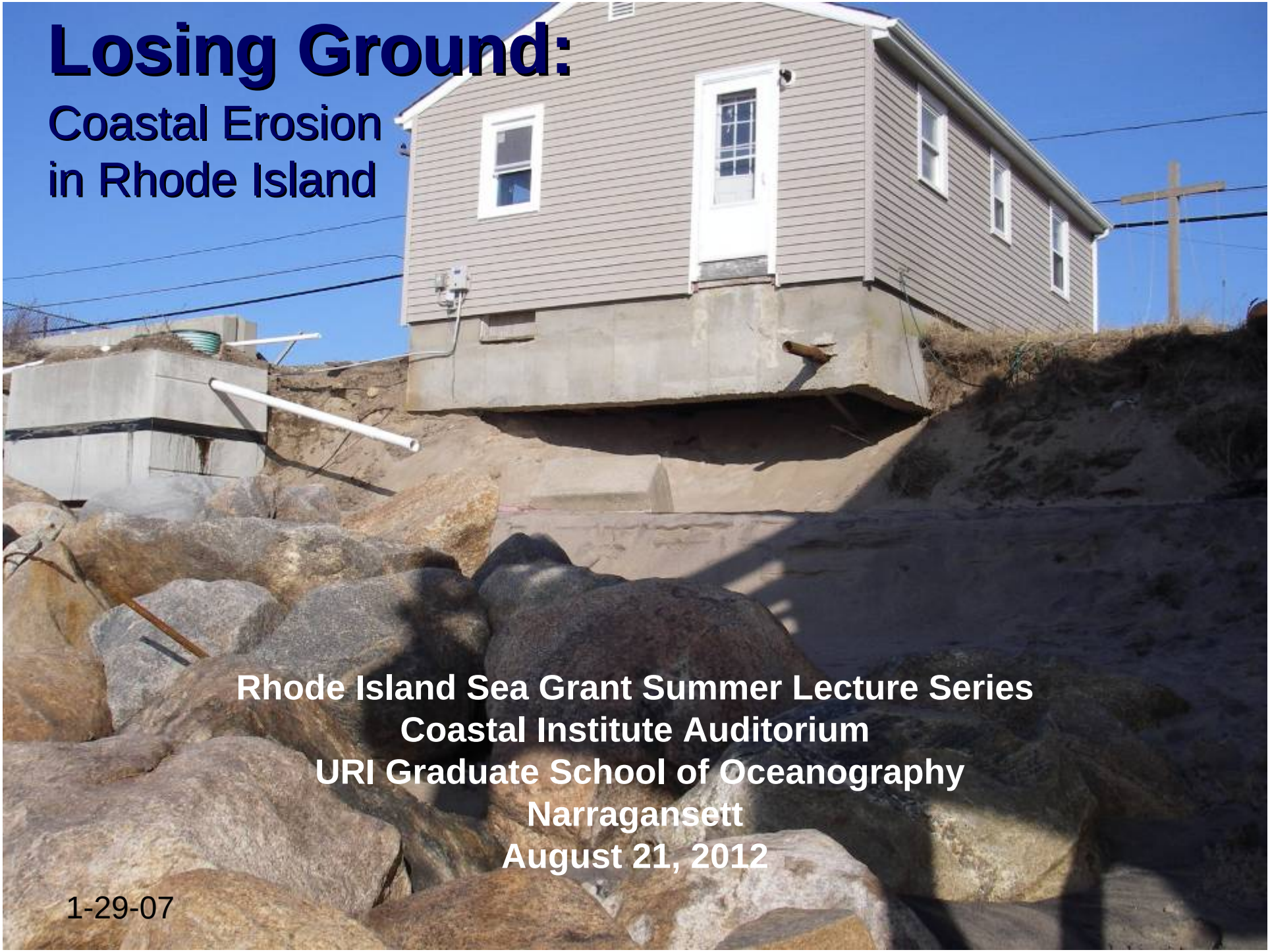
Losing Ground:

Coastal Erosion in Rhode Island



Rhode Island Sea Grant Summer Lecture Series
Coastal Institute Auditorium
URI Graduate School of Oceanography
Narragansett
August 21, 2012

