Why Do Wetlands Matter?

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Why Do Wetlands Matter?

Find part of the Trail near you!

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Threats to Wetlands

Lear more About Threats

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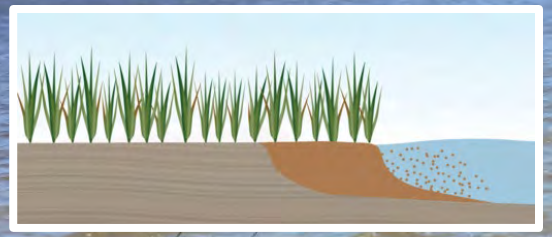
(NCDWR)

Threats to Wetlands

Lear more
About
Threats



Litter

(NPS)

Water Level
Saltwater Intrusion

Erosion

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Threats to Wetlands

Lear more About

Unresilient and *High Risk* Development Practices

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Restoration

- **Nature Based Solutions (NBS)**
  Green infrastructure, Building with Nature, Rewilding & Rewetting, Homeowner Activities, Thin-layer Placement, Reconnecting floodplains
- **Decision-making**
  Policies, Land Conservation, Buffers, Working with existing wetlands
- **Pollutant**
  Zero-emissions, Clean ups, Water Quality Management, Invasive Species Control
- **Education and Outreach**
- **Seed Banking, Salinity Control, & More**

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Restoration

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Challenges to Restoration

- Multi-hazards impacts
- Fragmented habitats
- Access to seed banks and plants
- Recovery takes time
- Lack of long-term monitoring
- Still learning what techniques are best
- Conflicting land uses
- Ownership and continued management
- Regulatory obstacles

(Clemson)

Innovation

Visit a public wetland

(J. Butler, City of Wilmington)

(Clemson)

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Why do we live on the coast?

Why do we live on the coast?

- **Access to resources =**  **Economics**
- **Goods** Fisheries, Resources
- **Services** Recreation, Tourism
- **Cultural** Heritage, Intrinsic Value

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COASTAL COMMUNITIES

Coastal populations will continue to grow

---

56 to 245 million people

at risk IPCC 1-5m Sea Level Rise Scenarios

IPCC = International Panel on Climate Change

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COMMUNITIES AT RISK

On the front lines of impact and produce new and innovative solutions to coastal management

CAUSES OF COASTAL WETLAND EROSION

- **Spatial and Temporal Scale**
- Wind and wave energy
- Drought & Drowning
- Population dynamics
- Habitat conversion
- Coastal squeeze
- *and more!*

How do we manage the shoreline?

3 CATEGORIES OF MANAGEMENT

1. Hold back the water
   Push the water away, armoring, flood prevention engineering

2. Retreat
   Move back

3. Adapt
   Increase structure height, nature-based solutions

(Titus et al., 2009b)

