Living Shorelines in the Gulf of Mexico

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Living Shorelines for Coastal Erosion Protection in a Changing World
NY Sea Grant
Hauppauge, NY
May 15, 2013

outline

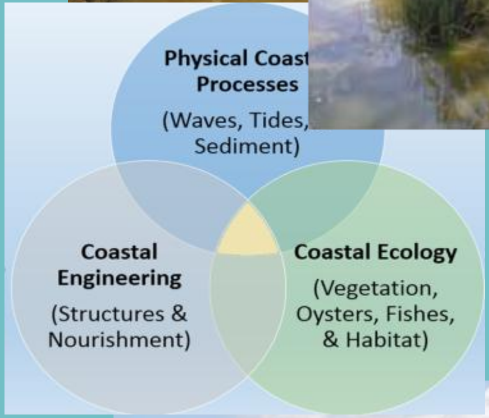
A. Some of the history of "living shorelines"

B. "mature" living shorelines

C. Science of living shorelines

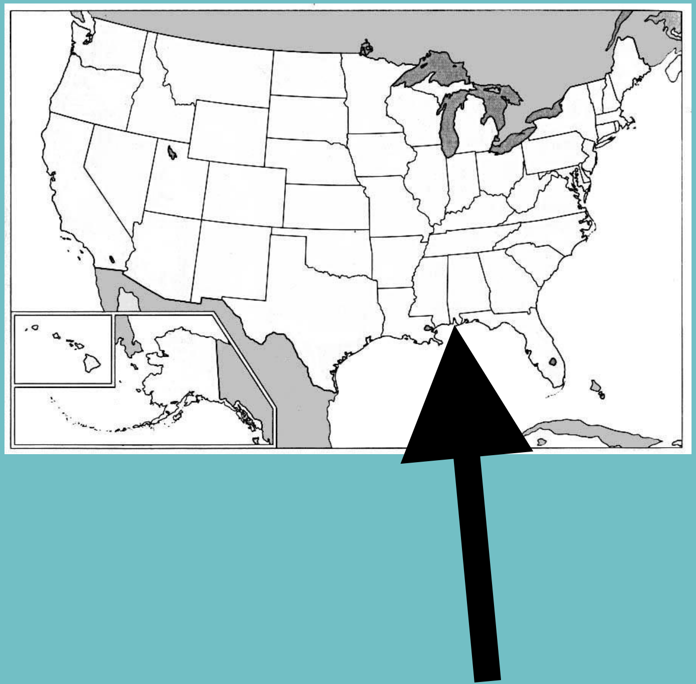
D. "young" living shorelines

E. A "living shoreline" project which is killing the shoreline!



Alabama:

60 miles of Gulf beaches and 600 miles of bay and bayou shorelines!



“Natural” shorelines of Mobile Bay

Pelican Point

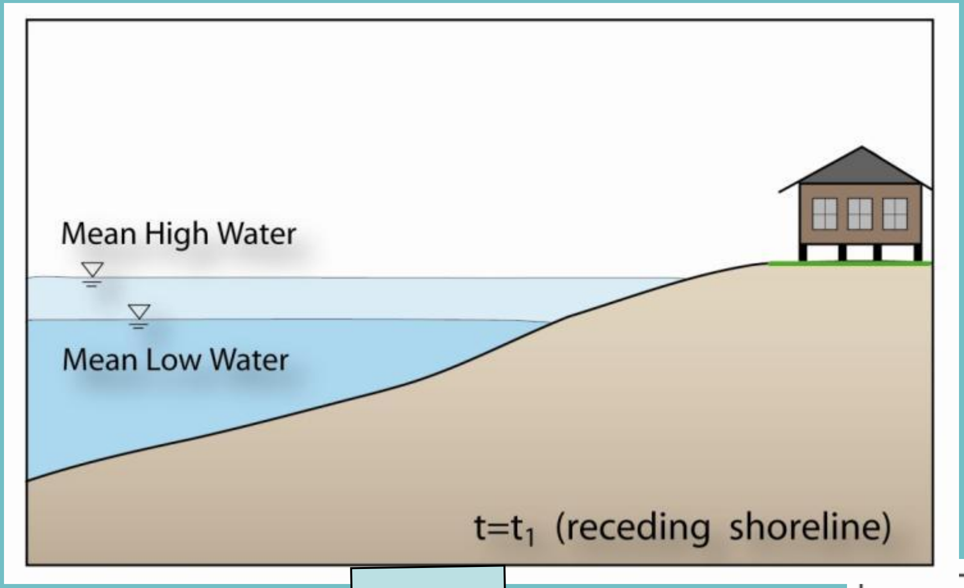
Daphne Bayfront Park

“hardened” shorelines of Mobile Bay

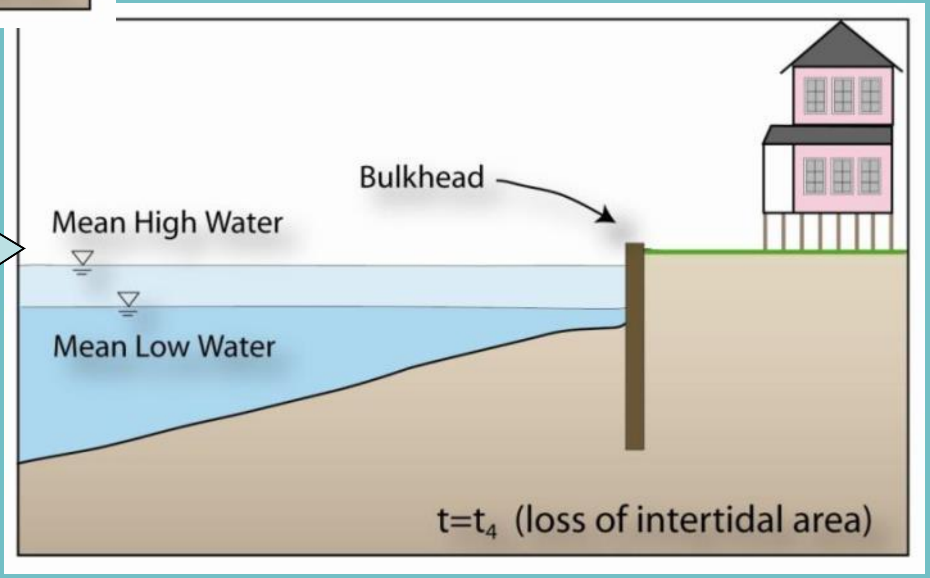
Eastern Shore – Mullet Point area

Alabama Port County Park

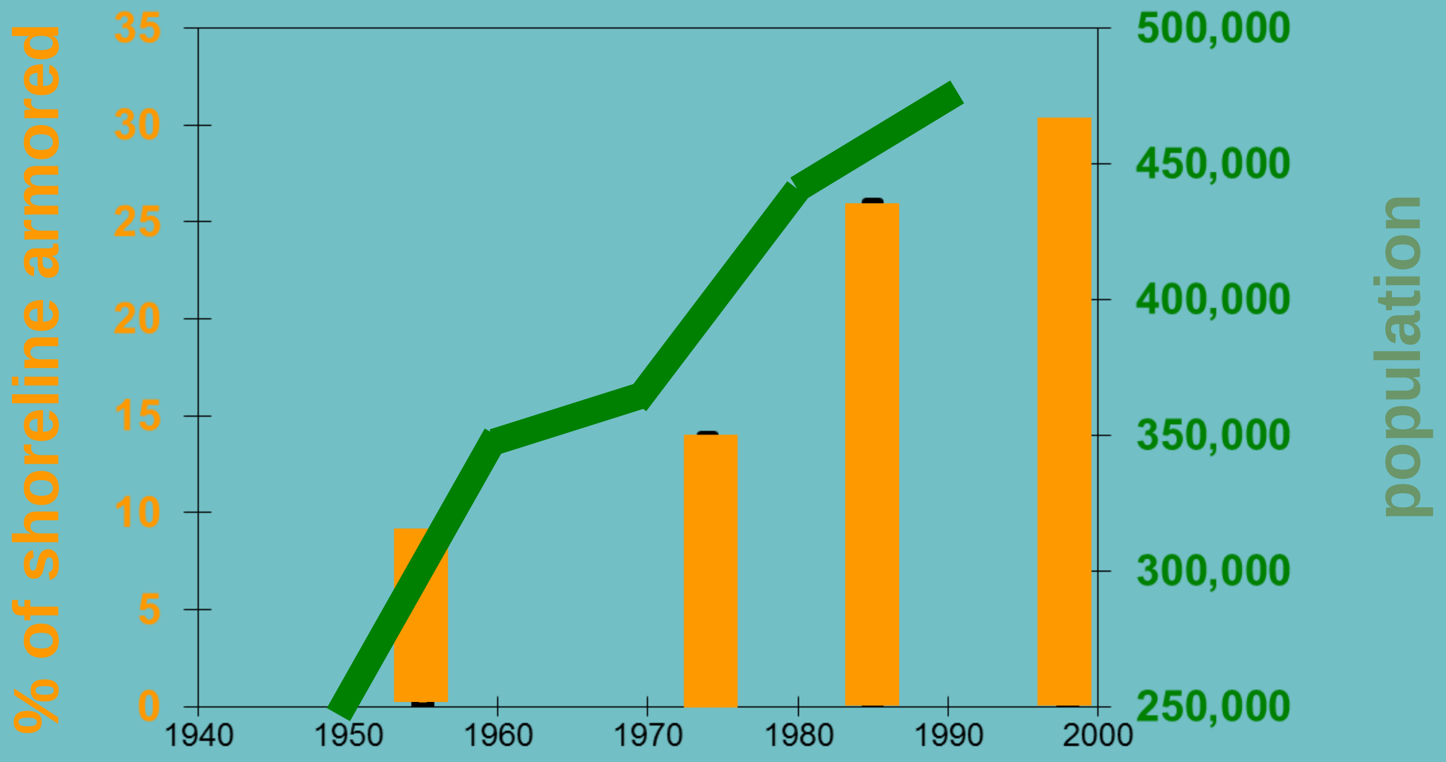
Progression of the Typical Response to Bay Erosion



Loss of intertidal area due to "passive erosion"



from Douglass & Pickel (1999)



from Douglass & Pickel (1999)

Rate of increase in armoring similar to increase in population

IMPLICATIONS?

