





### **Outline:**

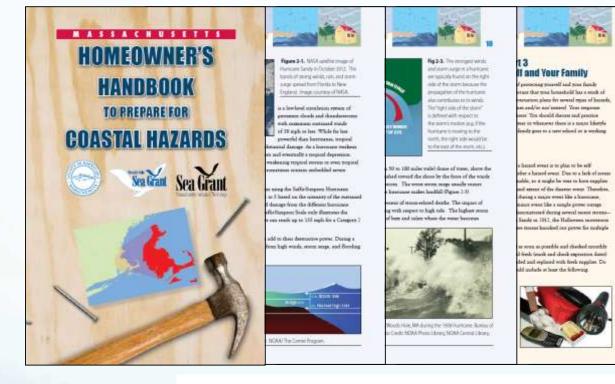
- ~30 min talk & time for questions
- Practical measures that can protect homeowners, renters, and their families, as well as minimize damage to homes and property from hurricanes, nor'easters, and flooding.
- Pros and cons of various shoreline stabilization techniques

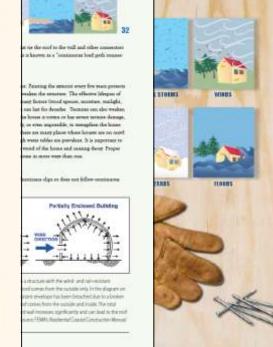




## Adaptation (The Handbook)



















5,000 copies of the handbook were first made available during Hurricane Preparedness Week (May 26 – June 1) and over ½ were distributed that 1<sup>st</sup> week.



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### Things You Can Do to Prepare

- Gather emergency supplies
- Compile an evacuation kit
- Create an evacuation plan for both a flood and a coastal storm
- Know your property and take appropriate action
- Know your house and take appropriate action
- Don't gamble with your house

Myth 1: "I survived Hurricanes Bob, Irene and Sandy, so I am sufficiently prepared."

Myth 2: "If a disaster occurs, it won't be that bad."

Myth 6: "My house survived Hurricanes Bob and Sandy, so I do not need to retrofit for hurricanes."







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1938 Carol / Edna Bob Sandy

(Nor'easters)



With 3' of Freeboard

Annual flood insurance: \$2,084



Without Freeboard
Annual flood insurance: \$5,499







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### **Shelter**

In place or at a designated shelter?
Arrangements for pets? Medicine?





**Emergency Notification Systems** 

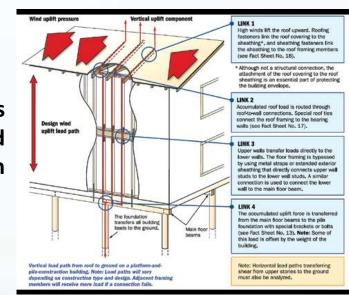




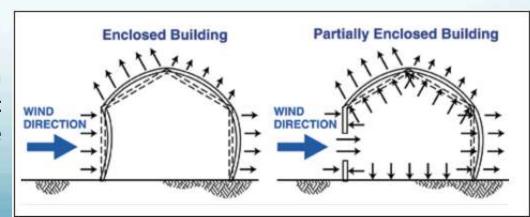
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The Severity of the Hazard Event
Your Location
How and When Your House Was Built
How Your House is Maintained
How You Strengthen Your House

continuous load path



wind and rain resistant envelope





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### **Retro-fitting**

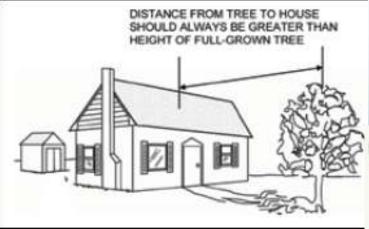
### hurricane clips



### bracing - polyurethane foam











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### Table 4-1. Pros and Cons of Various Types of Window Protection