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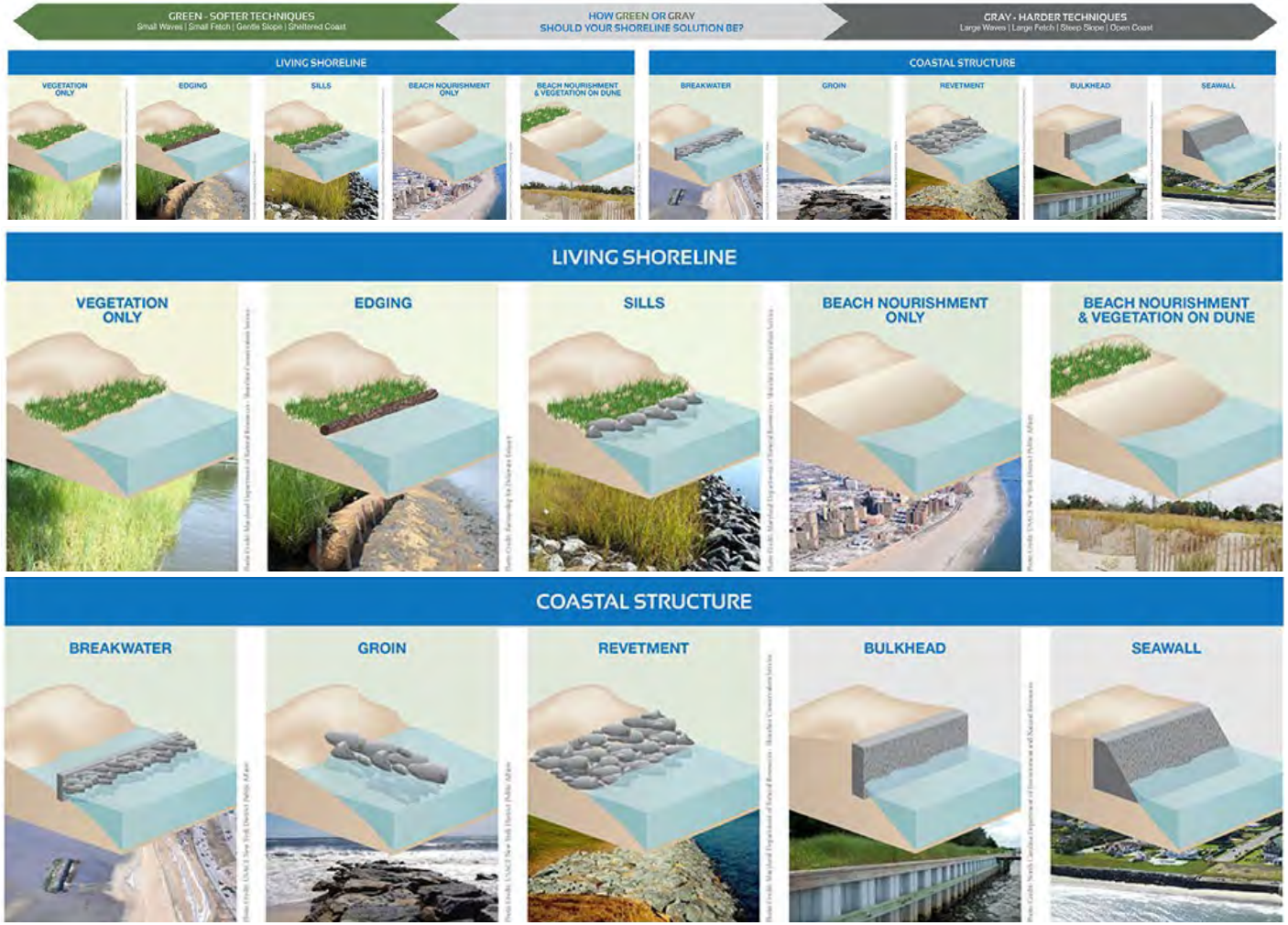
GREEN - SOFTER TECHNIQUES
Small Waves | Small Fetch | Gentle Slope | Sheltered Coast
HOW GREEN OR GRAY
SHOULD YOUR SHORELINE SOLUTION BE?
GRAY - HARDER TECHNIQUES
Large Waves | Large Fetch | Steep Slope | Open Coast
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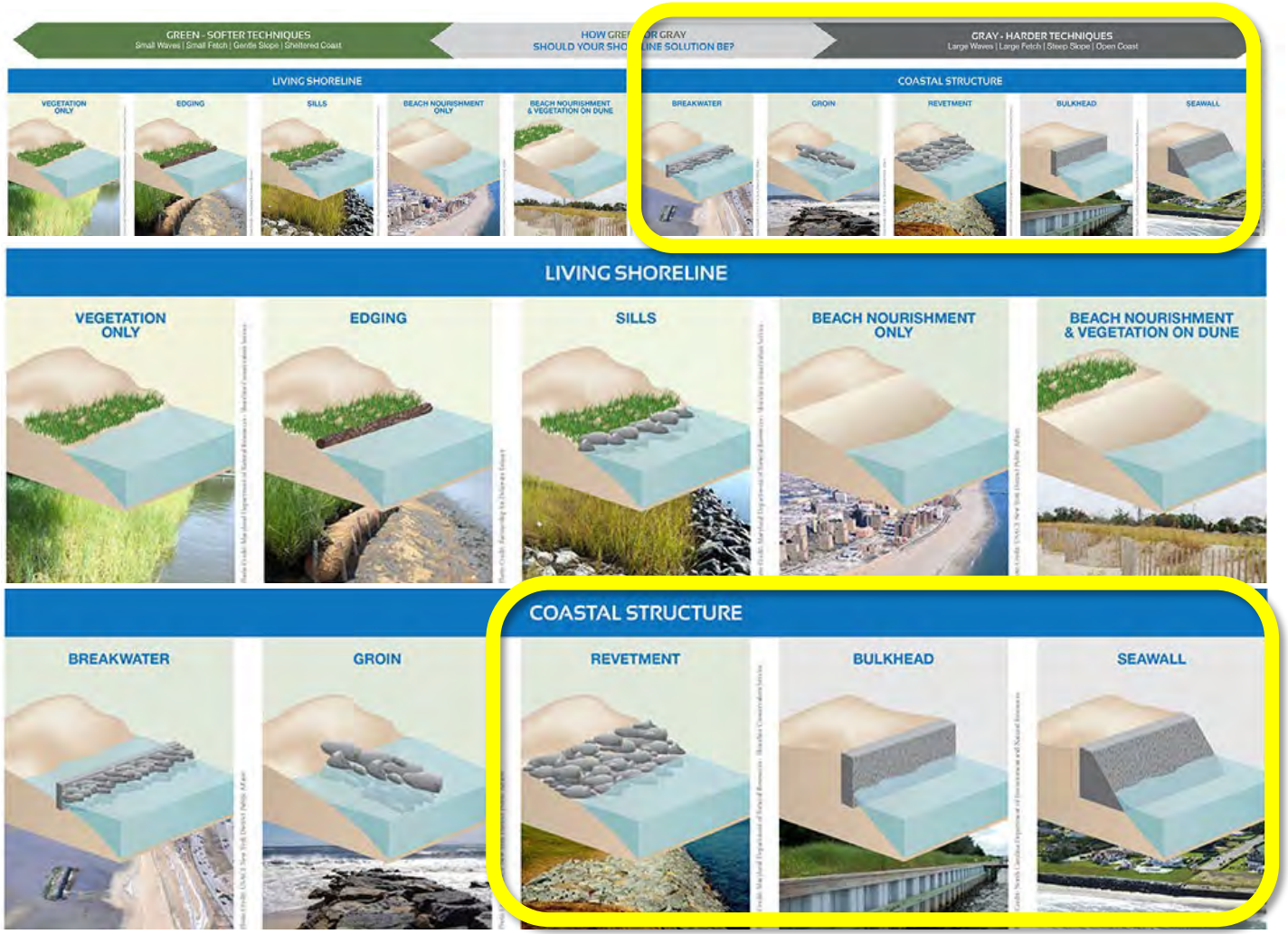
(Sage, n.d.)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(Sage, n.d.)