1-29-07


1951 Aerial Photography
N
0
100
200
300
400
Feet
RIGIS
C R M C
JHF 4-9-12

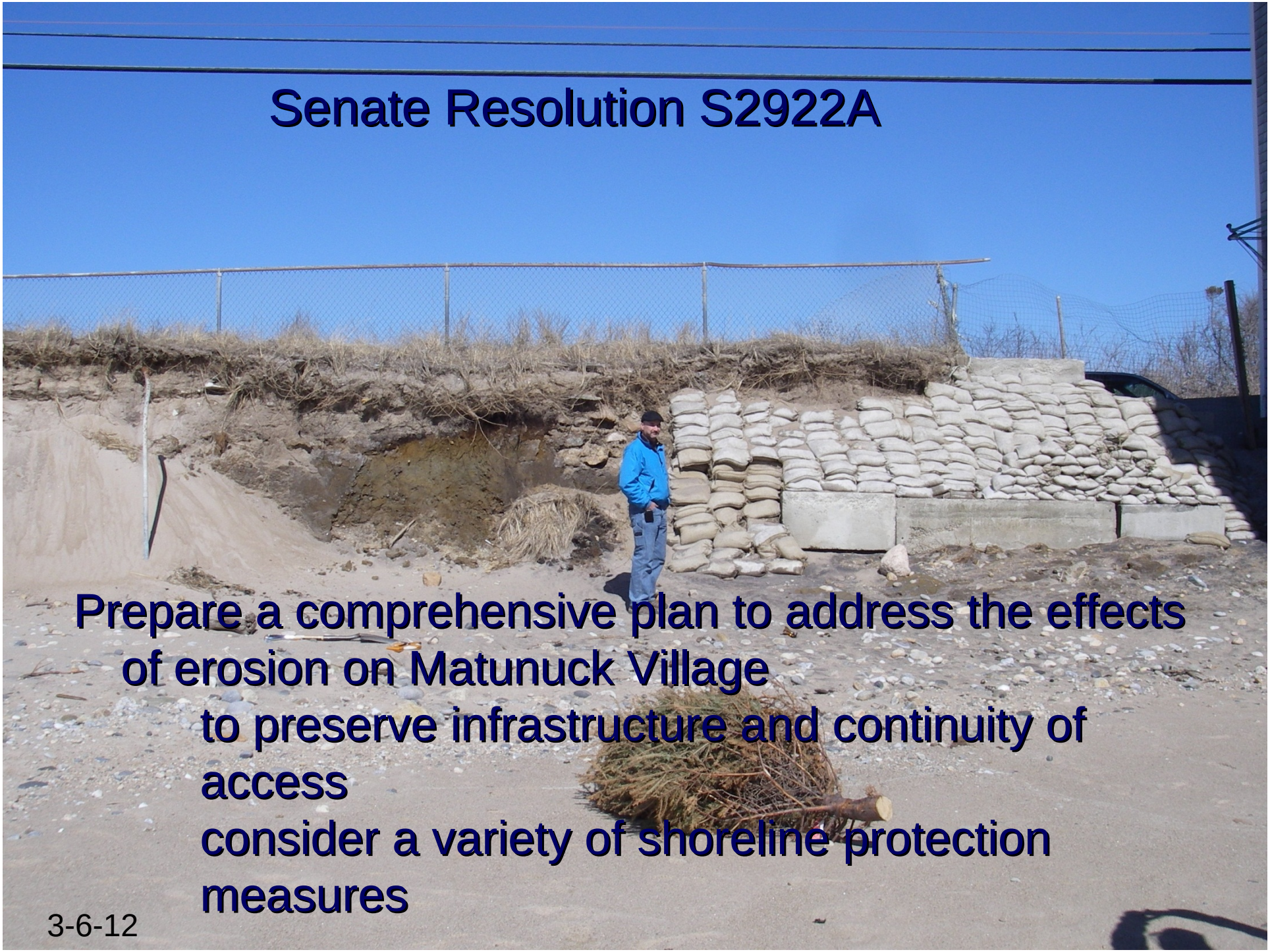

1985 Aerial Photography
N
0
100
200
300
400
Feet
RIGIS
C R M C
JHF 4-9-12


1997 Orthophotography
0 100 200 300 400
Feet
RIGIS
C R M C


2008 Aerial Photography
N
0 100 200 300 400
Feet
RIGIS
C R M C


2011 Orthophotography
N
0 100 200 300 400
Feet
RIGIS
C R M C

Senate Resolution S2922A



Prepare a comprehensive plan to address the effects of erosion on Matunuck Village

