

Cape Cod Strong: Meeting the Challenges of Coastal Storms

Greg Berman

(WHOI Sea Grant & Cape Cod Cooperative Extension)

October 1, 2015

CNN



WAQUOIT BAY
NATIONAL
ESTUARINE
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RESERVE



WAQUOIT BAY RESERVE
FOUNDATION
Friends of the Waquoit Bay Reserve
www.waquoitbayreservefoundation.org
waquoitbayreservefoundation@gmail.com



Meeting the Challenges of Coastal Storms

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





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



Contents

Part 1 — Introduction	1
Part 2 — Natural Hazards: An Overview for Homeowners	7
Part 3 — Protecting Yourself and Your Family	19
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Appendix A — Emergency Contact Information	75
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Appendix C — Construction at the Coast, Beach Management, and Coastal Property Checklist	78
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Useful Links and Resources	88

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.”

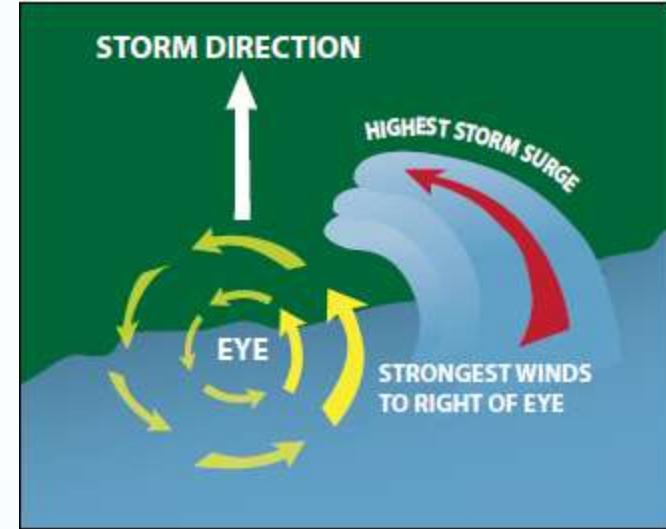
Myth 2: “If a disaster occurs, it won't be that bad.”

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



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With 3' of Freeboard
Annual flood insurance: **\$2,084**



Without Freeboard
Annual flood insurance: **\$5,499**



1938
Carol / Edna
Bob
Sandy

(Nor'easters)





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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

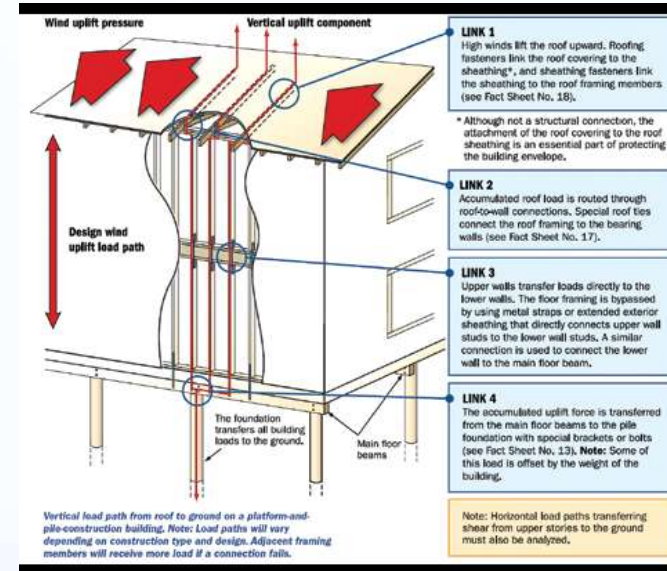
Your Location

How and When Your House Was Built

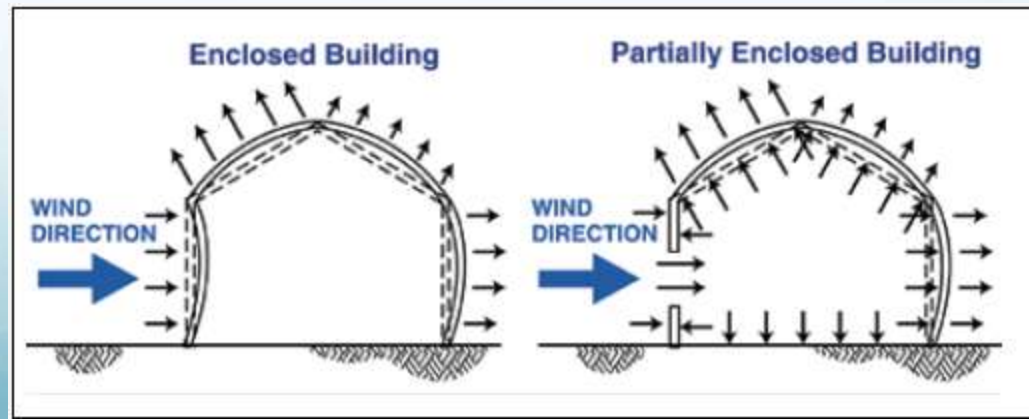
How Your House is Maintained

How You Strengthen Your House

continuous
load
path



wind and rain
resistant
envelope





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Retro-fitting

hurricane clips



bracing - polyurethane foam



DISTANCE FROM TREE TO HOUSE
SHOULD ALWAYS BE GREATER THAN
HEIGHT OF FULL-GROWN TREE





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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)
Roll-down Shutters	Easiest to deploy; Good overall protection, especially from wind-driven rain	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