"The tide don't go out no mo'!"

- walking
- playing
- oysters
- "jubilees"

from Douglass & Pickel (1999)

Is this the fate of our urban estuaries?

Today, 40% of Mobile Bay's shoreline is armored.

What is a "Living Shoreline?"

Living shorelines

A shoreline management practice that provides erosion control benefits; protects, restores, or enhances natural shoreline habitat; and maintains coastal processes through the strategic placement of plants, stone, sand fill, and other structural organic materials (e.g. biologs, oyster reefs, etc).

http://shoreline.noaa.gov/glossary.html June 9, 2012

Mature living shorelines*

Type 1: goal was to emulate sandy natural shorelines in constructed alternatives to bulkheads

* more than 10 years old, indeed built before "living shoreline" term

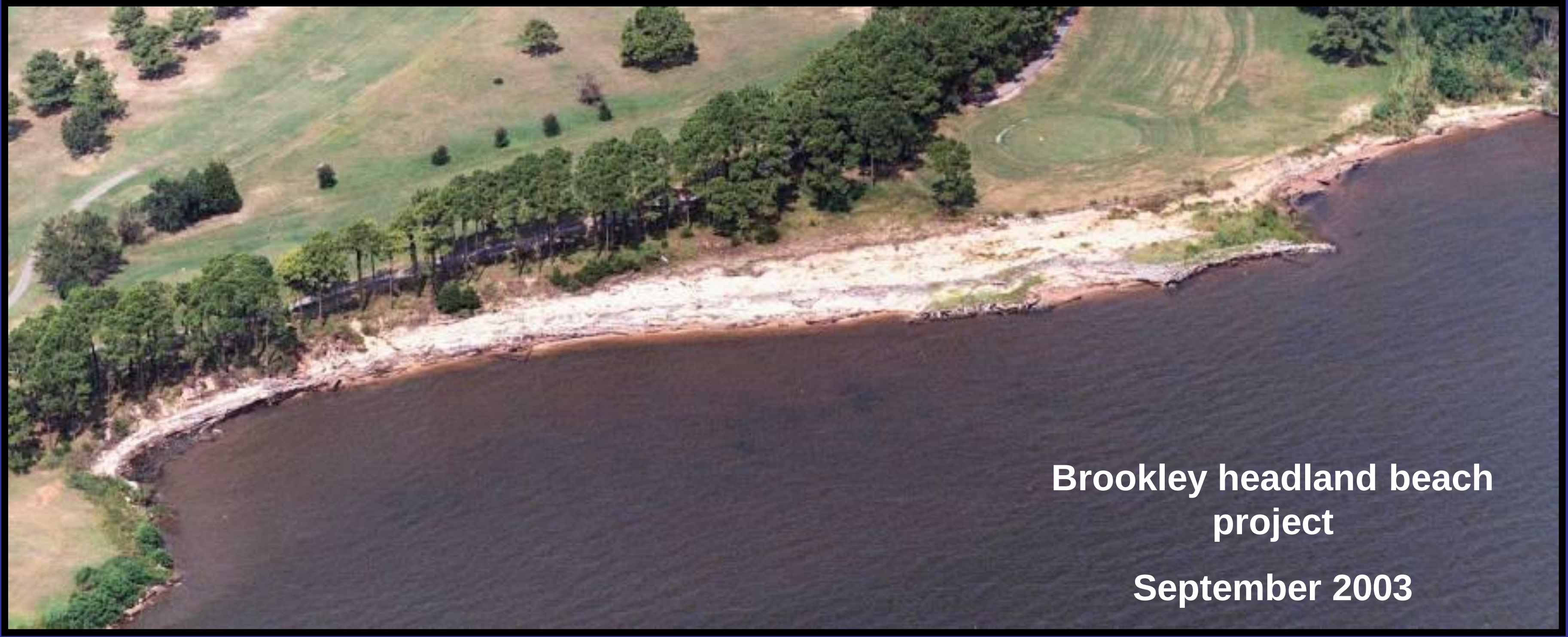
Demonstration project of an alternative to bulkheads on bay shorelines

Brookley headland beach project - 2000

- built Aug 1998
- two low elevation rock headland breakwaters
- 3000 m^3 sand fill
- survived Hurricanes Georges, Ivan, Katrina

Pocket beaches and headland breakwaters

(an alternative to bulkheads on bay shorelines)



- **Short structures can stabilize longer stretches of shoreline**
- **more natural shoreline than a bulkhead - NOTE MARSH BEHIND ROCKS!**

Project is 15 years old now

Brookley headland beach project

2011

Today, this would be a vertical bulkhead with rip-rap at the base of it if not for this alternative pocket beach.

a sandy beach as an alternative to a bulkhead

Marriott's Grand Hotel Resort, Mobile Bay, Point Clear, Alabama

- an engineered "pocket beach"
- built 2001
- 3 rock headland breakwaters
- 6000 m^3 sand fill

a sandy beach
as an alternative
to a bulkhead

Marriott's Grand Hotel Resort, Mobile Bay, Point Clear, Alabama

Pocket beach constructed in front of bulkhead/seawall

1998

2003

Marriott's Grand Hotel Resort, Mobile Bay, Point Clear, Alabama

Pocket “feeder “beach and artificial headland concepts in Fairhope, AL

Saved this live oak tree and bluff south of Pier St. boat ramp - threatened by erosion in 2004

Mature living shorelines*

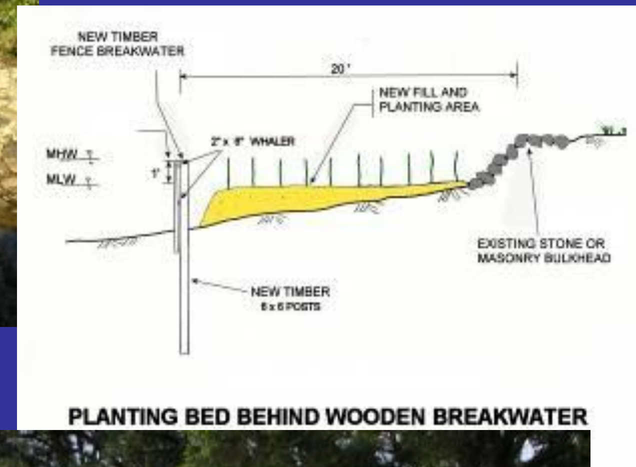
Type 2: goal was to emulate "fringe marshes" in constructed shoreline stabilization projects

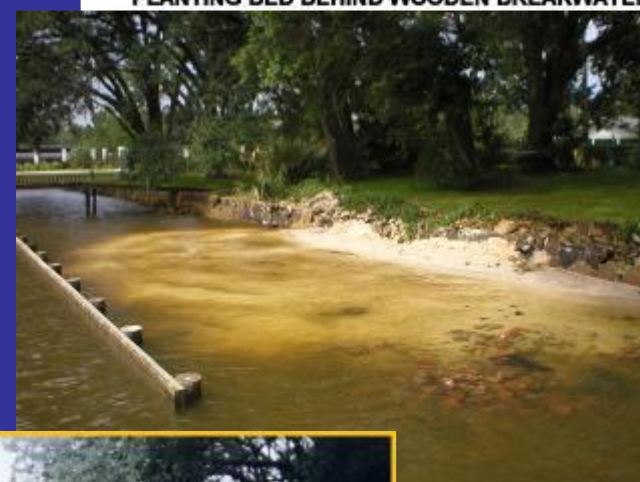
* more than 5-10 years old, indeed built before "living shoreline" term

Dog River Constructed Marsh

- built 2003
- Wave fence
- sand fill
- Plantings
- Dog River Clearwater Revival

Constructed wetland behind a “wave fence”



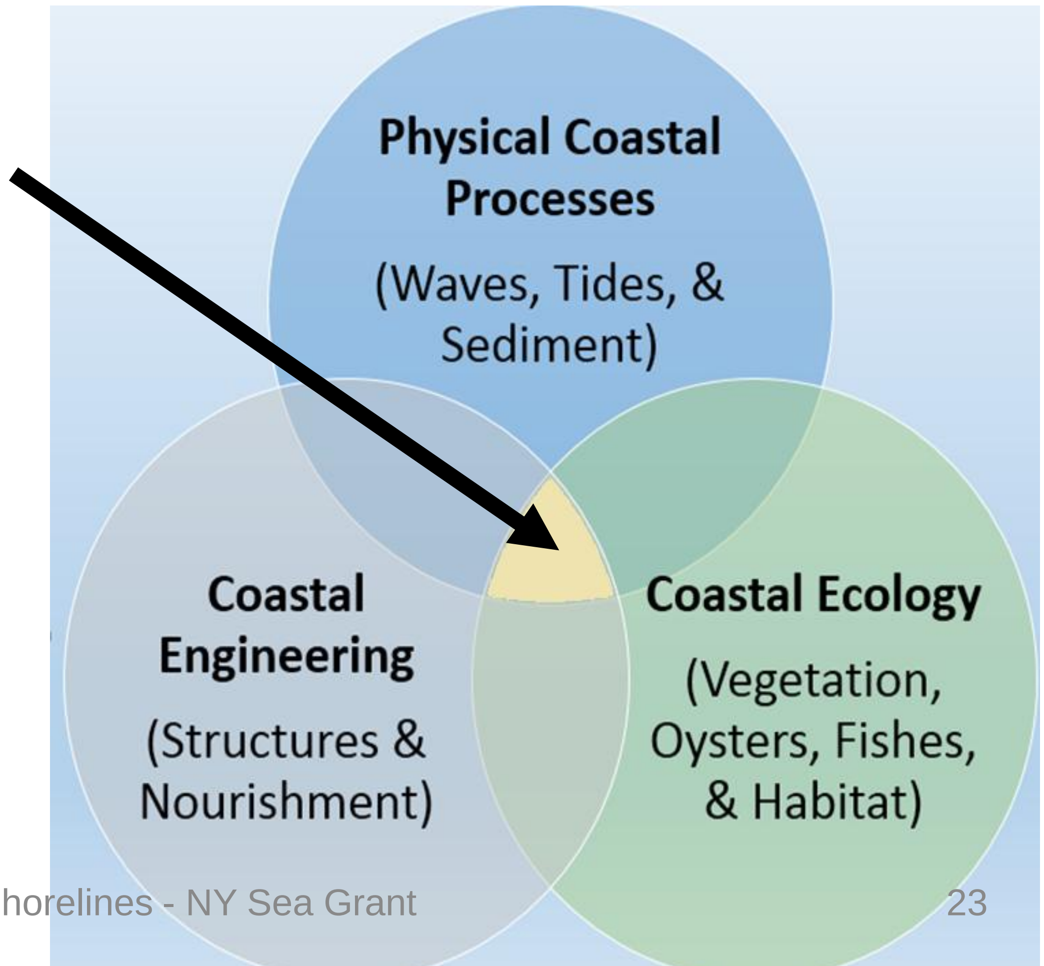


The Science of Living Shorelines

Elements of a Successful Living Shoreline Design

<u>Successful Living Shoreline Projects are a Combination of Elements</u>

- Knowledge of the local physical coastal processes and conditions of the site
- Goals for the desired stabilization and habitat enhancement/creation
- Application of engineered coastal structures and engineering design