Shoreline Hardening

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SHORELINE HARDENING

- Used for millennia
- Static shoreline
- Over 14% of the US hardened
  (Gittman et al. 2015)
- ↑ 173% increase in hardening
  (Correll-Brown et al. 2022)

Seawall

Revetment

Bulkhead

Image (USACE, Polk, USACE)

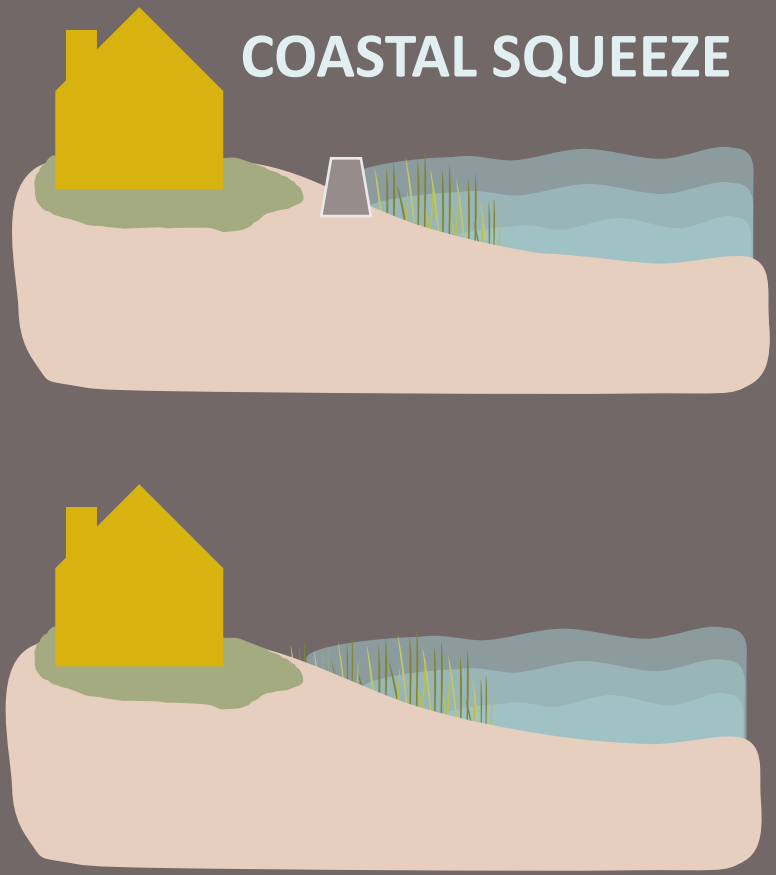
HARD STRUCTURES

Long history of use.

Can be the only option when building up or upland retreat is not an option.

14%

Of contiguous US has been hardened[9]