	<u># Policies In-force</u>	<u>Written Premium In-force</u>		<u>10% Savings</u>	<u>15% Savings</u>
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



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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.^{6,6}

Climate Change Variable	Current Trend in the 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 Massachusetts has risen 11 inches over the past 100 years.	Increased flooding. Loss of waterfront property and impacts to public access.



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5

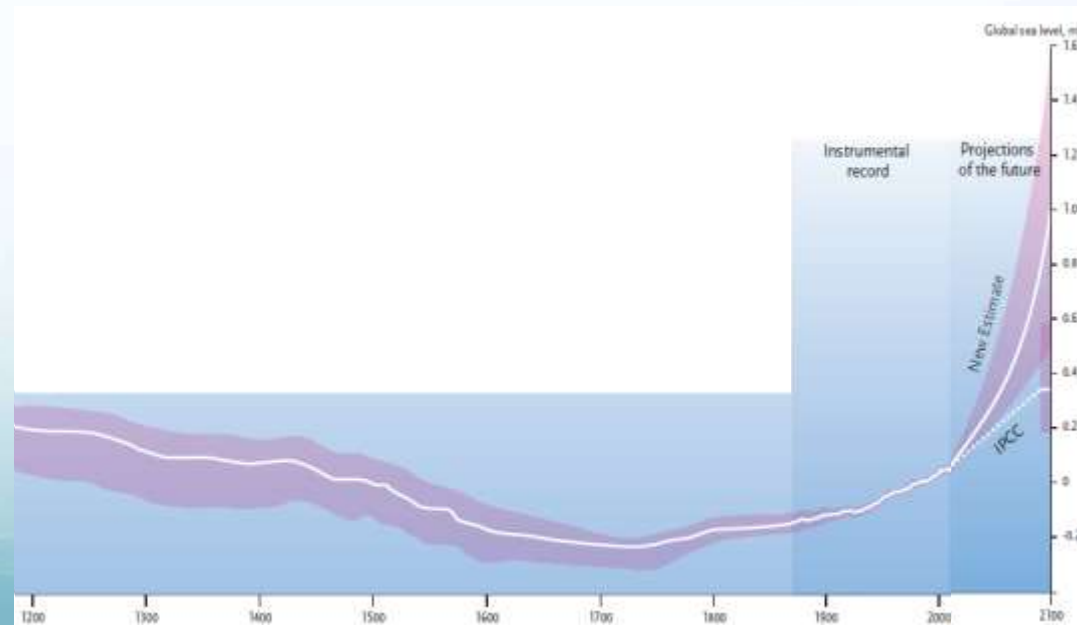
Massachusetts

Coastal Storms

Floods

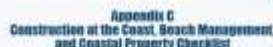
Drought/Extreme Heat

Sea-Level Rise





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It may be a natural property, namely, it's impossible to confirm the theorem *premises* themselves. Mathematics' theorems are all the premises (and not assumptions) of living in the world. Most properties that the mathematics-related facts mention, and other ones are *unrelated* to natural facts such as moving, moving, as well as, and, finally, *negation* seems should be *unrelated* to premises and other special *not* items in the same. Some basic mathematical facts included in this section.

significance contributed to the reduced frequency of transgenic 'super-PHARL' and 'super-PRG' events after various control breeding lines were crossed with these genotypes. The reduced frequency of transgenic events was also observed in the progenies of the 'super-PRG' and 'super-PHARL' control lines, which had reduced transgenic growth potential, with the same amount of transformation as the progenies from the control lines. It is likely that the reduced frequency of transgenic events in the progenies of the control lines is due to the reduced frequency of transgenic events in the control lines. The reduced frequency of transgenic events in the control lines is likely due to the reduced frequency of transgenic events in the control lines. The reduced frequency of transgenic events in the control lines is likely due to the reduced frequency of transgenic events in the control lines.

Additional content: content that enhances and facilitates learning, possibly by offering relevant literature, general educational content, or content, including various United States University Program Technical Solutions (see www.usu.edu/Programs/TechnicalSolutions).

CPD&A-0001: International National Commission on Global Health: Building on Strength and Best Practices (CPD&A-0001). Lead: Jeffrey A. Gerber (USU/Colorado) (CPD&A-0001). World Health Organization (WHO) (CPD&A-0001). Lead: Jeffrey A. Gerber (USU/Colorado) (CPD&A-0001). World Health Organization (WHO) (CPD&A-0001). Lead: Jeffrey A. Gerber (USU/Colorado) (CPD&A-0001).