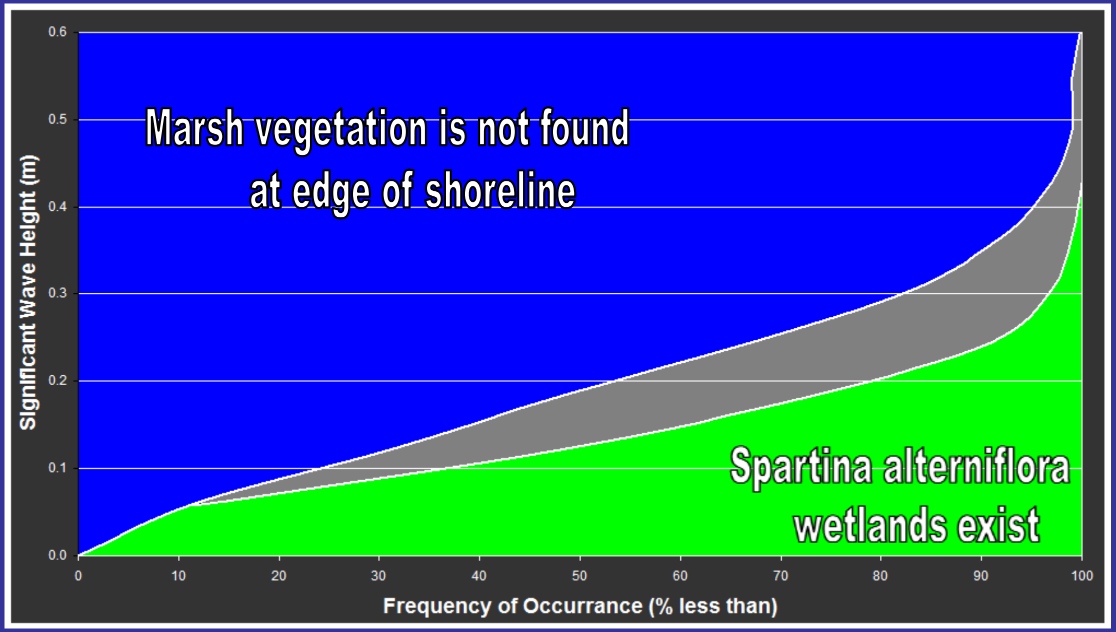


Science and engineering of Shoreline Stabilization

Say,… Headland Breakwaters

- **Technology has been in the coastal engineering literature for decades**
- **e.g. Hardaway and Gunn (1991), Silvester (1987), Bodge (1991)**

Science and engineering of marsh construction



after Roland and Douglass (2005)

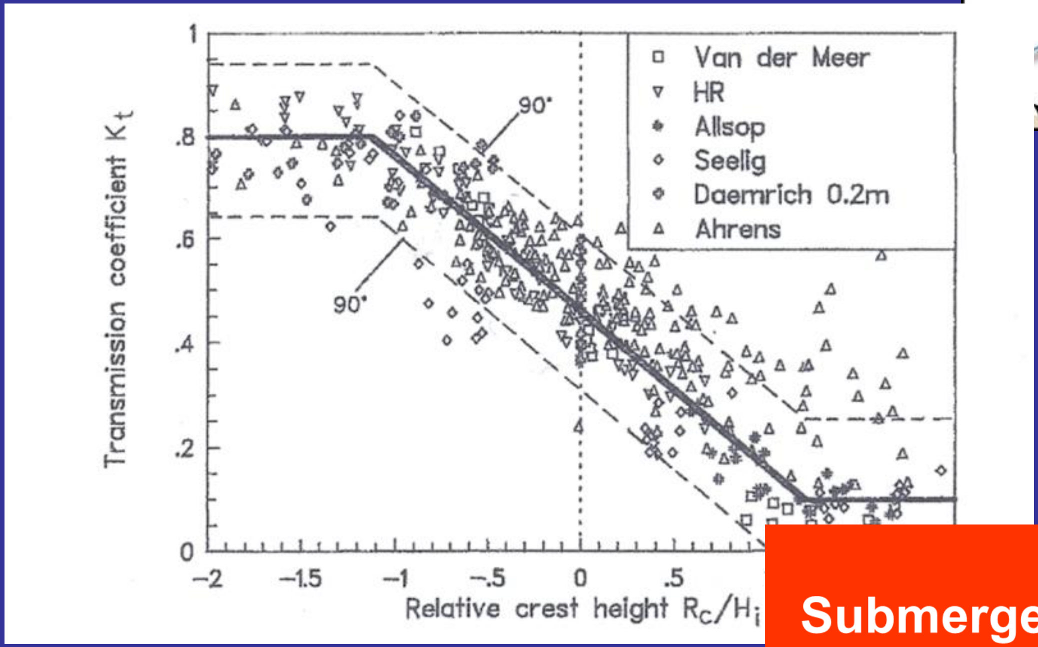
Texas example photo from Aspelin (2007)

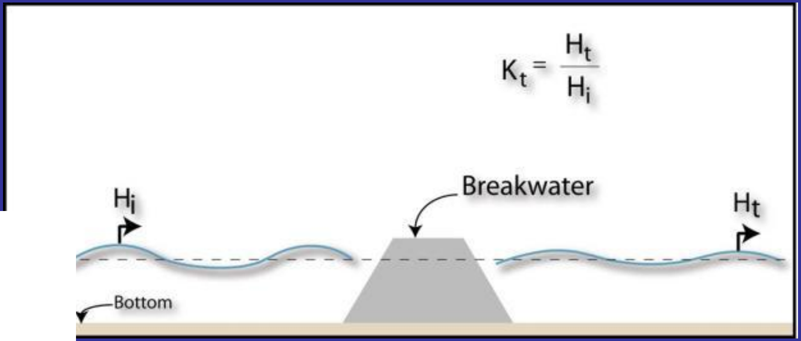
Say,… how much wave action can a marsh tolerate?

- Is a breakwater structure needed?
- Over-design can needlessly restrict ingress and egress
- Under-design can lead to poor performance

Engineering of breakwaters

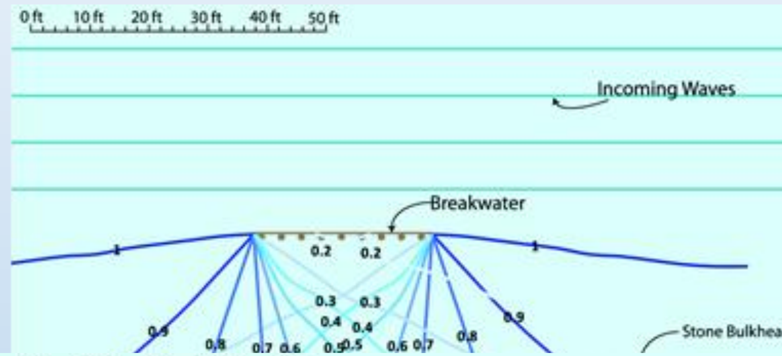
technology dates to D-Day!