Type of Protection	Pros	Cons	Approx. Cost for 3'x 4'Window Protection (2012)	
Good overall protection,		Most expensive of permanent shutter systems; Motorized versions need manual backup for power outages or an emergency power source	\$360 to \$600	
Accordion Shutters	Easily deployed; Simple manual operation; Good overall protection; Modest cost	Possible aesthetic issues	\$300 to \$360	
Bahama Shutters	Easily deployed; Good protection; Provides shade	Blocks some light and view	\$360 to \$480	
Storm Panels	Strong; Removable; Relatively inexpensive permanent shutter system; Good protection for the costs	Manual deployment required; Requires adequate space for storage when not in use	\$144 to \$168	
Stainless Steel Impact Screens	Always in place; Provides shade	Some aesthetic impact; Emergency escape issues must be considered; Less effective for wind-driven rain	\$375 to \$750	
Flat Impact Polycarbonate Units	Always in place; Minimal aesthetic impact	Emergency escape issues must be considered; Care must be taken in cleaning	\$375 to \$525	
Fabric Windscreen (Direct Mount)	Inexpensive; Easy to handle and store	Manual deployment required; Greater shutter deflection than metal systems	\$105 to \$180	
Impact Resistant Windows and Doors	Attractive and energy efficient; Provides security protection and storm resistance; Always in place; Many styles and options	Costs vary widely and can be high; Replaces existing windows or doors; Glass can still break requiring expensive replacement	Wide range in costs: \$360 to \$600 and higher	
Plywood	Materials readily available; Easy to install on lower levels; Inexpensive	Not as strong as some other shutter systems; Manual deployment is difficult on upper levels; Must be properly stored; Doesn't provide impact- resistance for winds > 130 mph	\$25 to \$35 for materials only	
Laminates	Storm, security and UV protection; Energy efficient; Always on; Allows light in; Ideal for hard-to-reach windows	Other systems are stronger; Need to lock laminate to frame; Frame must be strong; Window may need replacement after storm	\$180 to \$204	
Plastic honeycomb	Strong system; Lightweight; Reasonable cost; Won't warp or rot	Storage of panels; Time to create and deploy. While cost is reasonable, still most expensive of deployable systems; Materials difficult to obtain	\$140 to \$170	





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**Pre-Disaster Activities** 

**Protect Your Home from Damage Communicate with Your Insurance Agent** 

### **CRS Across Barnstable County**

	# Policies In-force	Written Premium In-force	10% Savings	<b>15% Savings</b>
4/30/2014	10,474	\$15,487,001	\$1,548,700	\$2,323,050
2/28/2015	12,350	\$17,101,036	\$1,710,104	\$2,565,155

1,876 \$1,614,035 \$161,404 \$242,105

10 Months later: 2,000 more people have policies \$160,000 more to be saved





Part 1 — Introduction





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Projected Change	Likelihood
Warming	Extremely likely (>95 percent chance of occurrence)
Higher sea levels	Extremely likely (>95 percent chance of occurrence)
Higher winter and spring precipitation	Very likely (>90 percent chance of occurrence)
Higher annual precipitation	Likely (>66 percent chance of occurrence)
Higher winter and spring streamflow	Likely (>66 percent chance of occurrence)
Greater hydrological extremes	Likely (>66 percent chance of occurrence)

Table 6-1. Summary of observed and documented current climate trends in the Northeast region.<sup>6.6</sup>

Climate Change Current Trend in the Variable Northeast Region		What This Means	
Air Temperature	Since 1900, the annual mean temperature has risen 1.5°F, with more rapid increases occurring over the past few decades (2°F since 1970).	Longer, hotter summers increasing drought potential and human health effects.	
Ocean Water Temperature	Annual average temperatures in the waters off the southern New England coast have increased by 2.2°F since the 1970s.	Change in species composition and dynamics.  Decline of some fish species while other southern species increase. Potential for more harmful algal blooms and invasive species.	
Precipitation and Weather	Studies have found a 5 to 17 percent increase in regional precipitation during roughly the last 100 years.	More rainfall in more intense storms means increased risk of flooding. Less snow in winter.	
Storminess	Hurricane intensity in the western North Atlantic Ocean has increased.	Increased erosion and damage to roads, bridges, buildings. Interruption of business.	
Sea-Level Rise  Rates of local relative sea-level rise are variable across the Northeast region. Sea level in Massachussetts has risen 11 inches over the past 100 years.		Increased flooding. Loss of waterfront property and impacts to public access.	