[illegible]

The research, management, and implementation processes in these systems have generally progressed from building systems designed to protect buildings in small and isolated to systems that protect and enhance the overall health of communities, even those systems, in fact, not constructed.



- ❑ Support mapping and assessment for resources and explore if resources
- ❑ Check whether there is existing strategies. If none, generate an idea of solution.
- ❑ Support assessment of strategy designs in physical world or process models and system.
 - Consider of large models and design regularly present with well-validated components and models with proper accounting structure
- ❑ Analyze more of design and hardware are needed and to require integrated
- ❑ Support system hardware system.
- ❑ Support assessment of chemical models and supporting phenomena.
 - Use various data sources available to the supporting system.

Received 12 June 2002; accepted 12 July 2002

- 2) **Reflexes** are **involuntary** responses to stimuli that can be initiated by sensory stimuli (e.g. tickle, heat, touch, light, sound, smell, taste, pain, etc.)
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More 2-1-1 offices will be opened during a week.
By phone-dial 211 (similar to 911)
<http://www.nyc111.com/>

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MEMA Region 2
Maddalena, Euse, and Sallusti: (972) 338-1300

MEMA Region 2
Stammbley, Bryant, Dolan, Norment, Nyeble, and Pymond: (930) 427-0400

MEMA Region 2/FL
Berkshire, Brink, Hargrave, Hargrave, and Wimsor: (413) 750-1400

MEMA Headquarters: (930) 435-2000
<http://www.mesa.gov/tenet>
www.tenet.com/MEMA
www.fairfield.com/fairfieldmemam

Massachusetts Department of Transportation (MassDOT)
617-421-6828
www.massdot.state.ma.us
www.twitter.com/MassDOT (Twitter feed)

Massachusetts Executive Office of Public Safety and Security
603-727-7779
www.mass.gov/eopss

800-775-1540 Cape Cod and Islands
 978-577-3130 Central MA
 617-734-6500 Eastern MA
 078-922-2224 Northeast MA
www.maforsale.com

Federal Emergency Management Agency (FEMA)
200-671-1981 (FEMA) (1802)
www.fema.gov

Utilities Contact:
National Grid - electricity 1-800-485-1212, gas 1-800-244-4121
SNTUR - 1-800-587-3000



When an emergency situation requires shelter across through local radio and television stations, law enforcement, Mass 311 (calling 311 from any land line phone), and other select specific shelters are available for the evacuation group will come.

Shelter planning in Massachusetts is a collaborative effort by volunteer parents. Communities, if able and if the shelter is for their residents. Due to recent events experienced in their own culture of shelter supplies and expenses contact your local Emergency Management Committee can find your local shelter. Depending on the event Emergency Management Agency officials, working with open Regional Shelters in impacted areas. These funds and the geographical areas which are impacted. They are neighborhoods, and serve multiple communities. The local emergency services to assist, as officials need to determine how best to respond to the needs of the community.

If you are advised to evacuate, try to keep family records, your evacuation kit, including important papers. It is an evacuation kit with you because food, you, blankets, are immediately available. All Manchurian community provide sufficient shelter space for evacuated persons.

If you plan to seek a hotel or motel as your shelter in Moscow, make sure the hotel or motel is open and open to fill up quickly when a hurricane is posing a threat to the

Préparez à l'avance les points de discussion que vous devez soulever. Mettez vos idées sur papier.

Remember that shelters may be opened selectively at the store. Should no vaccination become necessary on television station or go to www.aidsinfo.nih.gov, or call 211 for more information on the situation.



General Business Units

Bath as diabetic, low salt, liquid diet, and baby food and formula. Food and water are provided in shelter, but if a special diet is required, you should bring these foods with you.

Children and families

One surprising change of clothing including: sleeping bag, blanket, and pillow
 lots for adults, as you may not be needed!! Hair, soap and toothbrush.

Thermal stability

Wickelisch, small insect, soap, medicinal, medicinal, sensory aspects, tangens, paper
small, white, white, white, etc.

Medications: Insulin and aspirin.

Bring a three- to five-day supply of medications that is clearly marked with your name, dosage, type of medication, and prescribing physician. You must be able to take all medications by yourself. Eat and live as a normal person.

Hakea serotina

Clethrionomys glareolus, *Peromyscus leucopus*, *Rattus norvegicus*, *Sorex araneus*

Experimental design

Name and address of donor. Name and address of interest relative not living in area.
Identification and valuable papers.

Statistical analysis

Games, cards, toys, battery-powered radio, flashlight (no candles or incense)
 *Smoking or other open flames are not permitted.