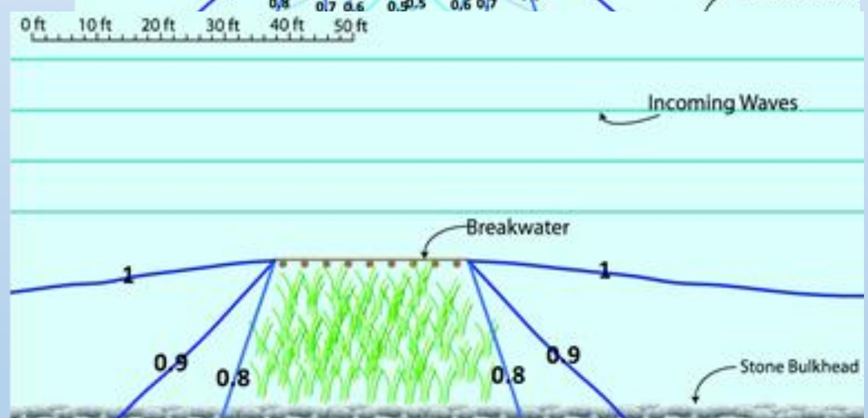




Submerged Breakwaters knock down less than 50% of wave height

The Science of Wave Diffraction around nearshore breakwaters

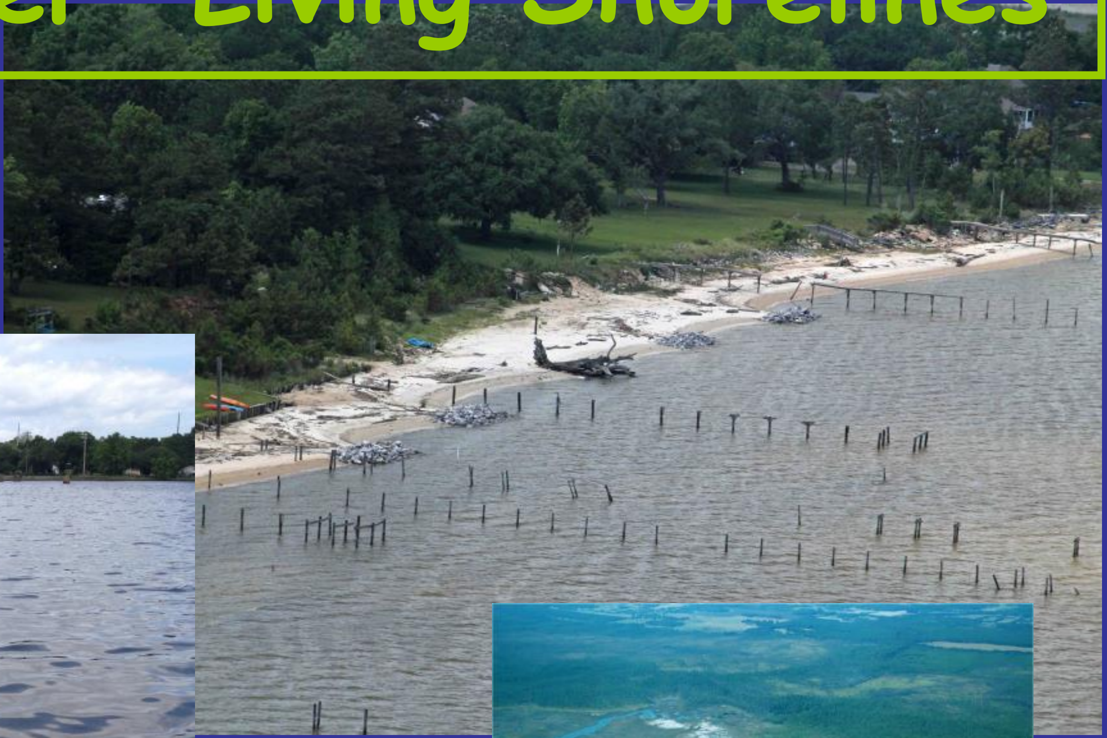




from Dixon (2010)

- **Goda's (1990) diffraction method applied to Dog River, Alabama wave fence**
- **Mature vegetation lines match diffracted wake height lines well**

Some "younger" Living Shorelines

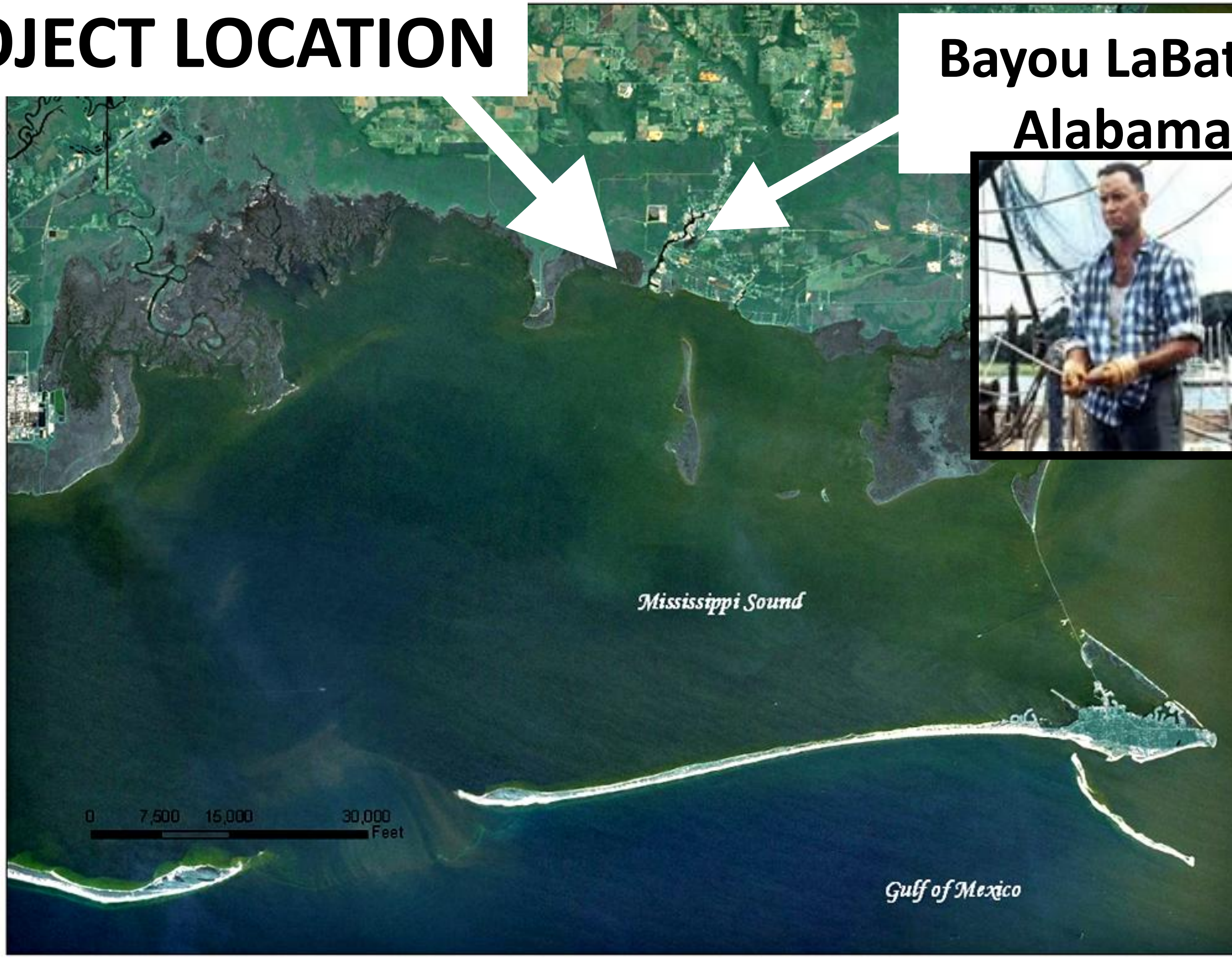


Little Bay Marsh Project Overview

- Finished in 2010
- $3 million construction
- 1.3 km long
- Unique breakwater system designed with laboratory tests
- Largest marsh restoration/protection project in Alabama history
- Award-winning project

PROJECT LOCATION

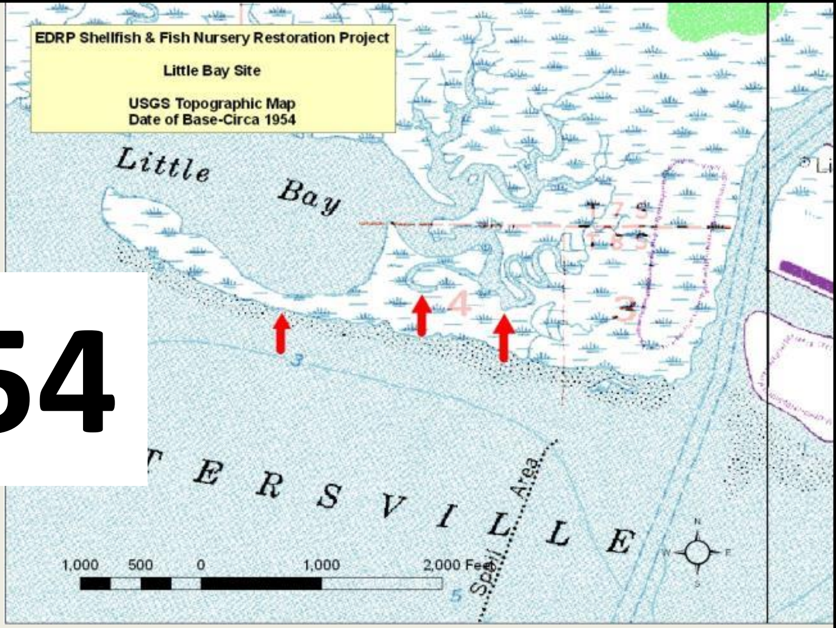
Bayou LaBatre, Alabama



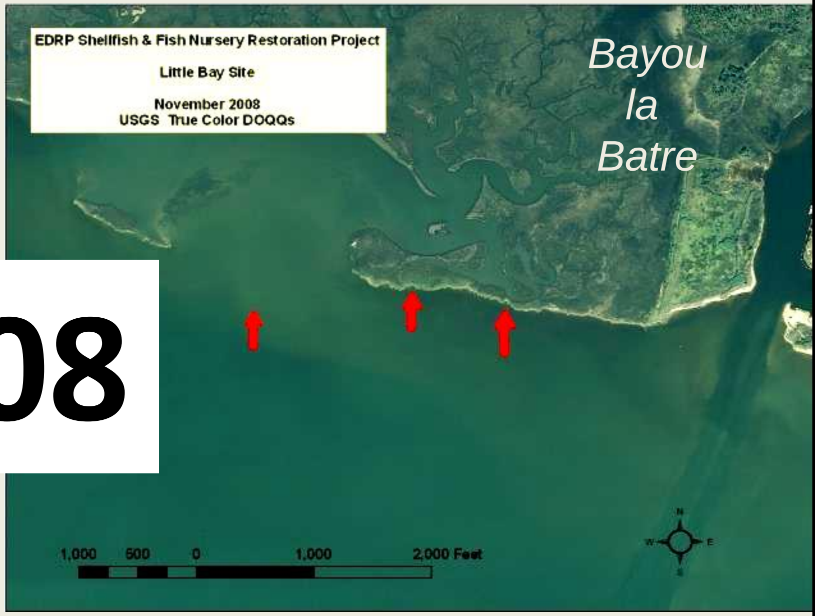
Along the north shore of Mississippi Sound

- 100 m of shoreline recession (average)
- peninsula breach began 15 m wide (1955)
- expanded to 800 m wide (2008)