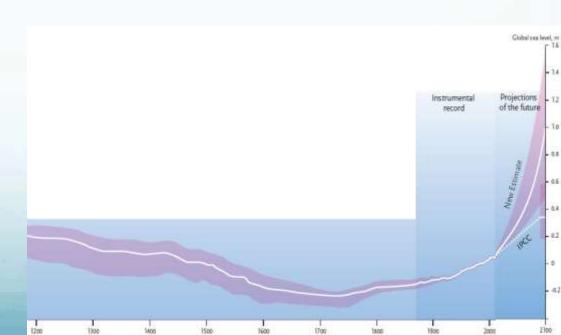


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### Massachusetts

Coastal Storms
Floods
Drought/Extreme Heat
Sea-Level Rise











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### Construction at the Coast, Seach Management, and Coastal Property Checklist

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### Appendix A **Emergency Contact Information**

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Management Surgeony Management Agency (MEMA)

MEMA Region 2 Middleses, Even and Sulfrito (670) 129-1500

MEMA Region II

Secretific Brand, Dries, National North and Physioth. (900) 421 0400 MESON Region BUTY

Solution Problem Stepules Statution and Women: (413) 750-1406 MENIA Houtenamer (300) \$20-2000

http://www.acces.gov/scena

www.retroccom/bloofD6A

year freehold com/Monoclones (OA)

Manufacts Repended of Transportation (Manufact)

B15-st1-stm www.mandet.com.no.com

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007-727-7779

WITH BUILDING ARTHOUGH

SM-775-1548 Cape Cod and blands 1000-517-5150 Control Mile

MATERIAL SAME Francis MAN. 079-922-2224 Northeasten 969www.pulcoon.org

Federal Emergency Management Agency (FEHA)

CHISAMIFICACING www.framager

Titleben Contacts

Natural Gold - electrony 1 600-405-1212, per 1-800-241-5125

NETUR - 1-880-397-2000



### Appendix 8 **Shelter Informa**

When an emergency emotion vacuum abeliar acrossos through local radio and relevance avaisant, howeversus. Mast 111 (calling 111 frees are lard line phone), and relwhich specific distances are available for enumerous grasp off over.

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D'you are advised to evanues, we to keep family mends year encuation bit, including important papers. It is ea amazasaten kit with was buesaw food, com, blaylam, an be immediately smalable. All Massachusetts communicis promise aufficient shalter space for expected everyone.

If you plus to seek a horal or moral ar your abelon in M. man, make more the bond or morel in open and space in fill up quickly often a humanum to posting a flower to the

Perpare a plan for pen in case you must resource. Make excloration in tarrest

Remaraber than shelters may be opened selection of the stores. Should as evacuation become note radio os televisios statios, os go to reversidados. or call 215 for agree the uniques information on a



### WHAT TO BRIDG TO A SHELTER.

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# What is Erosion?

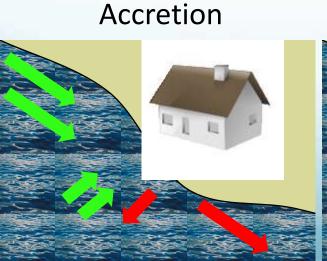
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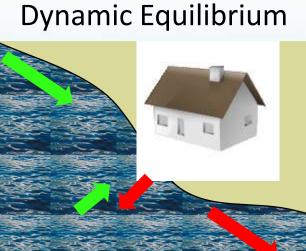
### The Erosion Problem: Education Perspectives

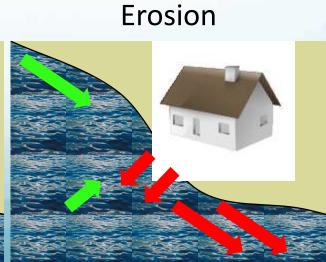




It's all sediment transport!
What is Erosion???..... just more leaving than coming in