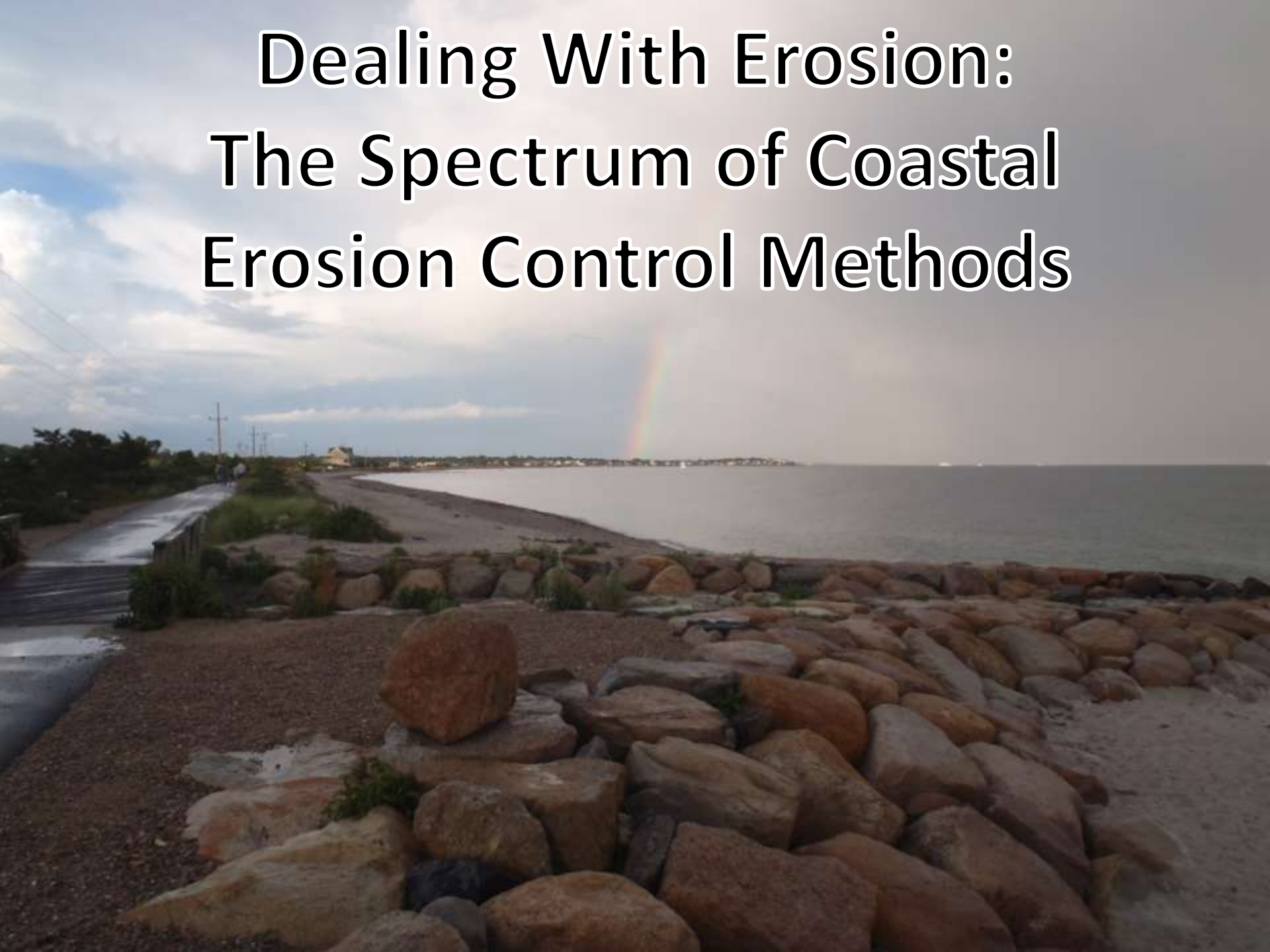
Be aware that some shelters will only allow service animals. Depending on the type of disaster, animal shelters may be set up where possible. Pet-friendly shelters will be noted when shelter locations are announced during an evacuation. Pets will be restricted to the pet section of the shelter, and visitors will not be allowed to bring pets into general evacuation areas.

Pets should have ID tags, and be sure that your pet's license and vaccinations are current. A pet supply kit should include items such as bowls, food, medications, bedding, waste disposal bags, and grooming tools, and never leave them alone.