- to preserve infrastructure and continuity of access
- consider a variety of shoreline protection measures

Setbacks

Green Hill sometime between 1972 and 1981


April 16, 2007

2007

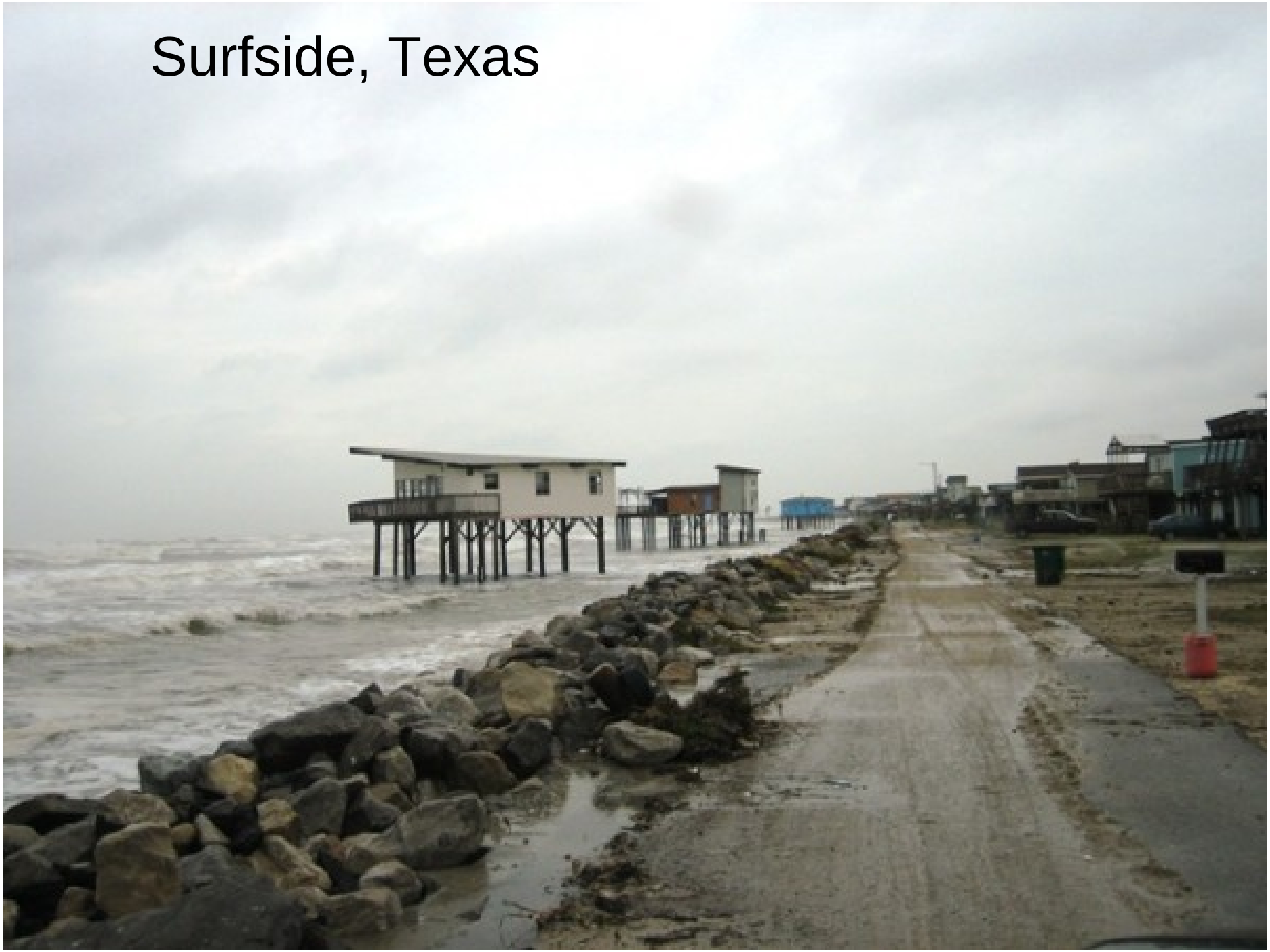
Retreat


2009

Saco, Maine after Patriots Day Storm 2007

Florida

Surfside, Texas

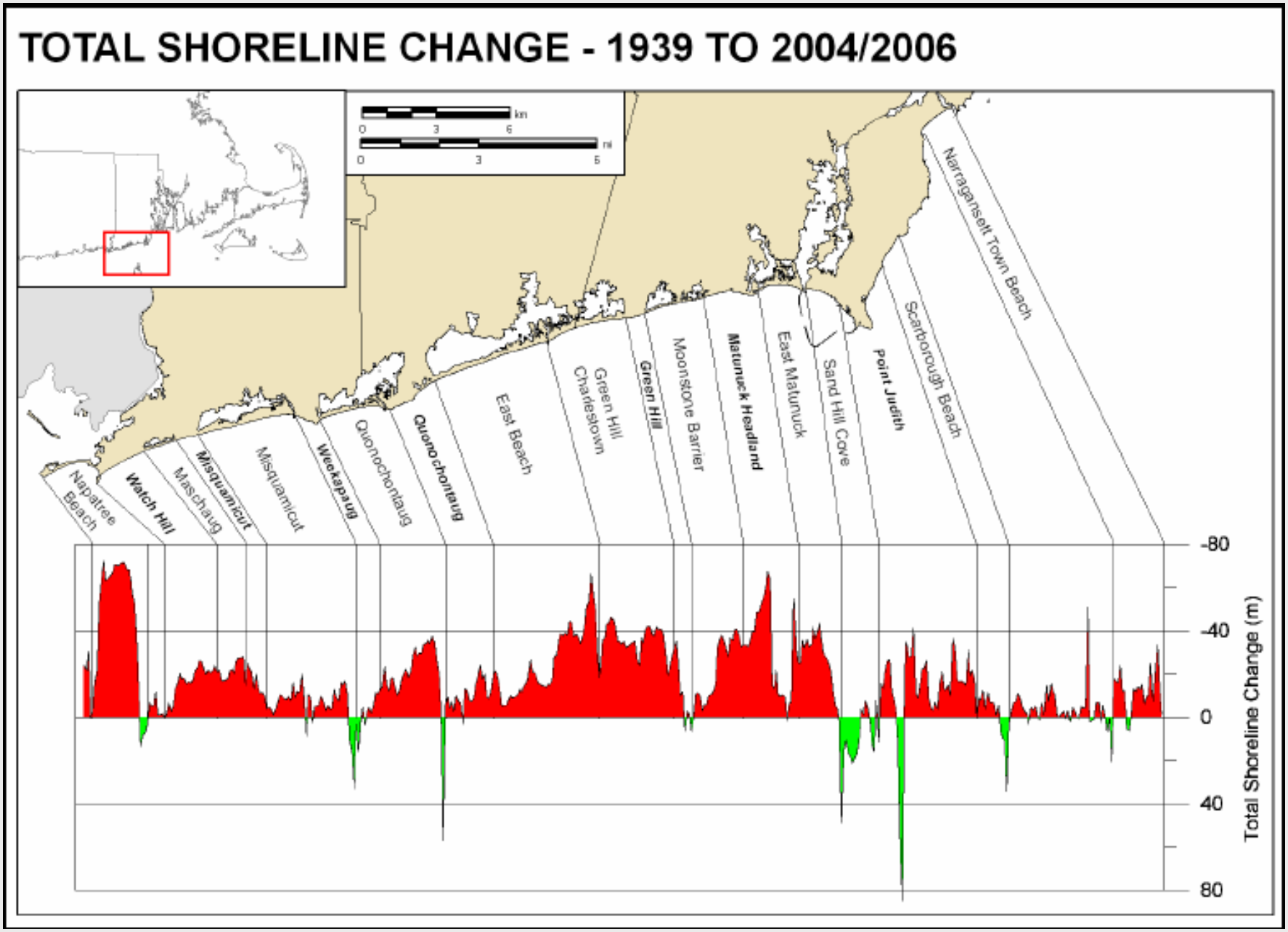


Bolivar Peninsula, Texas after Hurricane Ike