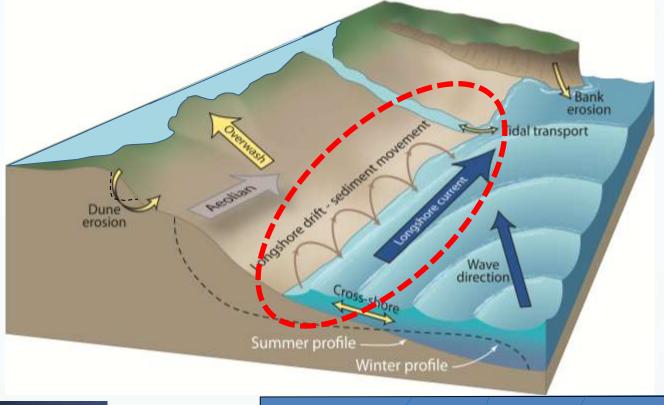




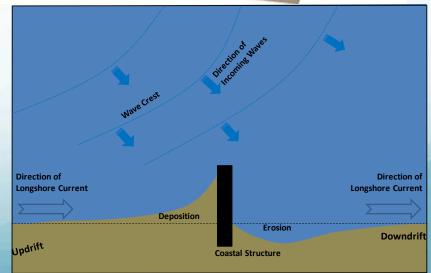


### Parallel Transport......Blocked LST











### Perpendicular Transport......Blocked input







### Coastal Processes: Key Points



- 1. Erosion of glacial landforms is the MOST important source of sediment for dunes and beaches in Massachusetts.
- 2. Wind and waves then transport sediment.
- 3. Without erosion and then longshore re-deposition there would be no beaches.





### Coastal Processes: Key Points



1. Erosion of glacial landforms is the MOST important source of sediment for dunes and beaches in Massachusetts.

2. Wind and waves th

3. Without erosion and beaches.

Thanks for contributing sand to our coastal resource areas

on there would be





### **Erosion Control Structures**



Designed to extend the "usable life" of a property.

General practice 1920s – 1950s.

Scientists wrote letter in 1970's... MA "needs" erosion.



310 CMR 10: "no new coastal engineering structure on a coastal beach/dune/bank to protect a structure built after 8/10/1978"

**Towns: Engineered structures may require nourishment** 

# Shoreline Stabilization





### Do nothing

- 1. Will system recover by itself?
- 2. How far is the structure from the water?
- 3. Grandfathering protects structures (not lawn) before August 10, 1978









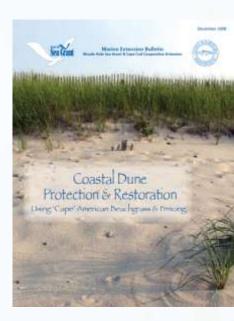
### Do nothing



Plant Natives:
Root systems stabilize.
Take up water.
Break the impact of raindrops or wave-splash.
Slow down runoff

### **Remove Invasive**











Do nothing Vegetation

Re-grade









OF BARIS

Do nothing

Vegetation

Re-grade

**Managed retreat** 





E R T I C A







### 09/29/2015 - 01/15/2016 - 10/12/2017













Do nothing

Vegetation

Re-grade

Managed retreat

Beach nourishment = Fill of a CRA





### **Sacrificial**



### Cobble (Mixed)







Do nothing

Vegetation

Re-grade

Managed retreat

### **Beach nourishment**











- Do nothing
  - Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing













- Do nothing
  - Vegetation
- Re-grade
- Managed retreat
- Beach nourishment













- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing













Do nothing

Vegetation

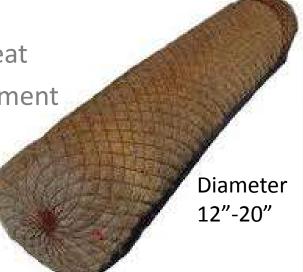
Re-grade

Managed retreat

Beach nourishment

Sand fencing

**Fiber rolls** 













Do nothing

Vegetation

Re-grade

Managed retreat

Beach nourishment

Sand fencing

Fiber rolls













Do nothing

Vegetation

Re-grade

Managed retreat

Beach nourishment

Sand fencing

Fiber rolls

Coir Envelopes









- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
- Fiber rolls
- Coir Envelopes









- Do nothing
- Vegetation
- Re-grade
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- Fiber rolls
- Coir Envelopes