Discussion

- + NO alcoholic beverages or weapons are allowed
- + Take a bath and eat before you leave home
- + Register immediately upon entering the school
- + Obey staff's rules
- + Know the building exits and security

Dealing With Erosion: The Spectrum of Coastal Erosion Control Methods



- **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

March 2013



May 2013



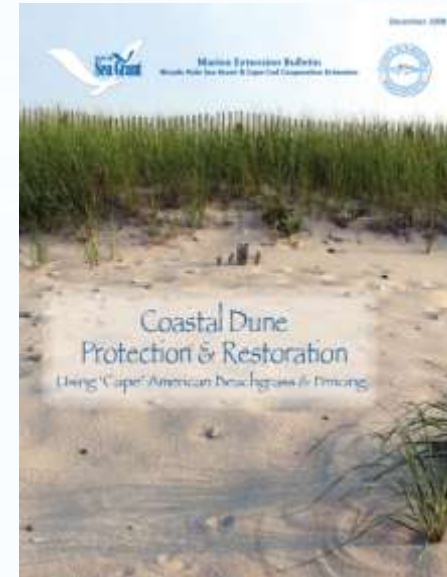
Photo Credit: Ann McNichol

- Do nothing
- Vegetation



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**



- Do nothing
- Vegetation
- Re-grade
- **Managed retreat**



V
E
R
T
I
C
A
L



- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- **Beach nourishment = Fill of a CRA**



Photo Credit: Ted Keon

Sacrificial



Cobble (Mixed)

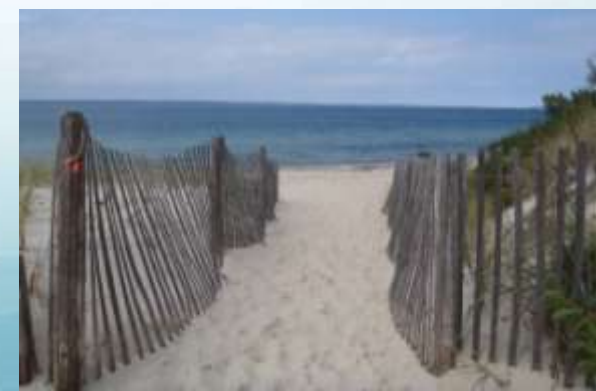


Photo Credit: CZM

- 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**



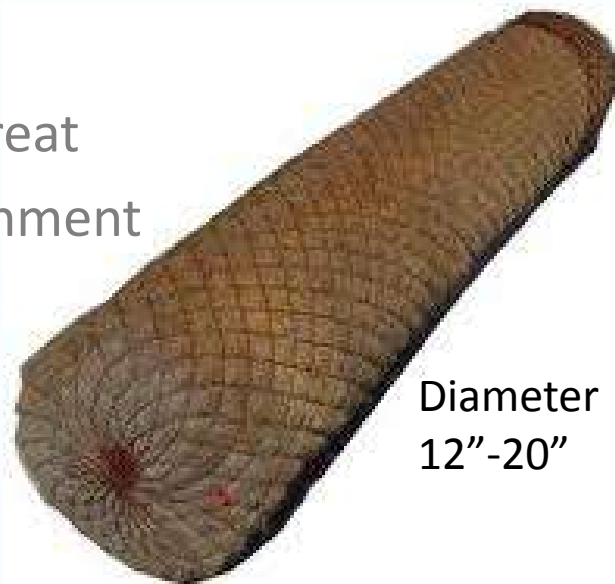
- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- Beach nourishment
- **Sand fencing**



- 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**



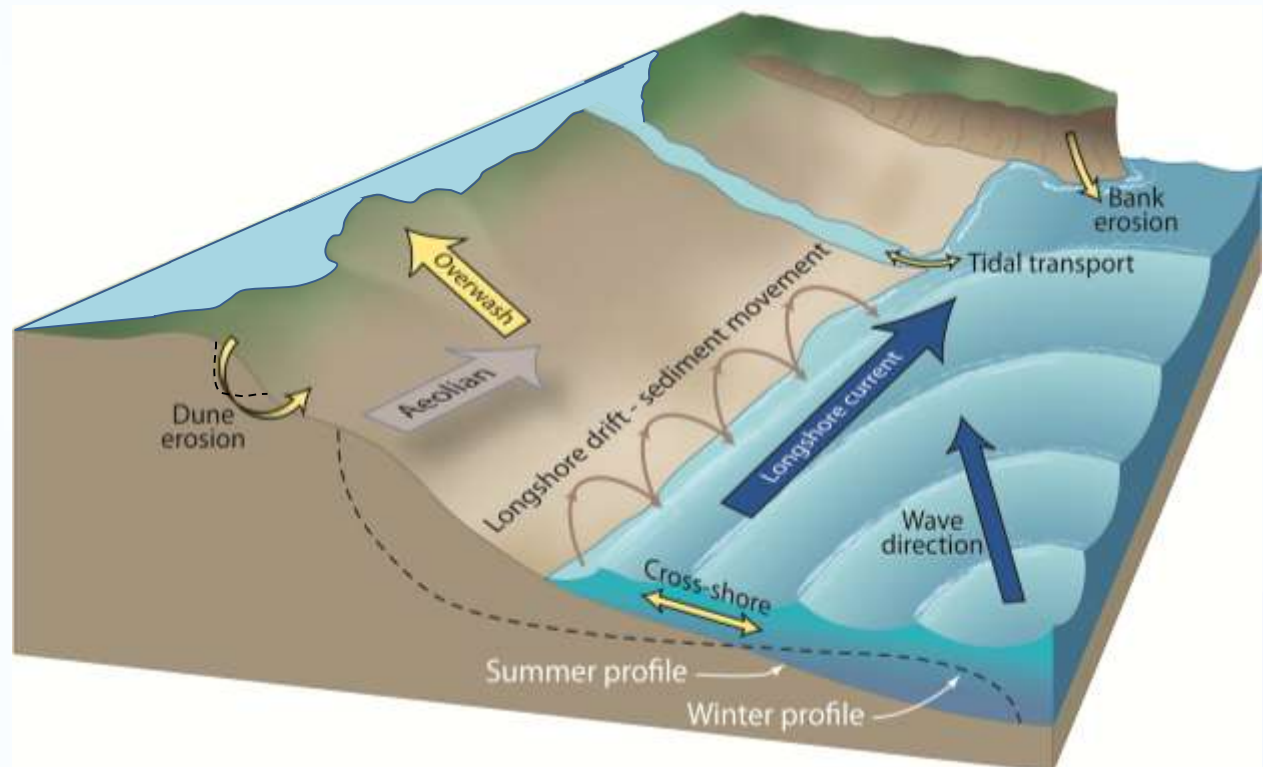
- Do nothing
- Vegetation
- Re-grade
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- Sand fencing
- Fiber rolls
- **Coir Envelopes**