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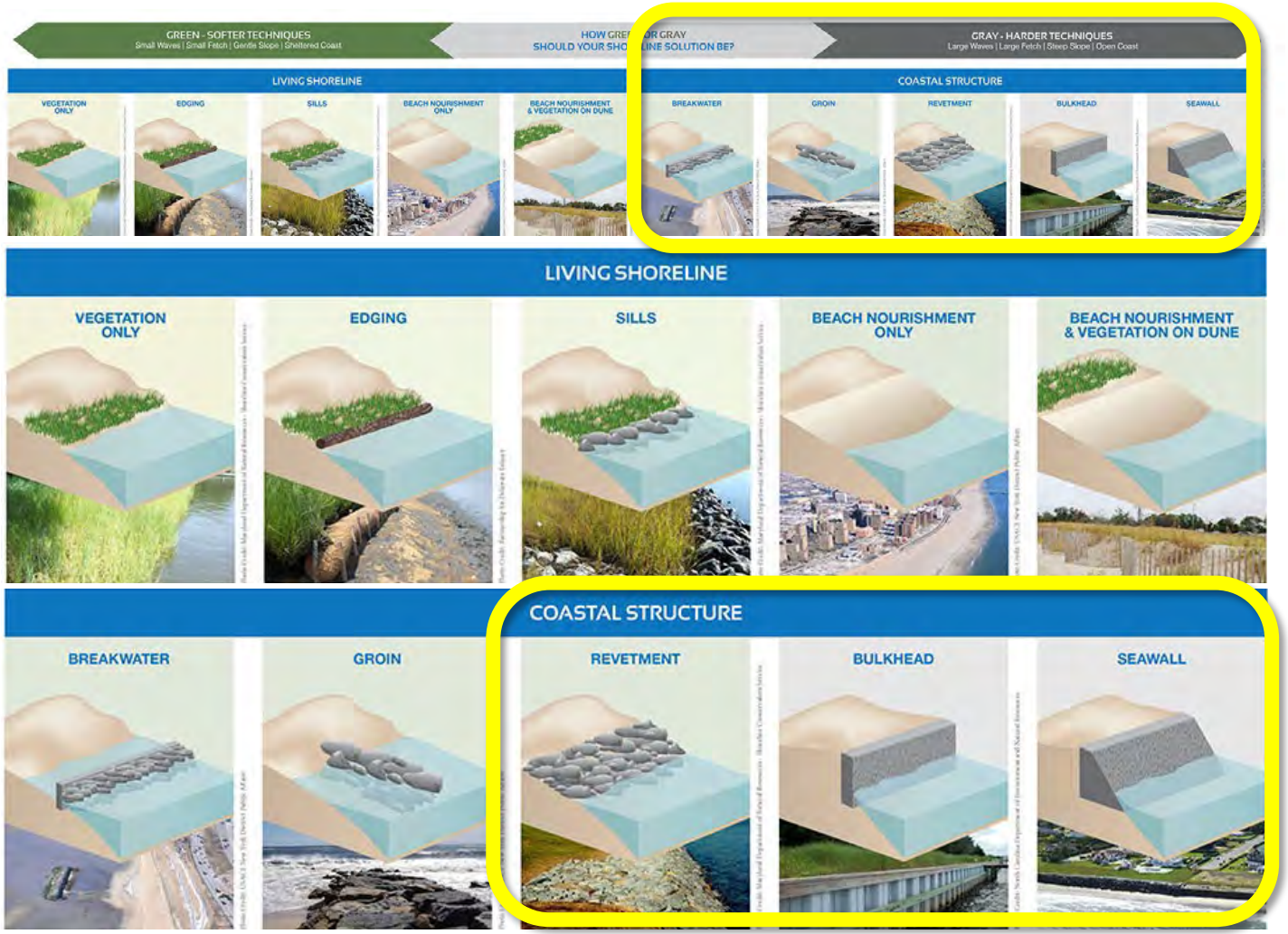
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(Sage, n.d.)

BULKHEAD

- Wood, Vinyl, Concrete
- May be only solution for narrow canals and marinas/harbors

Images (Google Earth, NC DCM)

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BULKHEADS

Benefits

- Static Shoreline
- Durable (in low energy conditions)
- Initial installation can sometimes cost slightly less

Drawbacks

- Expensive to Maintain
- Short life expectancy
- Disconnect land & water
- Erosion & habitat loss

RIPRAP REVETMENT

- Granite, marl, concrete
- Used on sediment banks

Images (Google Earth: LANDSAT, NC DCM)

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RIPRAP REVETMENT

Benefits

- Static Shoreline
- Suited for high energy
- Less scour issues
- Can sometimes provide habitat for a few species