Do nothing

Vegetation

Re-grade

Managed retreat

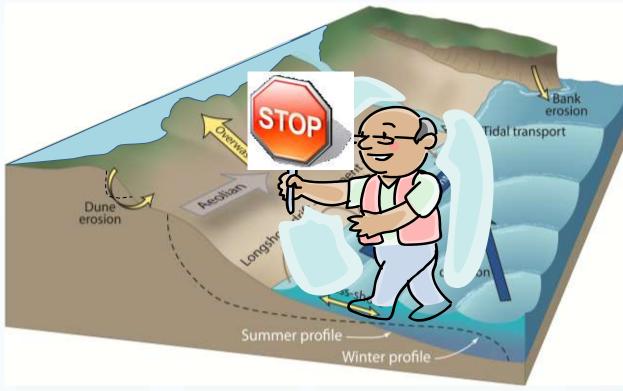
Beach nourishment

Sand fencing

Fiber rolls

Coir Envelopes

#### CES



<u>WPA:</u> Coastal engineering structure means, but is not limited to, any breakwater, bulkhead, groin, jetty, revetment, seawall, weir, riprap or any other structure that is designed to alter wave, tidal or sediment transport processes in order to protect inland or upland structures from the effects of such processes.

#### Woods Hole Sea Grant

#### The Spectrum of Coastal Erosion Control Methods



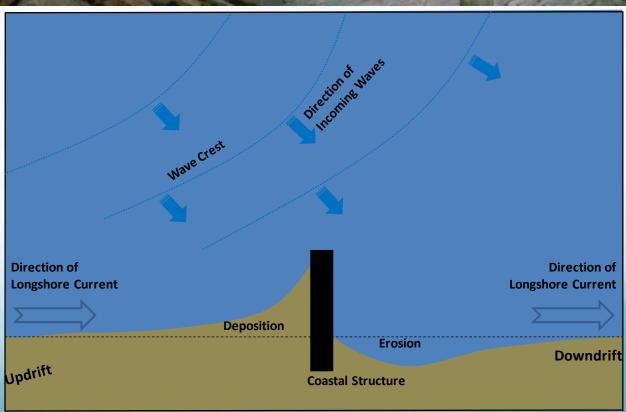
- Do nothing
  - Vegetation
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- Fiber rolls
- Coir Envelopes

### CES

Groin



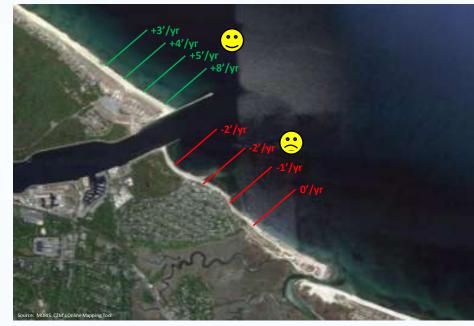








- Do nothing
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#### CES

Groin







- Do nothing
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### CES

• Groin

#### **Sand Bags**







#### The Spectrum of Coastal Erosion Control Methods

OF BARNS BUT OF BARNS BACHUSE

- Do nothing
  - Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
- Fiber rolls
- Coir Envelopes

#### CES

• Groin

- Sand Bags
- Gabion











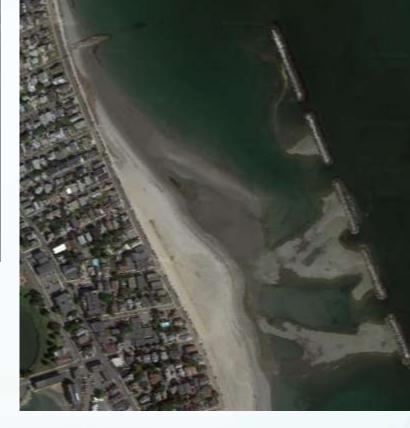


#### Woods Hole Sea Grant

#### The Spectrum of Coastal Erosion Control Methods



- Do nothing
  - Vegetation
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- Managed r
- Beach nou
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- Coir Envelopes