1954



2008



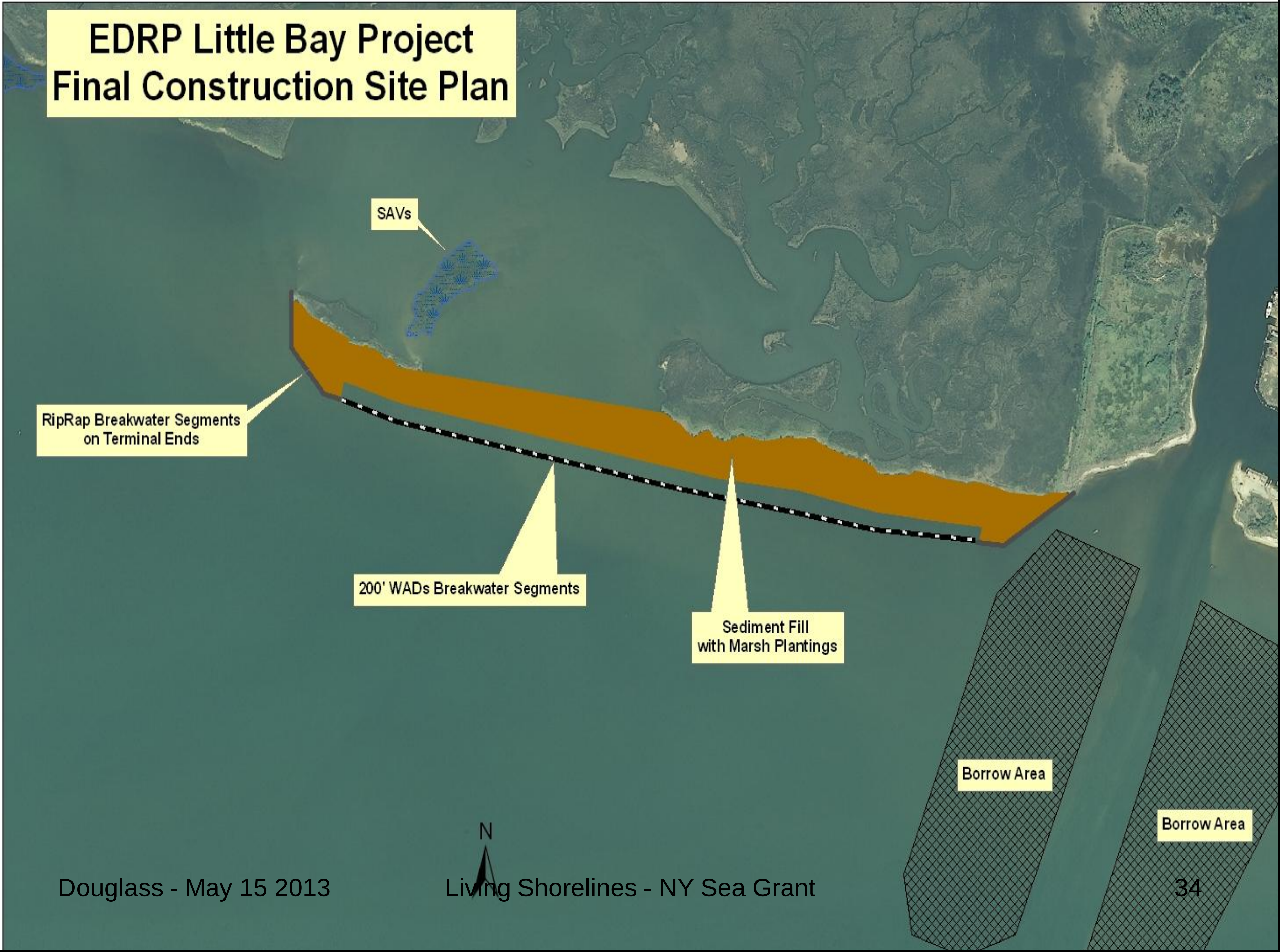
April 2009 Aerial Oblique

Little Bay: 1000+ acres of some of the most productive salt marsh habitat in the Gulf

Micro-tidal range = 0.4 m, dirunal

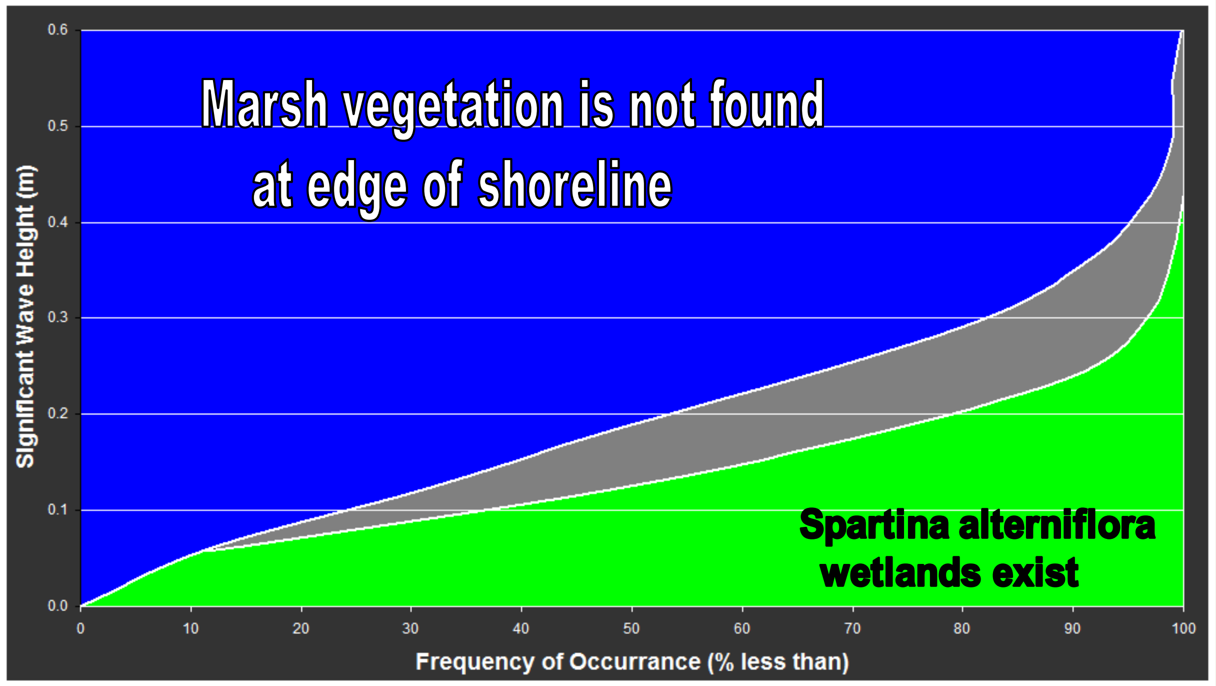
Shallow water

Typical pre-project shoreline


EDRP Little Bay Project
Final Construction Site Plan
SAVs
RipRap Breakwater Segments
on Terminal Ends
200' WADs Breakwater Segments
Sediment Fill
with Marsh Plantings
Borrow Area
Borrow Area
N

Coastal engineering analysis

- **Breakwaters <u>are</u> needed for marsh grass survival**
  - **Roland and Douglass (2005)**
  - **Evaluation of existing nearby shorelines**



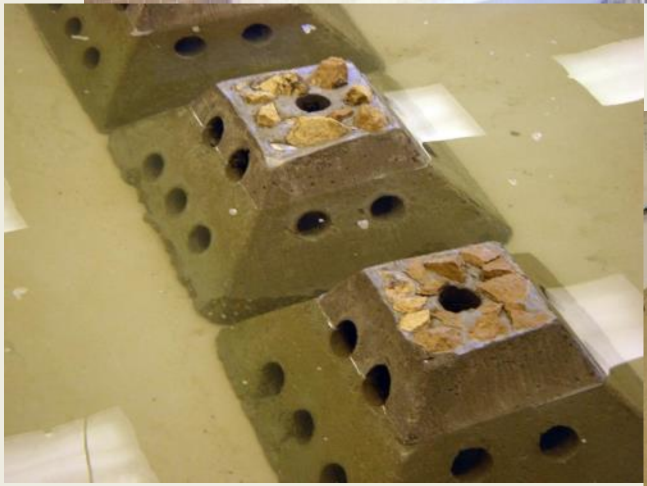
after Roland and Douglass (*J. Coastal Res*., 2005)

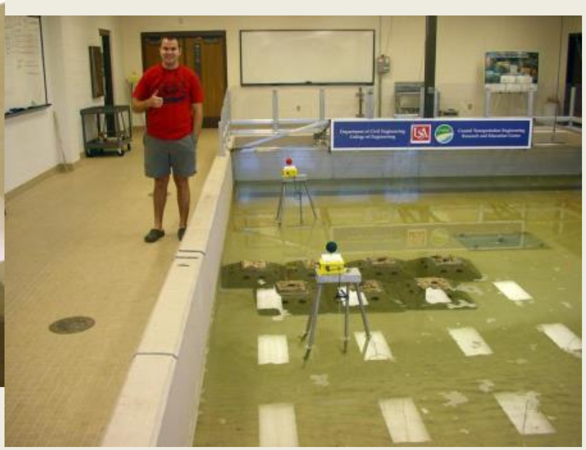
So-called “Wave Attenuation Devices,” (WADs) were to be considered as a design alternate:

- Multiple individual concrete units placed as a breakwater
- But there was no available transmission data

Wave transmission tests were conducted for the "WADs" in the University of South Alabama wave basin

- 6 m x 9 m x 0.9 m
- 1:5 scale models of WADs
- Monochromatic waves
- "burst" method
- Modified K_t definition ("influence coefficient" of Takayama et al. 1985)
- Different configurations and depths (and H, T)