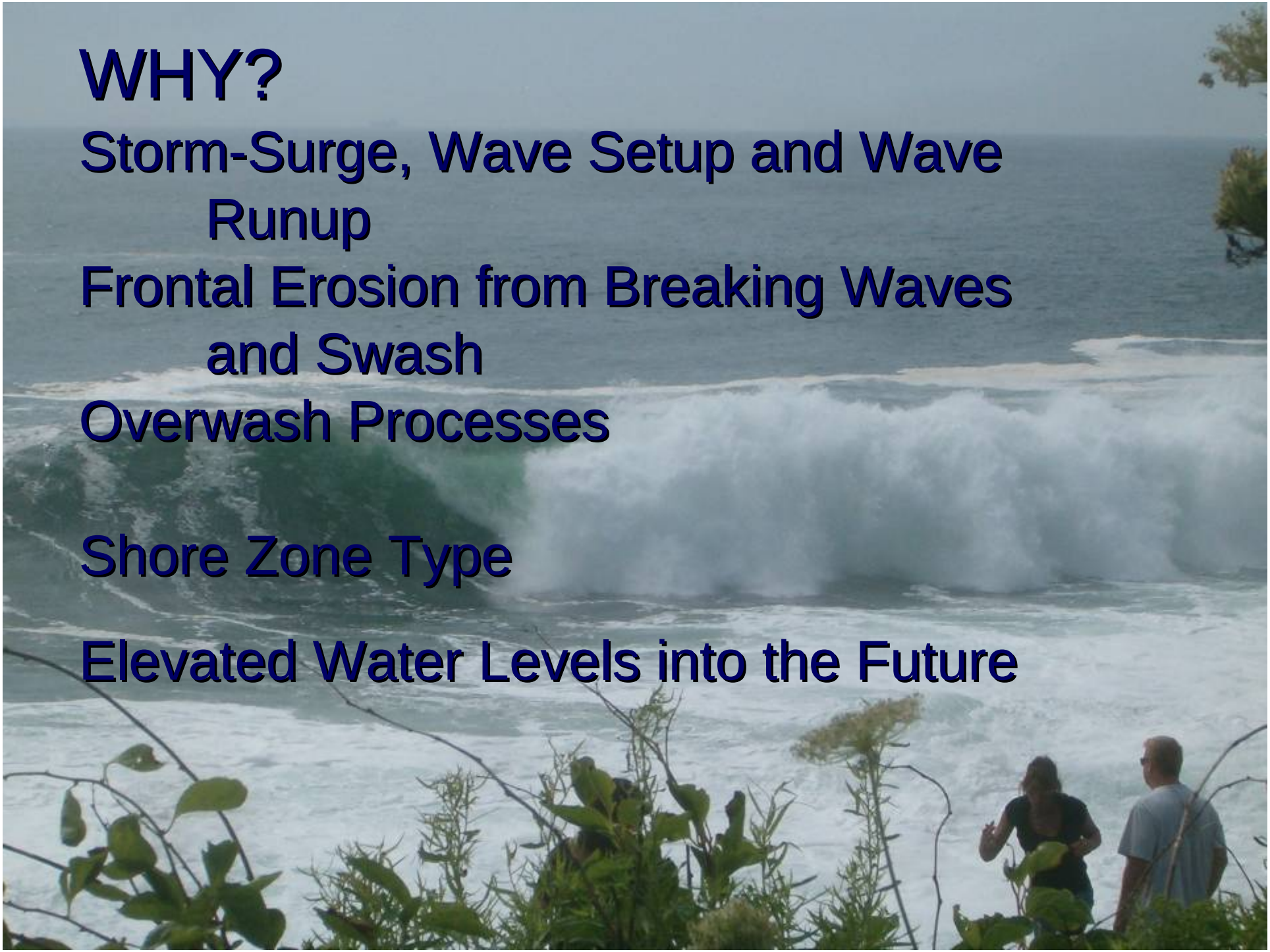
NOAA

Kingscliff, Australia

http://coastalcare.org/2010/08/kingscliff-battles-beach-erosion-australia/



Courtesy of Jon Boothroyd



WHY?