#### CES

Groin

- Sand Bags
- Gabion
- B
  - **Breakwater / Sill**

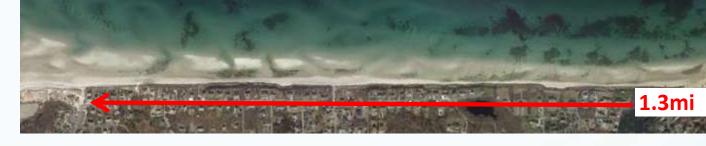


#### The Spectrum of Coastal Erosion Control Methods



- Do nothing
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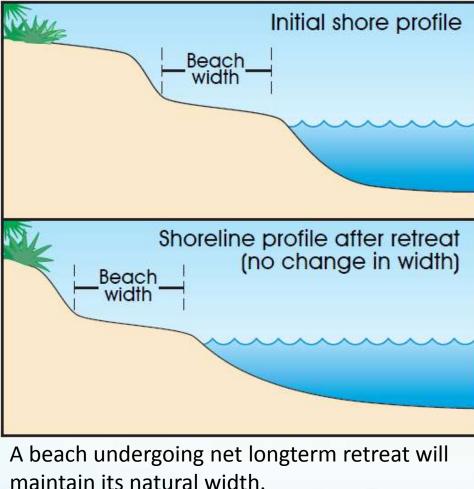




#### CES

- Groin
- Sand Bags
- Gabion
- Breakwater / Sill
- Revetment
- Jetty



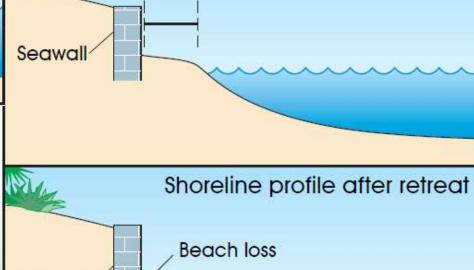


Beach loss eventually occurs in front of a seawall for a beach experiencing net longterm retreat.

Beach width

Seawal

Initial shore profile



Source: U.S. Army Corps of Engineers (1991)

Images adapted from Natural Hazard Considerations for Purchasing

Coastal Real Estate in Hawaii - A Practical Guide of Common Questions and Answers, by University of Hawaii Sea Grant College Program, 2006.

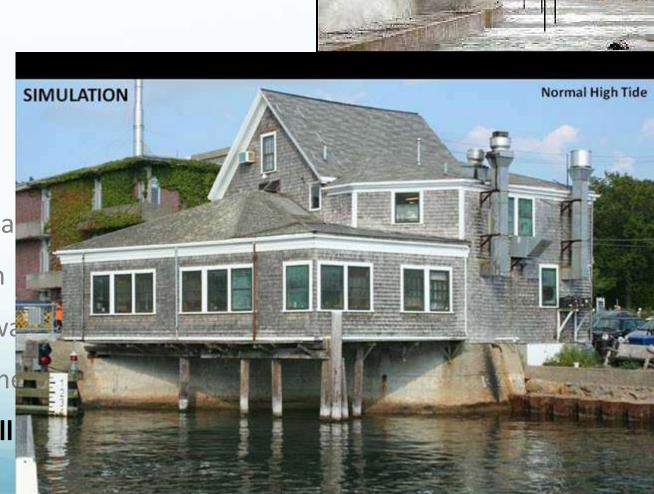




- Do nothing
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- Managed retreat
- Beach nourishment
- Sand fencing
- Fiber rolls
- Coir Envelopes

#### CES

- Groin
- Sand Ba
- Gabion
- Breakwa
- Revetme
  - Seawall





#### The Spectrum of Coastal Erosion Control Methods



- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- Sand fencing
- Fiber rolls
- Coir Envelopes