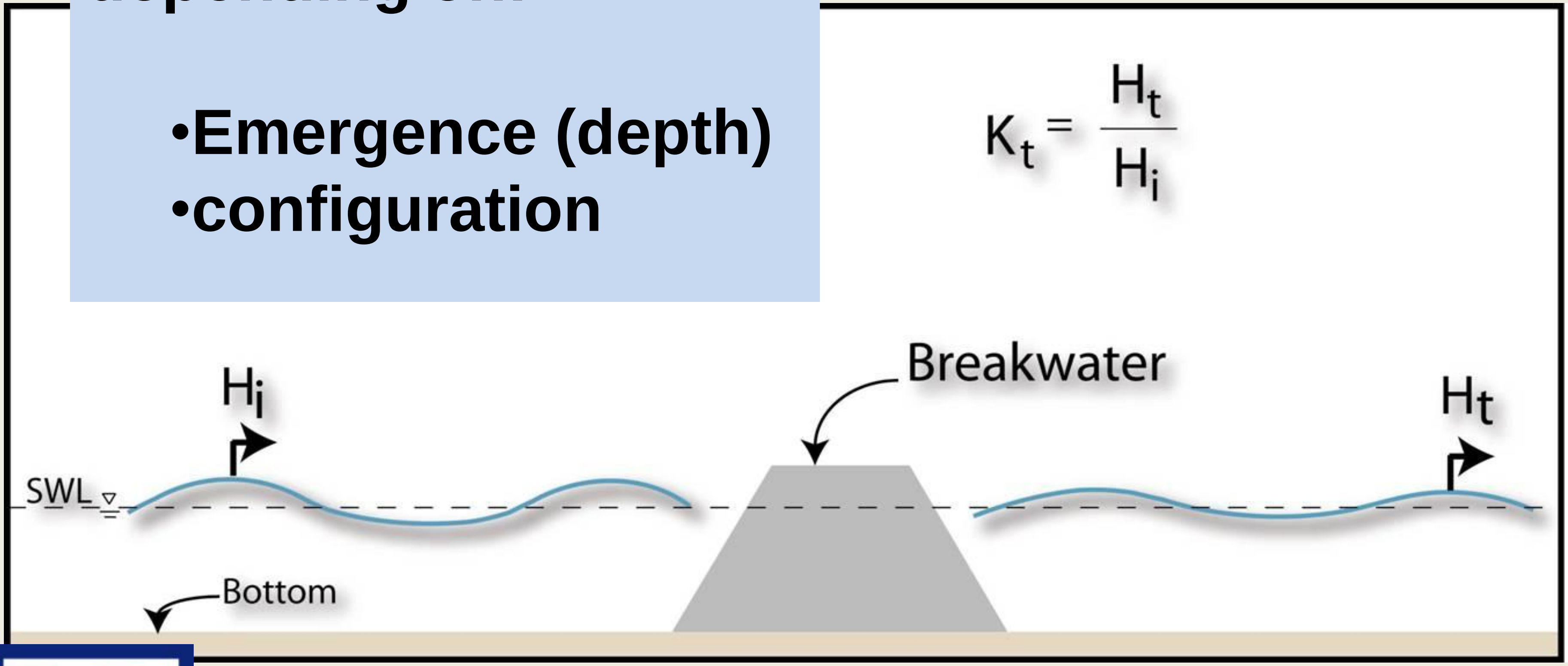




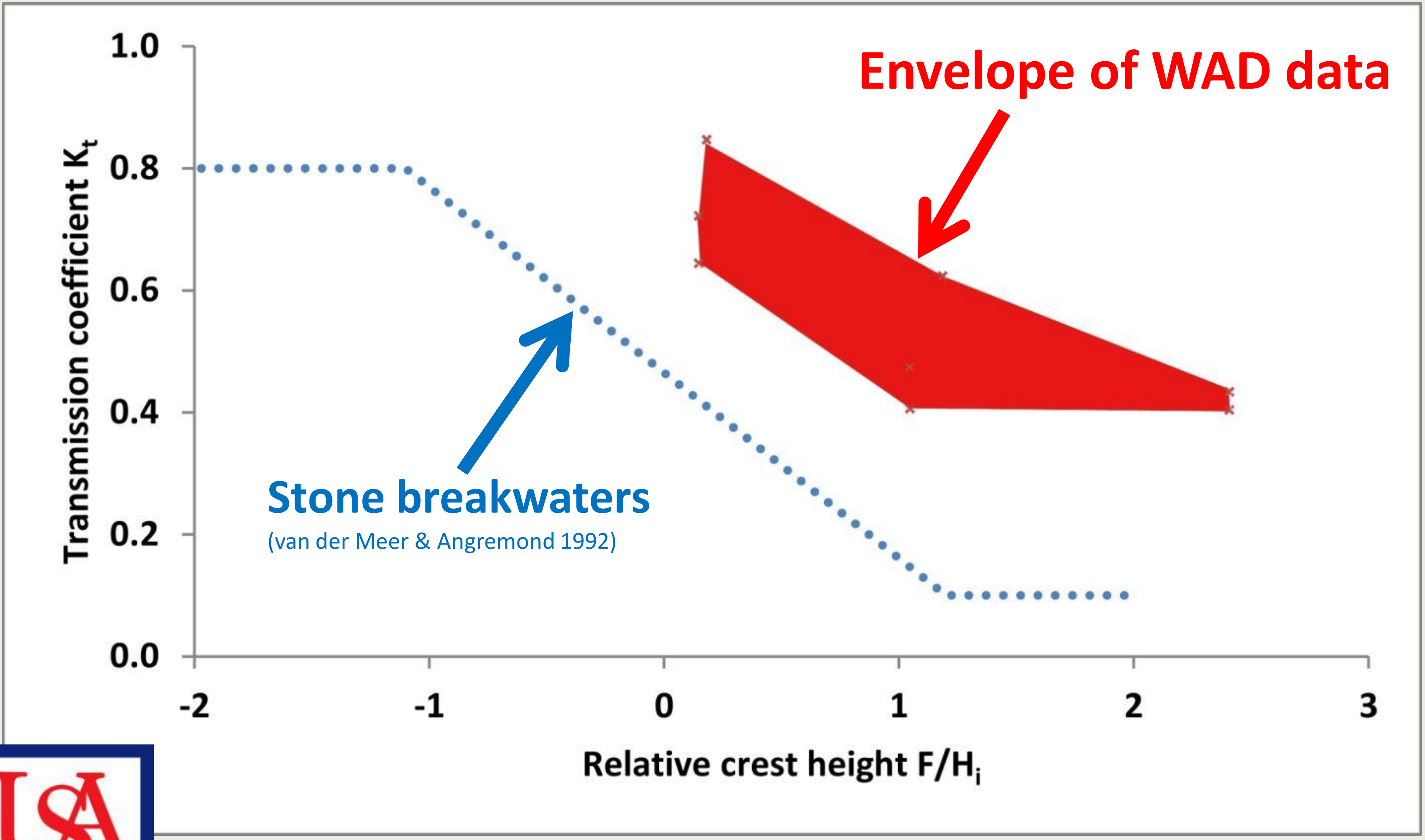
RESULTS: Laboratory Tests of Wave Transmission though "Wave Attenuation Devices"

$40\% < K_t < 90\%$
depending on:

- **Emergence (depth)**
- **configuration**



RESULTS: Laboratory Tests of Wave Transmission though "Wave Attenuation Devices"

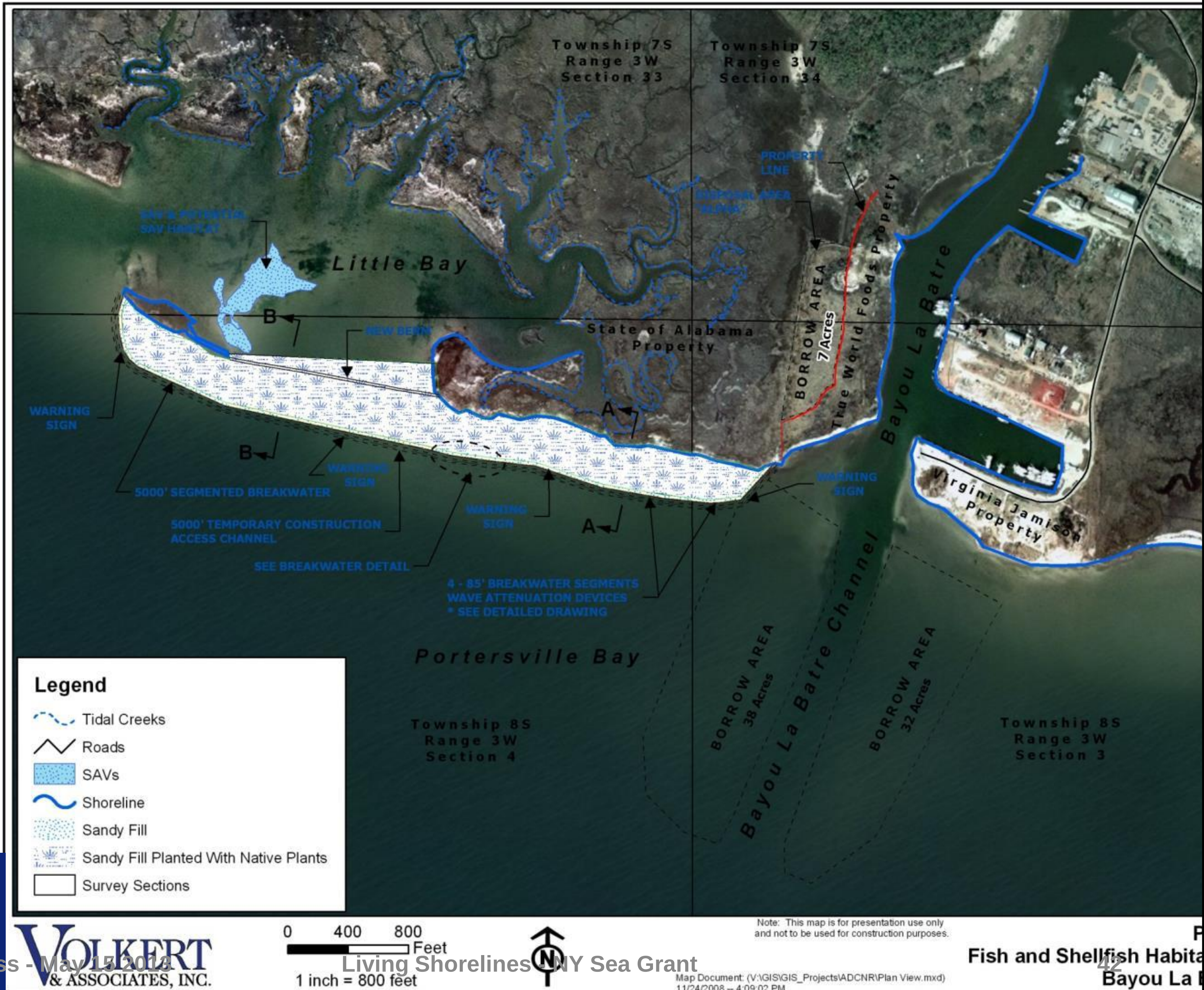


The lab test results led directly to two project design decisions (changes):

1. Increased structure height to 1.8 m (6 ft)
2. Used the most dense configuration of 2-rows of WADs, staggered and closely spaced

The WAD design alternate was selected and constructed:

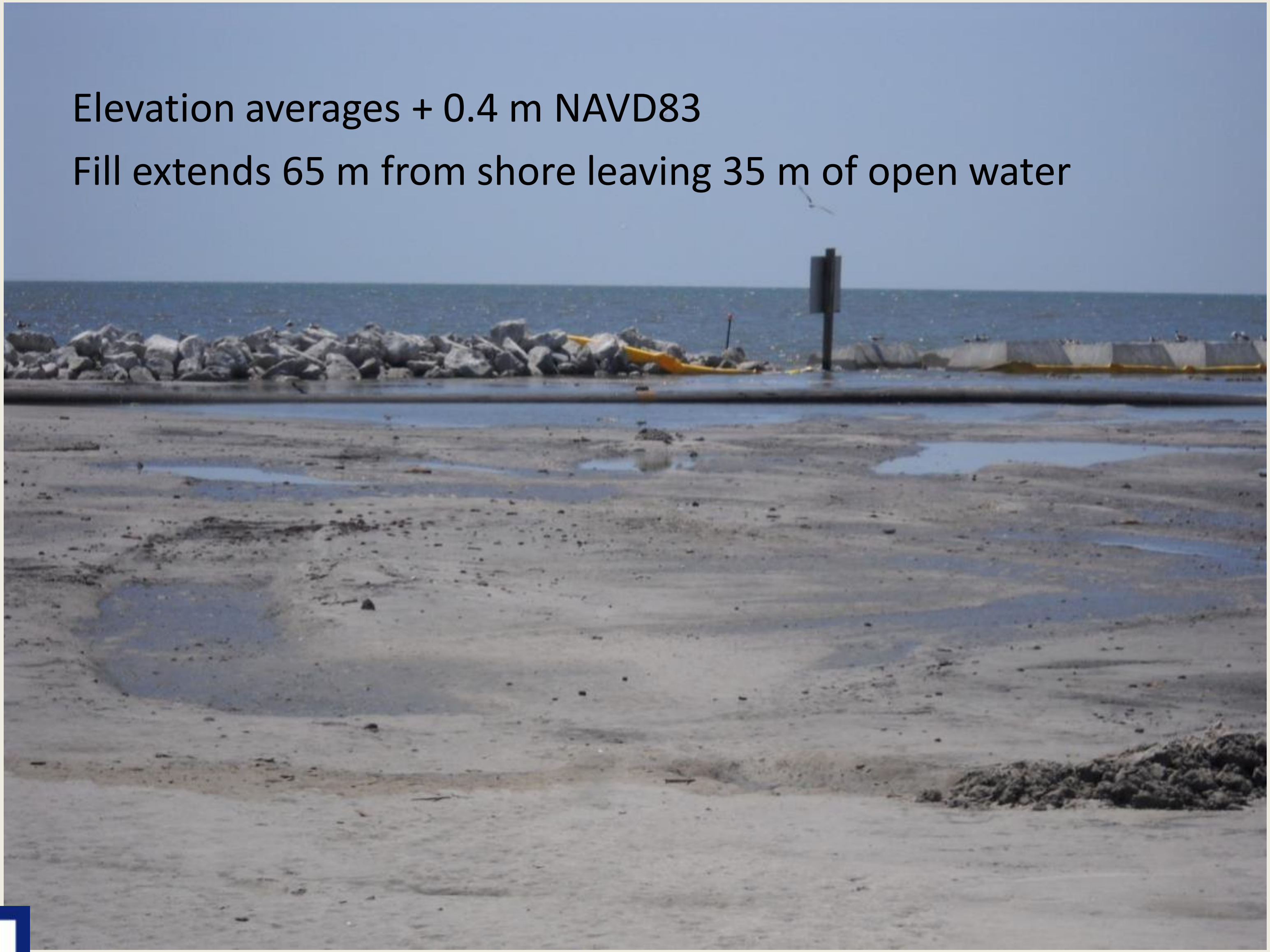
- Constructed off site and barged
- 1.8 m tall (6’), 3 m X 3 m bottom (10’x 10’), 1.5 m x 1.5 m top (5’x5’)
- Open bottom, open top, circular holes on 4 sides
- 7.2 metric tonnes each (16,000 lbs.)
- 546 WADS were used


Township 7S
Range 3W
Section 33
Township 7S
Range 3W
Section 34
Little Bay
State of Alabama
Property
BORROW AREA
7 Acres
True World Foods Property
Bayou La Batre
Virginia Jamison
Property
Bayou La Batre Channel
WARNING SIGN
5000' SEGMENTED BREAKWATER
5000' TEMPORARY CONSTRUCTION ACCESS CHANNEL
SEE BREAKWATER DETAIL
4 - 85' BREAKWATER SEGMENTS
WAVE ATTENUATION DEVICES
* SEE DETAILED DRAWING
Portersville Bay
BORROW AREA
38 Acres
BORROW AREA
32 Acres
Township 8S
Range 3W
Section 4
Township 8S
Range 3W
Section 3
Legend
Tidal Creeks
Roads
SAVs
Shoreline
Sandy Fill
Sandy Fill Planted With Native Plants
Survey Sections
VOLKERT & ASSOCIATES, INC.
0 400 800 Feet
1 inch = 800 feet
N
Note: This map is for presentation use only and not to be used for construction purposes.
Map Document: (V:\GIS\GIS_Projects\ADCNR\Plan View.mxd)
11/24/2008 -- 4:09:02 PM
Fish and Shellfish Habita
Bayou La

FILL FOR TIDAL MARSH

Elevation averages + 0.4 m NAVD83

Fill extends 65 m from shore leaving 35 m of open water



PLANTING

- Donor sources adjacent to site
- 103,000 plants transplanted

PLANTING

- Spartina alterniflora 80%
- Spartina patens 17%
- Juncus roemerianus 2%
- Baccharis L. < 1%
- Distichlis spicata <1%

FIRST SEASON GROWTH WAS EXCELLENT

Completed Project!

Survived Tropical Storm Lee (Sept 2011) and Hurricane Isaac (2012)!

USA photo

June 2011

Black skimmer egg in project - June 2011





June 2011


Crab hiding underwater
in project - June 2011

2012

Dog River Park Shoreline Stabilization - 2010

•MBNEP

•Series of segmented nearshore timber and rock breakwaters

•Sand fill

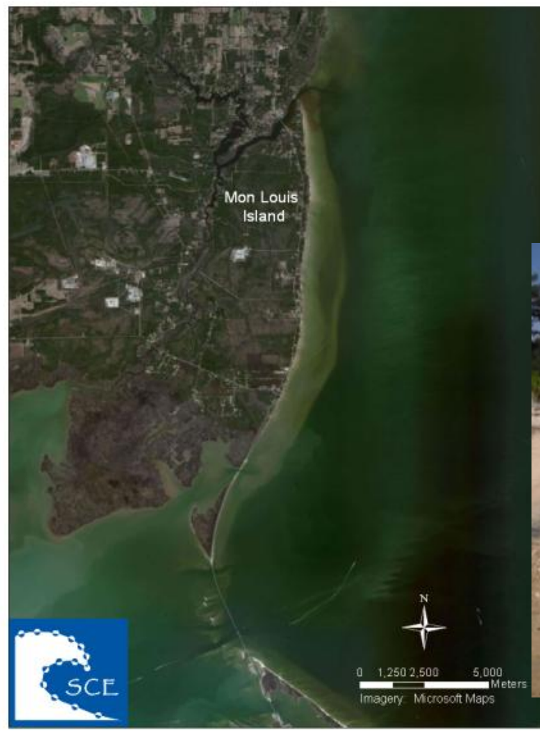
•Vegetation plantings in lee and in between

•Improved water quality due to reduced erosion

•Providing habitat

Mon Louis Island Living Shoreline project – 2012

- **<u>Hired to design a living shoreline with a linear, nearshore reef structure</u>**
- **700 feet of eroding sandy shoreline on Mobile Bay**
- **Mobile Bay National Estuary Program**
- **Funding from grants (USFWS, NOAA)**

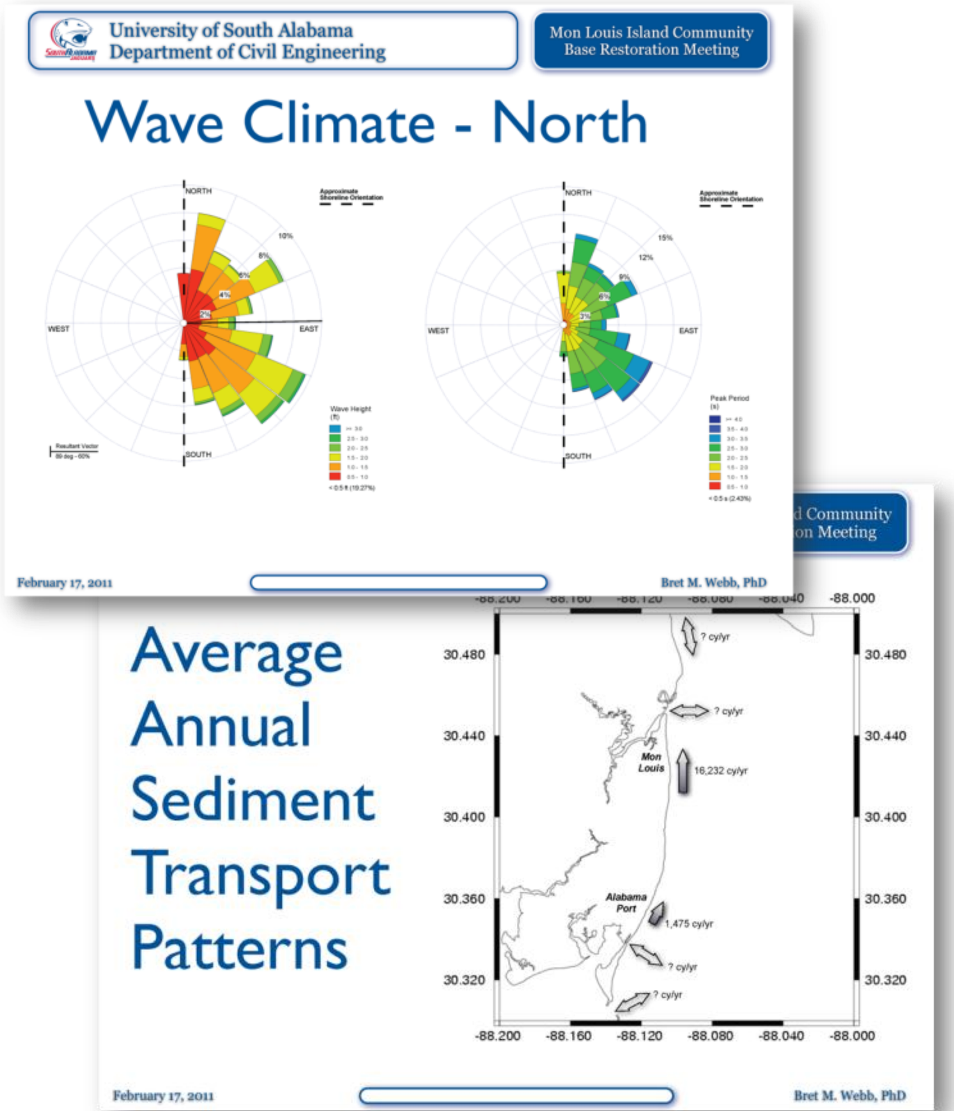


4-12-2012

Mon Louis Island Living Shoreline project – 2012

- But we had to say no… that a nearshore reef/marsh would cause downdrift erosion!