Drawbacks

- Large footprint
- Disconnect land & water
- Erosion & habitat loss

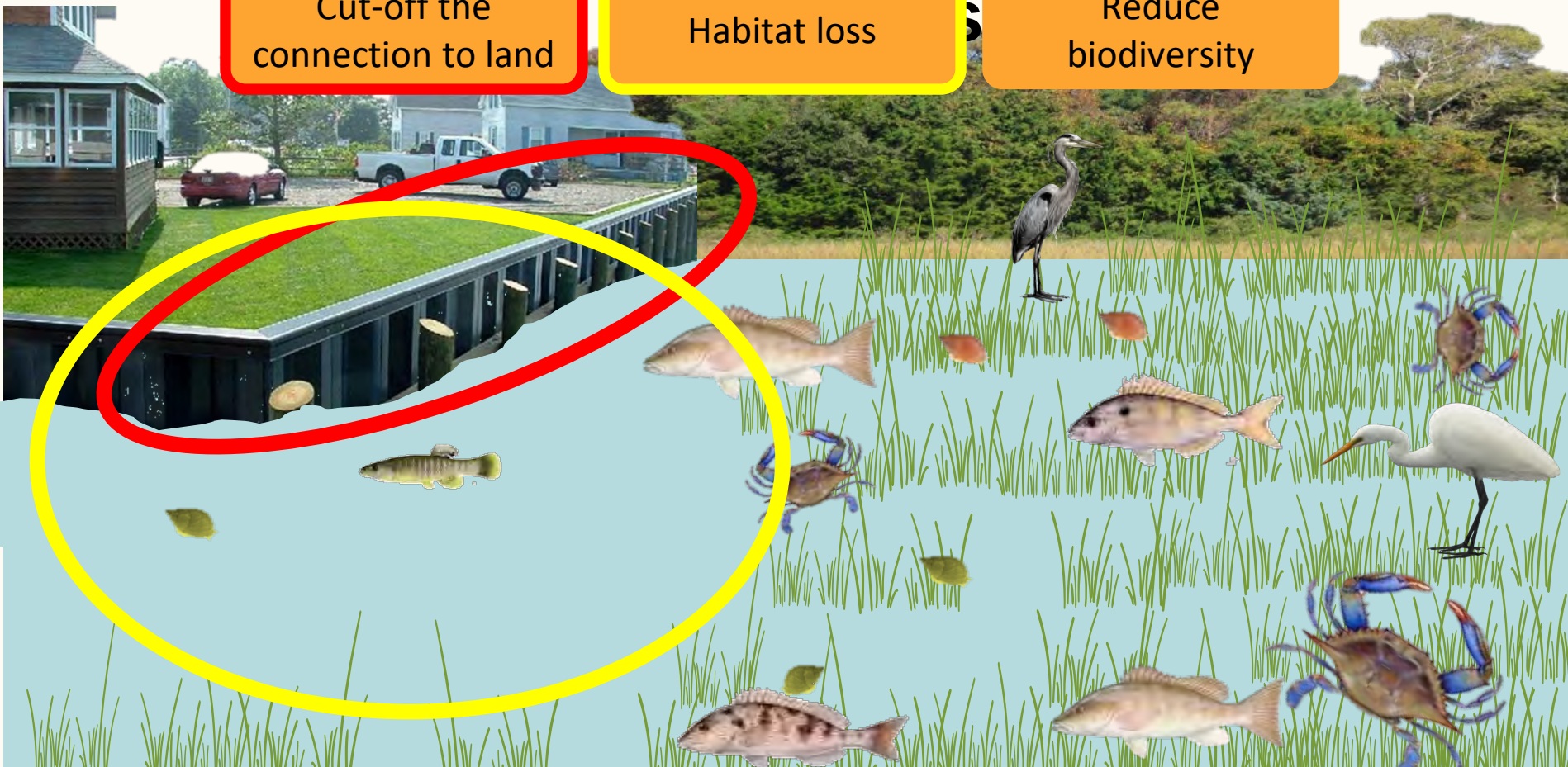
Hardening Shorelines

Hardening

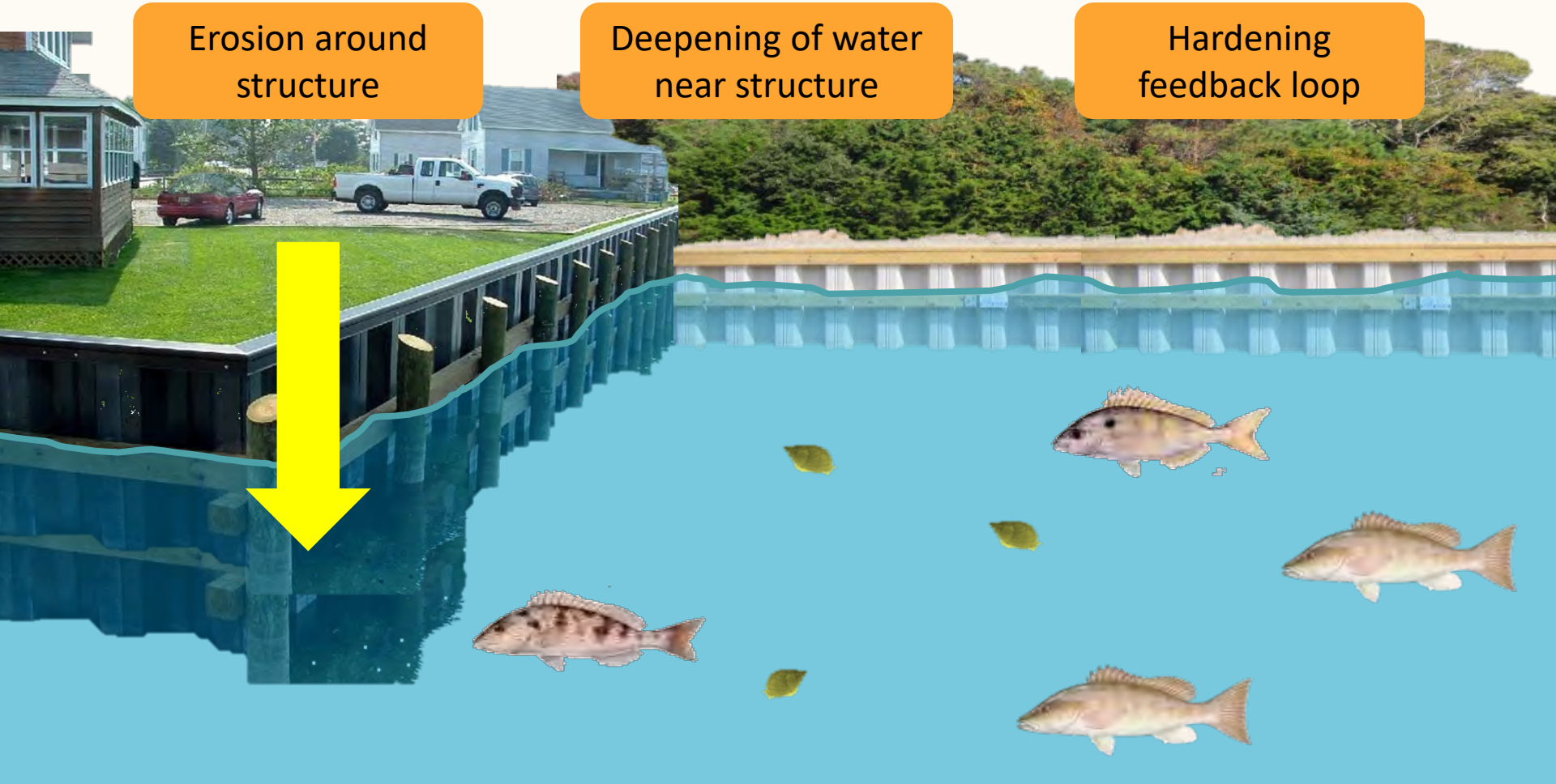
Cut-off the connection to land