#### CES

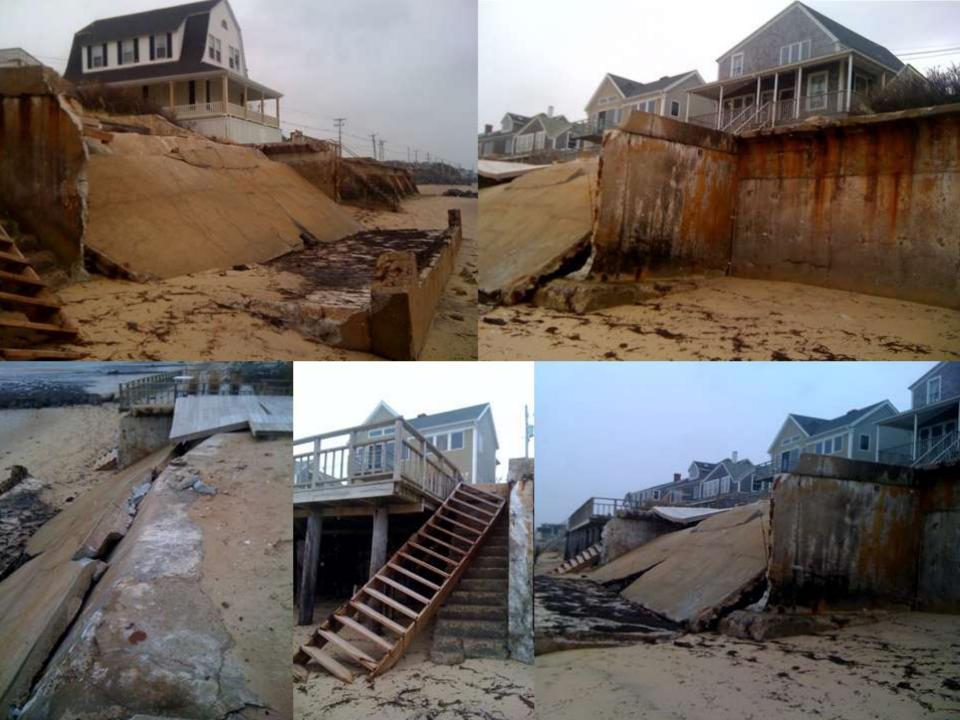
- Groin
  - Gabion
  - Breakwater / \$10

Sand Bags

• Revetment

Jetty • Sea









- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
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#### CES

- Groin
  - Gabion
  - Breakwater / Sill

Sand Bags

- Revetment
  - Seawall

Jetty

**Bulkhead** 





Do nothing

-Vegetation-

How the "Spectrum" could be used:

Re-grade

Notice of Intent (NOI)  $\rightarrow \rightarrow \rightarrow \rightarrow$  Alternative Analysis

- Managed retreat

Beach nourishment

Sand fencing

Fiber rolls

Coir Envelopes

...start at top and move down, explaining why each one isn't suitable.

#### CES

Groin

Sand Bags

Gabion

Breakwater / Sill

Revetment

tty Seawall

•

Bulkhead







- Do nothing
- Vegetation
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- Sand fencing
- Fiber rolls

#### Not a complete list (and methods are being invented/modified)











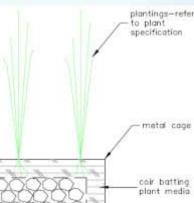
Groin

- Sand Bags
- Gabion
- Breakwater / Sill
- Revetment
  - Seawall













Do nothing

Vegetation

Re-grade

Managed retreat

Beach nourishment

Sand fencing

Fiber rolls

Coir Envelopes

- Not a complete list (and methods are being invented/modified)
- With revetments...if neighbors don't do the same then you'll have to keep extending return.
- Very few projects only employ 1 method, and when we are determining if it's a CES we need to use the "hardest" aspect of the project.

#### CES

Groin

Sand Bags

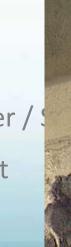
Gabion

Breakwater /

Revetment

Seawall

Bulkhead









#### Do nothing

#### Vegetation-

- Re-grade
- Managed retreat
- Beach nourishment-
- Sand fencing-
- Fiber rolls
- Coir Envelopes

#### Combination



#### CES

- Groin Sand Bags
  - Gabion
  - Breakwater / Sill
  - Revetment

Jetty Seawall

Bulkhead





- Do nothing
- Vegetation \
- Re-grade
- Managed retreat
- Beach nourishment
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- Coir Envelopes

#### CES

- Groin
- Sand Bags
- Gabion
- Breakwater / Sill
- Revetment
- Jetty Seawall
  - Bulkhead

#### **Combination**



#### The Spectrum of Coastal Erosion Control Methods



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### CES

- Groin Sand Bags
  - Gabion
  - Breakwater / Sill
  - Revetment –

Seawall

Bulkhead

Combination



- Jetty

#### The Spectrum of Coastal Erosion Control Methods



**Combination** 

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment •
- Sand fencing
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#### CES

- Groin
- Sand Bags
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  - Bulkhead





↑ Resilience ≠ ↓ Natural Systems

# Questions?