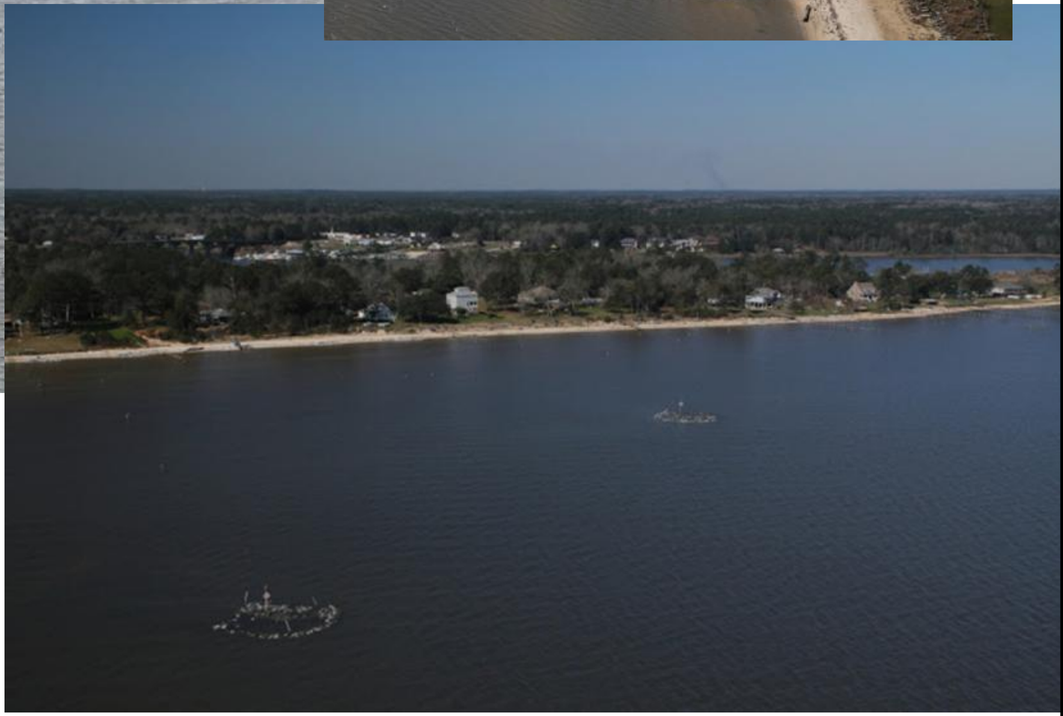
- Based on the site specific characteristics - wave climate and sand transport analysis



Mon Louis Island Living Shoreline project – 2012

- **Sand beach nourishment**
- **4 onshore, headland breakwaters**
- **2 offshore, submerged rock reefs for oyster habitat**
- **MBNEP**

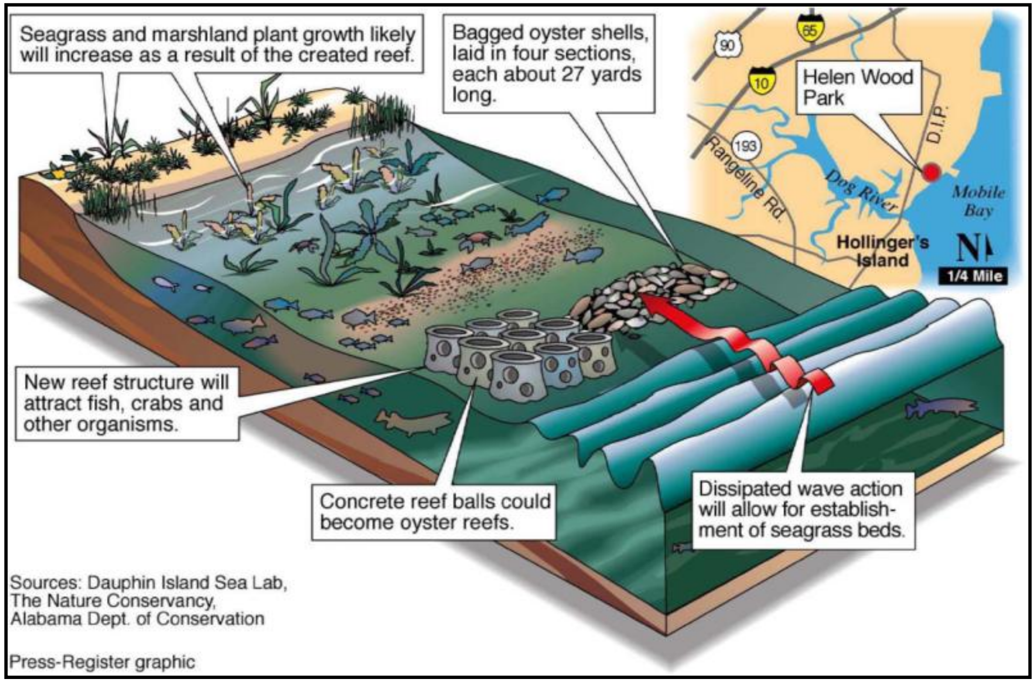
Mon Louis Island Living Shoreline project



Photos courtesy of Sam St. John

Recent trends in Alabama

- **Easier permits**
- **oyster reefs**
- **Public involvement**



This so-called “living shoreline” project is actually killing the shoreline!

This so-called "living shoreline" project is actually killing the shoreline!

TNC's Living shoreline oyster project utilizes 3 different techniques:

1. **Bags of oyster shells**
2. **Reef Balls**
3. **ReefBlk cages**

www.nccoast.org

www.coral.org

The Nature Conservancy

This so-called "living shoreline" project is actually killing the shoreline!

This so-called "living shoreline" project is actually killing the shoreline!

•not reducing erosion rate

•Two research papers say that it is!

• the conclusions of Scyphers, et al (2011) and The Nature Conservancy (2013) are not correct. They are incorrectly evaluating their data

•They biased their data unknowingly

•AND, it does not reduce wave energy to levels a marsh grass can tolerate. i.e. Roland and Douglass (2005)

This so-called "living shoreline" project is actually killing the shoreline!

- the project is actually accelerating or causing additional erosion and wave setup induced destruction of the marsh

    - Trapped sand causing erosion at flanks
    - Reef setup locally raising surge level in storms which is rapidly destroying landward marsh

- It has changed the character of the shoreline from a reasonably stable eroding sandy beach to a rapidly eroding dead marsh platform.

This so-called "living shoreline" project is actually killing the shoreline!

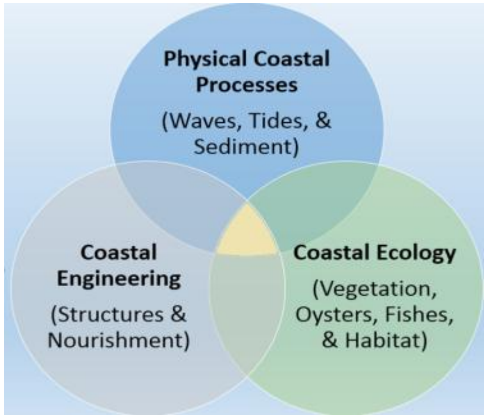
Designed in ignorance of, or disregard for, established textbook principles of

- coastal sediment processes sciences (Komar 1998)
- coastal engineering (Sorensen 2006)
- Existing literature on wave tolerance

summary

A. Some of the history of "living shorelines"

B. "mature" living shorelines



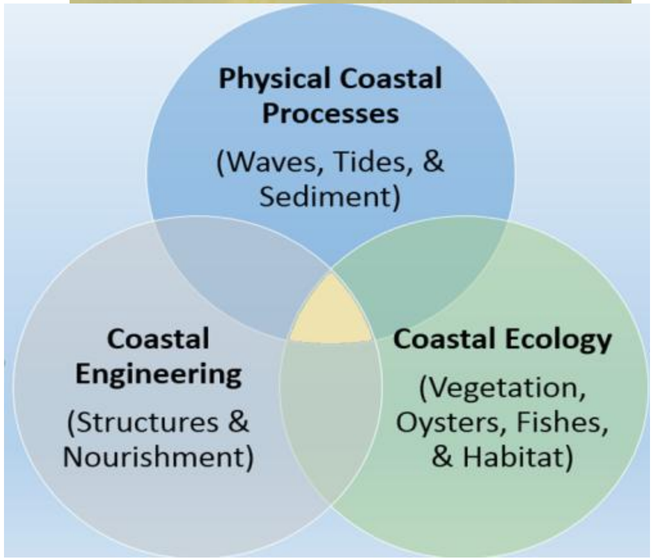
C. Science of living shorelines

D. "young" living shorelines

E. A "living shoreline" project which is killing the shoreline!

Conclusions

A. We need more "living shorelines" – shorelines which function more naturally and preserve the habitats and environs we love



B. Living Shoreline designs which include coastal engineers and physical scientists on the design teams, perform better.

C. Some so-called "living shoreline" projects can cause serious ecosystem damage if poorly designed

Questions?

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