Storm-Surge, Wave Setup and Wave Runup

Frontal Erosion from Breaking Waves and Swash

Overwash Processes

Shore Zone Type

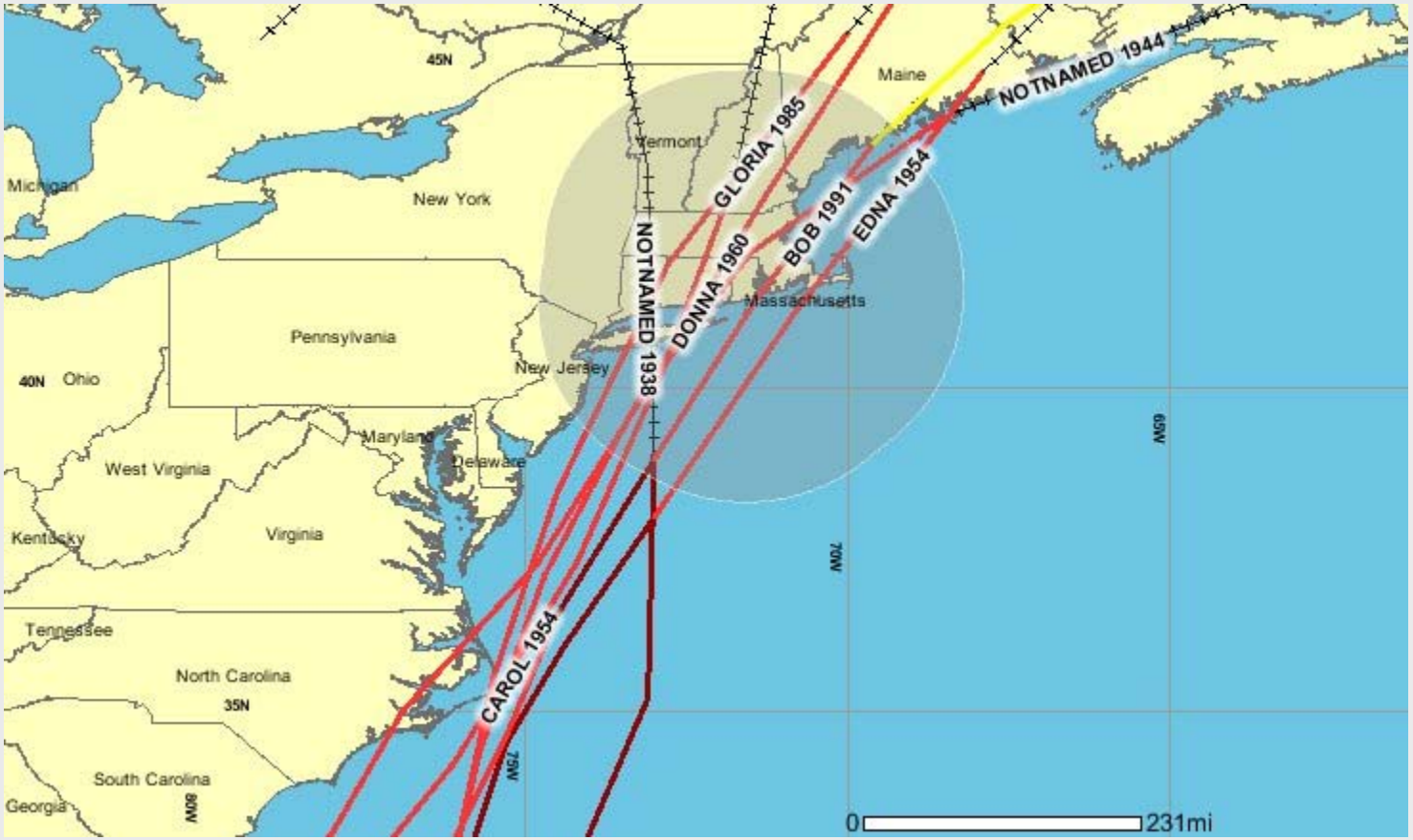
Elevated Water Levels into the Future

Erosion happens during storms!