Habitat loss

Reduce biodiversity



Hardening Shorelines

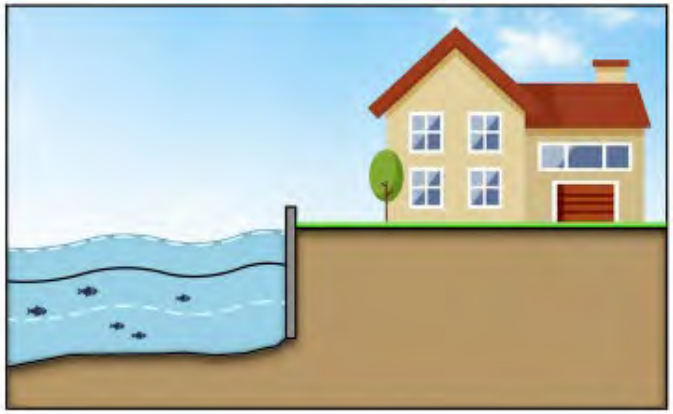


Hardening Shorelines

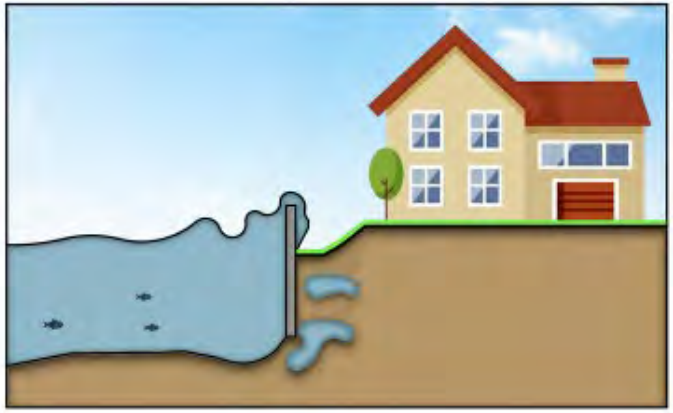
Encourages development in high-risk spaces