- Do nothing
- Vegetation
- Re-grade
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- **Coir Envelopes**



- Do nothing
- Vegetation
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- Coir Envelopes

C E S

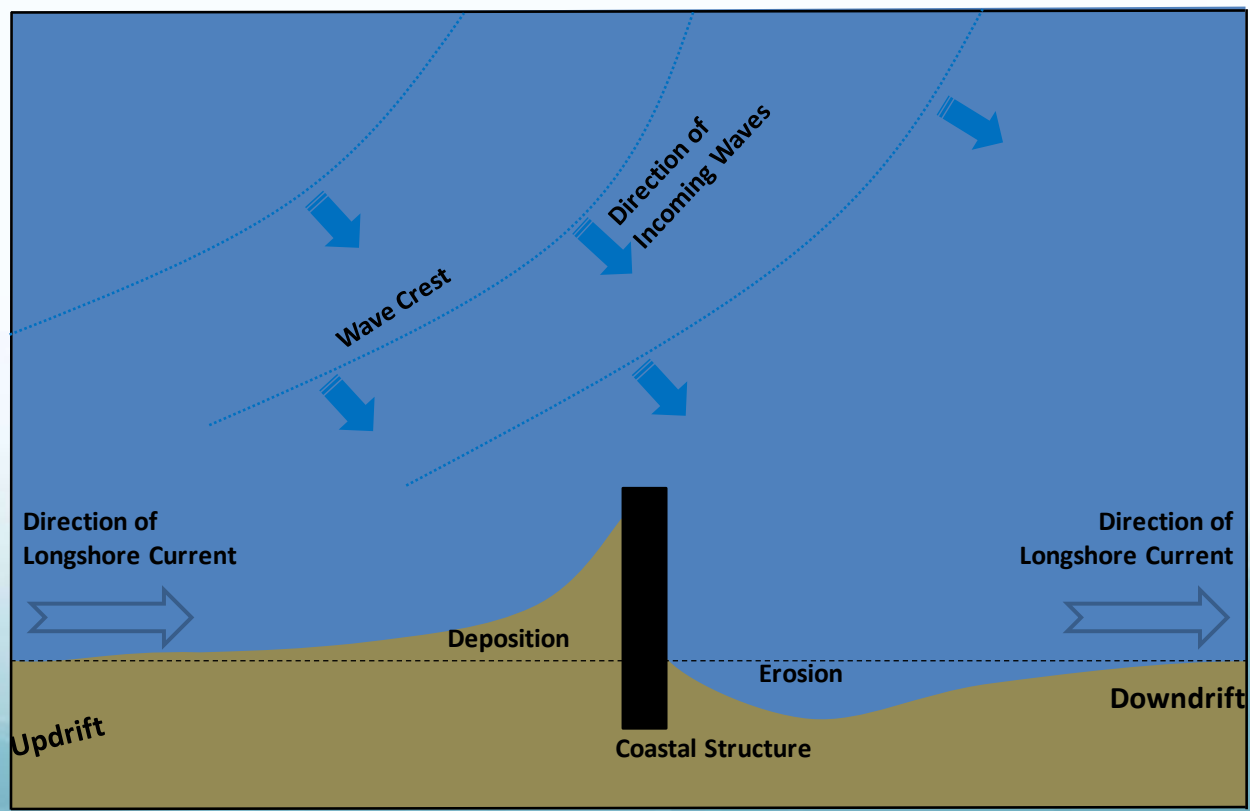
WPA: Coastal engineering structure means, but is not limited to, any breakwater, bulkhead, groin, jetty, revetment, seawall, weir, riprap or any other structure that is designed to **alter wave, tidal or sediment transport processes** in order to protect inland or upland structures from the effects of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