Increased usage

Gittman et al. 2016. *BioScience*

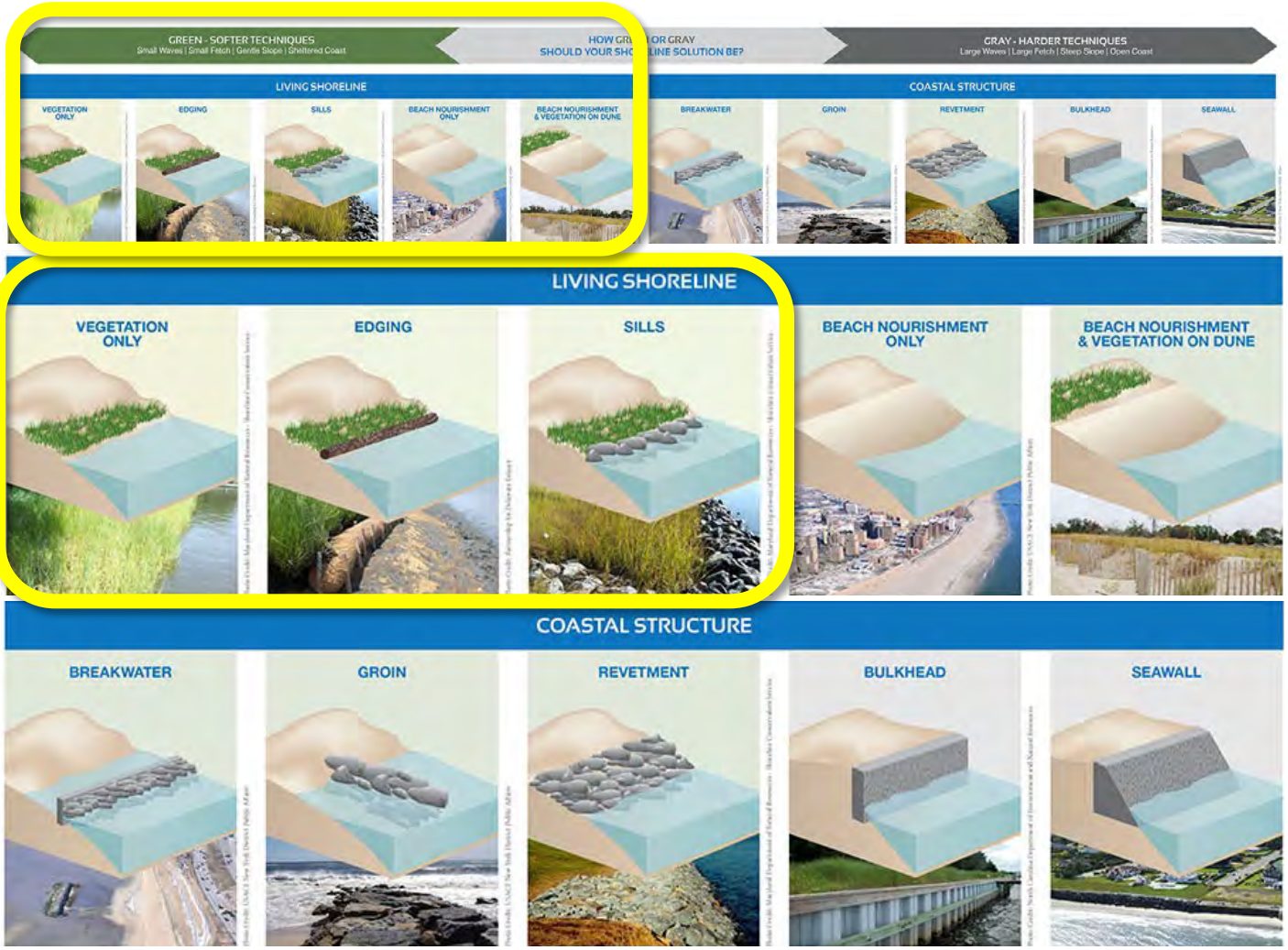


Influence of high wave energy on a bulkhead



PBS NEWS HOUR

https://www.youtube.com/watch?v=sAZ_pjqDqDE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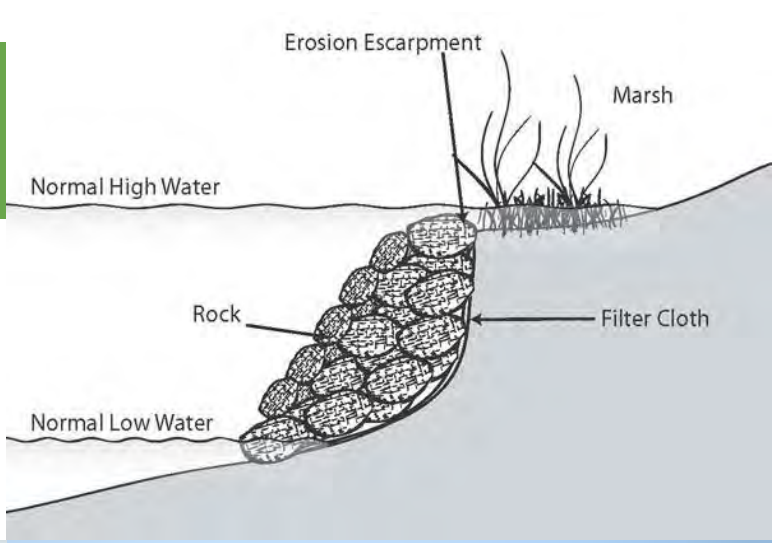
(Sage, n.d.)

MARSH TOE REVETMENT

- Granite, marl
- Used in front of a marsh



Images (NC Coastal Federation, NC DCM)

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MARSH TOE REVETMENT

Benefits

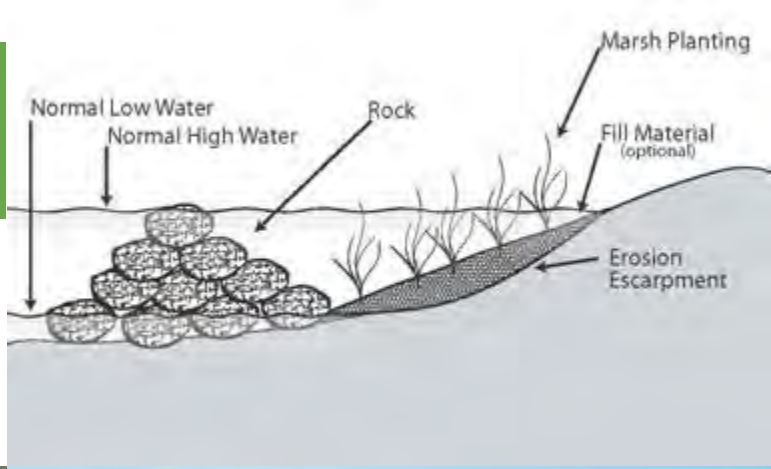
- Erosion control
- Suited for high energy
- Land & Water Connection
- Maintains salt marsh

Drawbacks

- Large footprint
- Prevents waterward growth
- Can sometimes have scour

SILL

- Granite, marl, oyster bag, loose shell, concrete, sheetpile



Images (Smith, NCDCM,)

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SILL

Benefits

- Erosion control
- Land & Water Connection
- Maintains salt marsh
- Low-cost maintenance