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

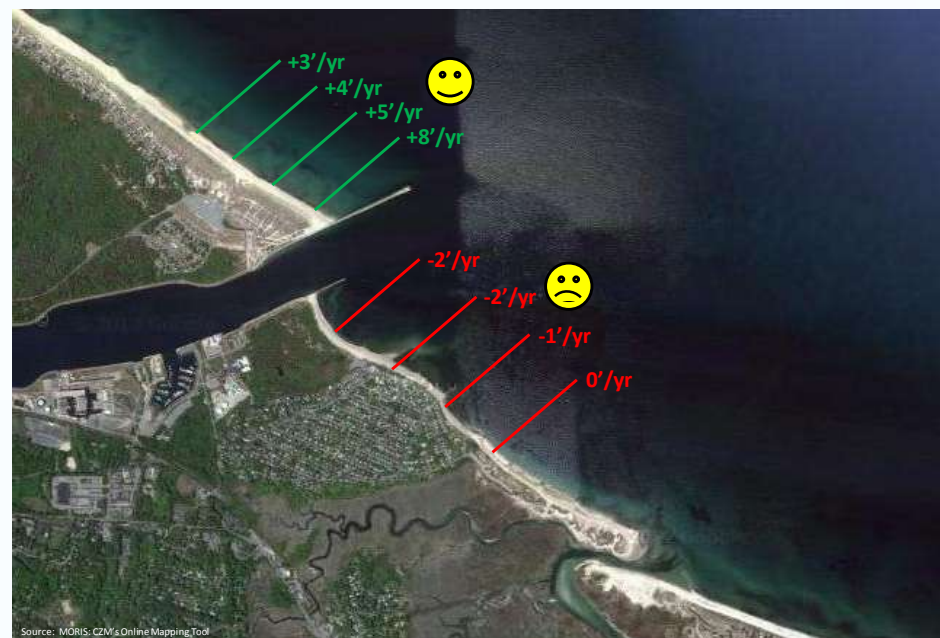


C E S

- **Groin**



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



C E S

- Groin



- Jetty

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



C E S

- Groin
- Jetty

Sand Bags



- Do nothing
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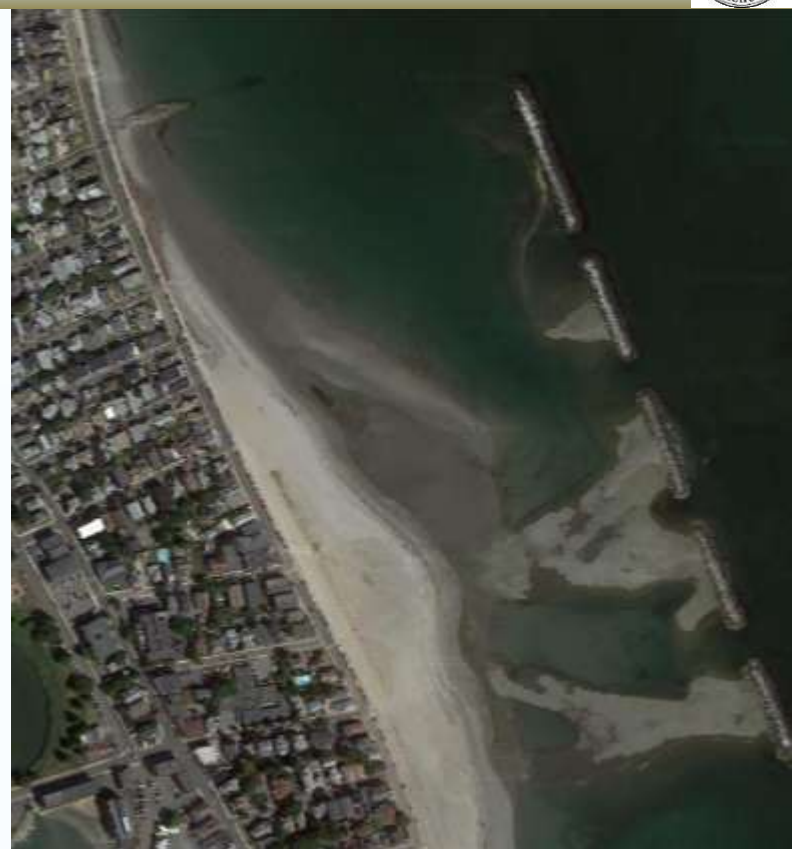
Gabion (10-20 yrs)

C E S

- Groin
- Sand Bags
- **Gabion**
- Jetty



- Do nothing
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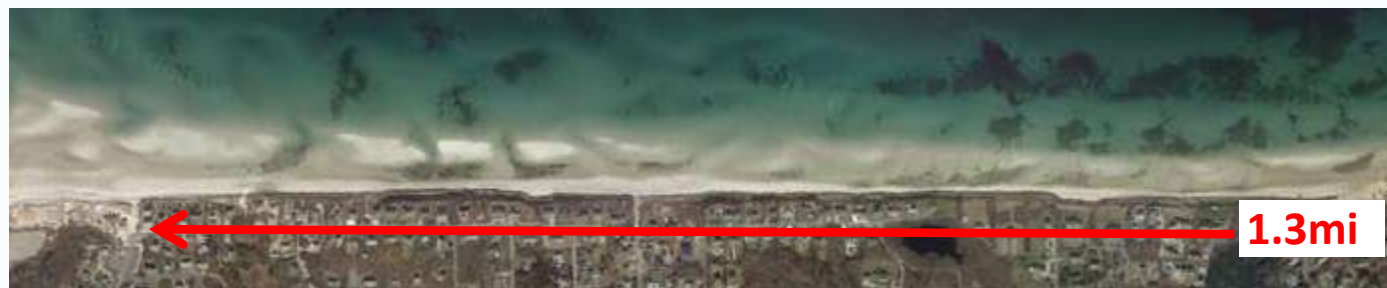


C E S

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



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



1.3mi

C E S

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



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



C E S

- | | |
|---------|------------------|
| • Groin | • Sand Bags |
| | • Gabion |
| | • Breakwater |
| | • Revetment |
| • Jetty | • Seawall |



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



C E S

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



- ~~Do nothing~~
- ~~Vegetation~~
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How the “Spectrum” could be used:

Notice of Intent (NOI) →→→→ Alternative Analysis

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

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Massachusetts Department of Environmental Protection
Bureau of Watershed Protection - Wetlands
WPA Form 3 - Notice of Intent
MASSACHUSETTS WETLANDS PROTECTION ACT 91A G.L.C. 121 §40

PROJECT INFORMATION

1. Project Location: (Include address, map or other location to locate project area)

2. Project Description: (Include a brief description of the project, including the location and purpose of the project)

3. Applicant Information: (Include the name and address of the applicant, and the name and address of the project manager)

4. Project Justification: (Include a brief justification for the project, including the benefits to the community and the environment)

5. Project Impact: (Include a brief assessment of the potential impacts of the project on the wetlands and the surrounding environment)

6. Project Mitigation: (Include a brief description of the measures that will be taken to avoid, minimize, and compensate for the impacts of the project)

7. Project Monitoring: (Include a brief description of the measures that will be taken to monitor the project and its impacts)

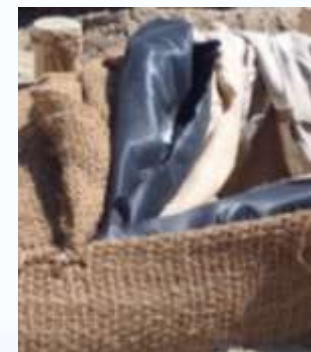
8. Project Closure: (Include a brief description of the measures that will be taken to close the project and restore the wetlands)

9. Project Significance: (Include a brief assessment of the significance of the project and its impacts)

10. Project Conclusion: (Include a brief conclusion of the project and its impacts)

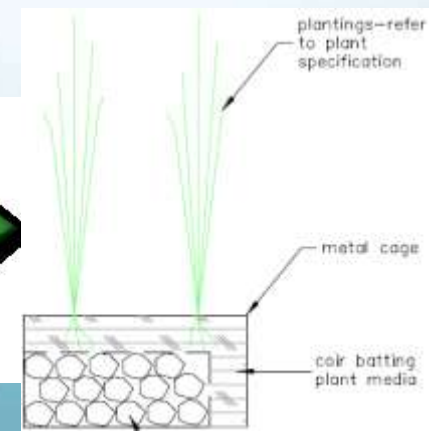
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- **Not a complete list**
(and methods are being invented/modified)



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- **With revetments...if neighbors don't do the same
then you'll have to keep extending return.**

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- **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.**

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Combination



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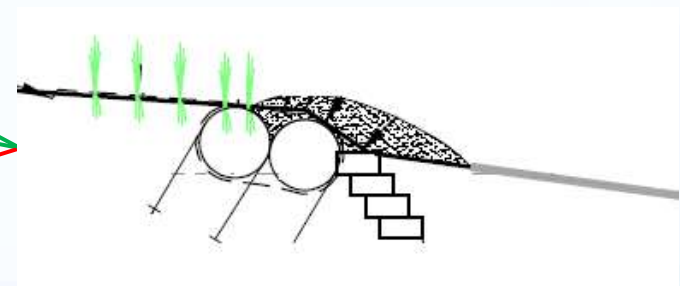


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Combination



↑ Resilience \neq ↓ Natural Systems

Thank you