Drawbacks

- Some designs can be costly
- May require adjustments
- Not a cure-all

BREAKWATER

- Granite, marl, concrete, wood, vinyl sheet – with gaps

SILL

Benefits

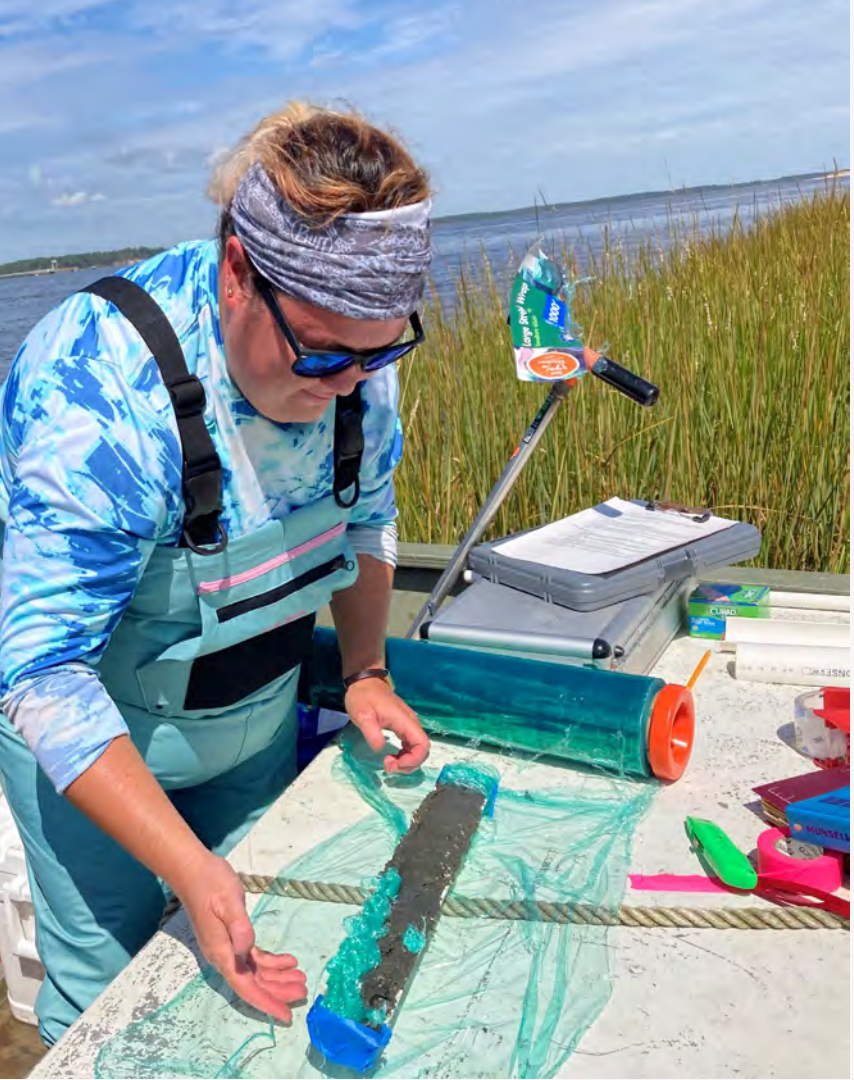
- Erosion control
- Land & Water Connection
- Maintains salt marsh

Drawbacks

- Not ideal for high energy
- May result in scour in front of the structure

Benefits of Living Shorelines

- Protection from wave energy and storm events: Up to **60%** reduction in energy



Benefits of Living Shorelines

- Reduction in erosion short and long term
- Accumulate sediment and grow shorelines

Benefits of Living Shorelines

- Habitat provisioning
- Habitat complexity
- Multi-habitat connectivity
  Habitat continuum
- Multifunctionality

Considerations

- Custom site designs and configurations
- Not a magical cure all, need a better understating of limits
- Up and coming living shoreline products

NC Sea Grant: Carteret Community College Living Shoreline Academy

https://www.youtube.com/watch?v=qIkJxaWNTiQ

Images (SCDNR, Tampa Bay Watch, Allied Concrete, Atlantic Reefmaker, Native Shoreline, Topsail News, Synthetex, Coastal Technologies Corp)

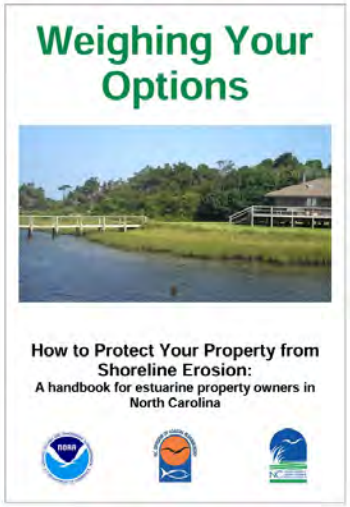
Why aren't living shorelines as popular?

- Perception that bulkheads are more effective
- Neighboring property influence
- Knowledge: Landowners, Marine Contractors
- Early on over-use of bulkheads
- Perception that living shorelines aren't appropriate for high energy

Resources

NC Division of Coastal Management

Contact your DCM Field Representative to know your options



Where Can I see a Living Shoreline?

Carolina Beach State Park
1010 State Park Rd, Carolina Beach, NC 28428

Bradley Oaks
Bradley Drive, Wilmington, NC 28409

Airlie Gardens
300 Airlie Rd, Wilmington, NC 28403

Morris Landing Clean Water Preserve
State Rd 1538, Holly Ridge, NC 28445

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