Tropical Storms (hurricanes)
Extra-tropical storms (nor'easters)

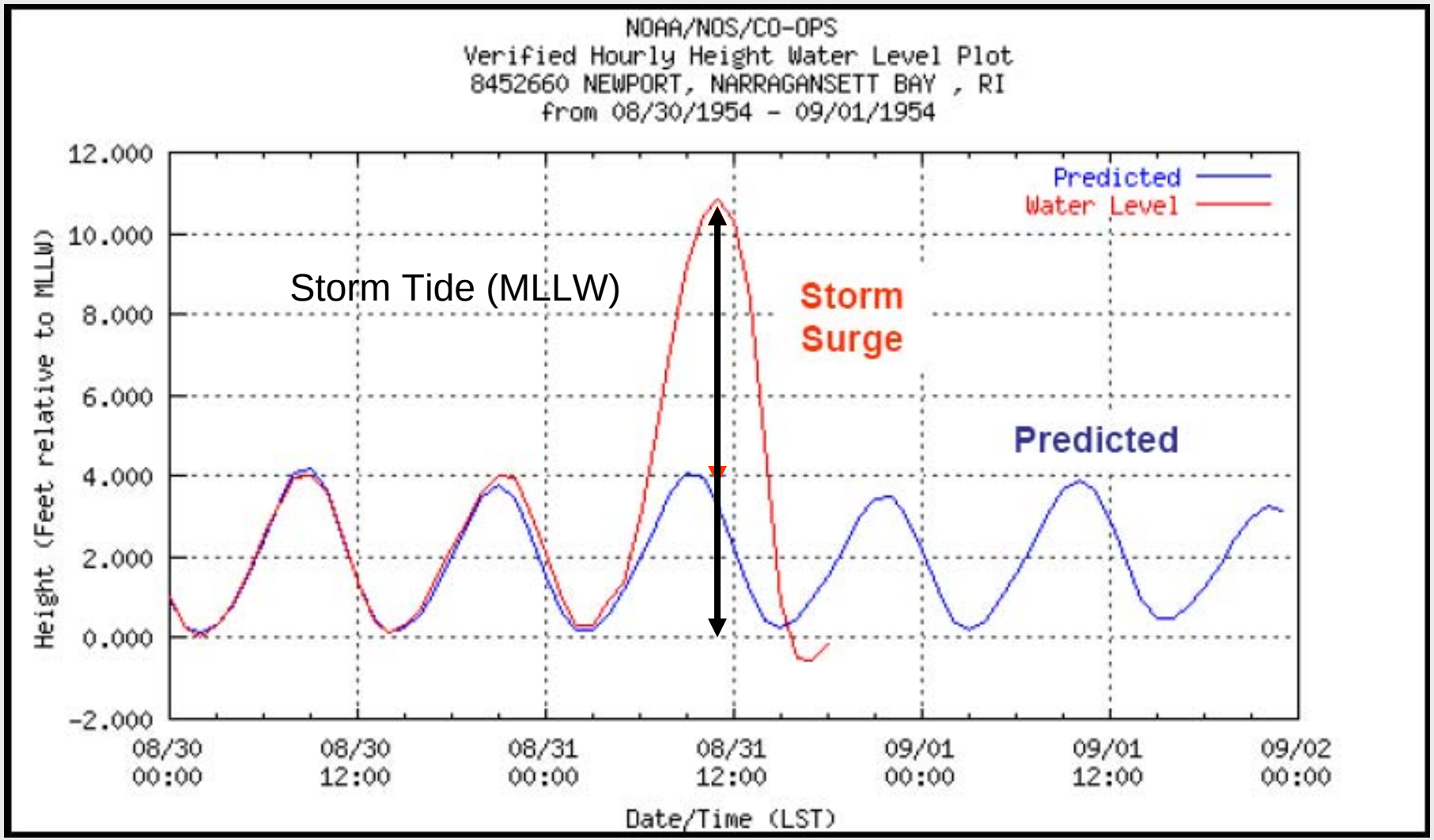
TS Irene

Category 2-5 Historic Hurricane Tracks 1850-2007



From: http://maps.csc.noaa.gov/hurricanes/viewer.html

Storm Tide is the combination of Storm Surge and astronomical tide

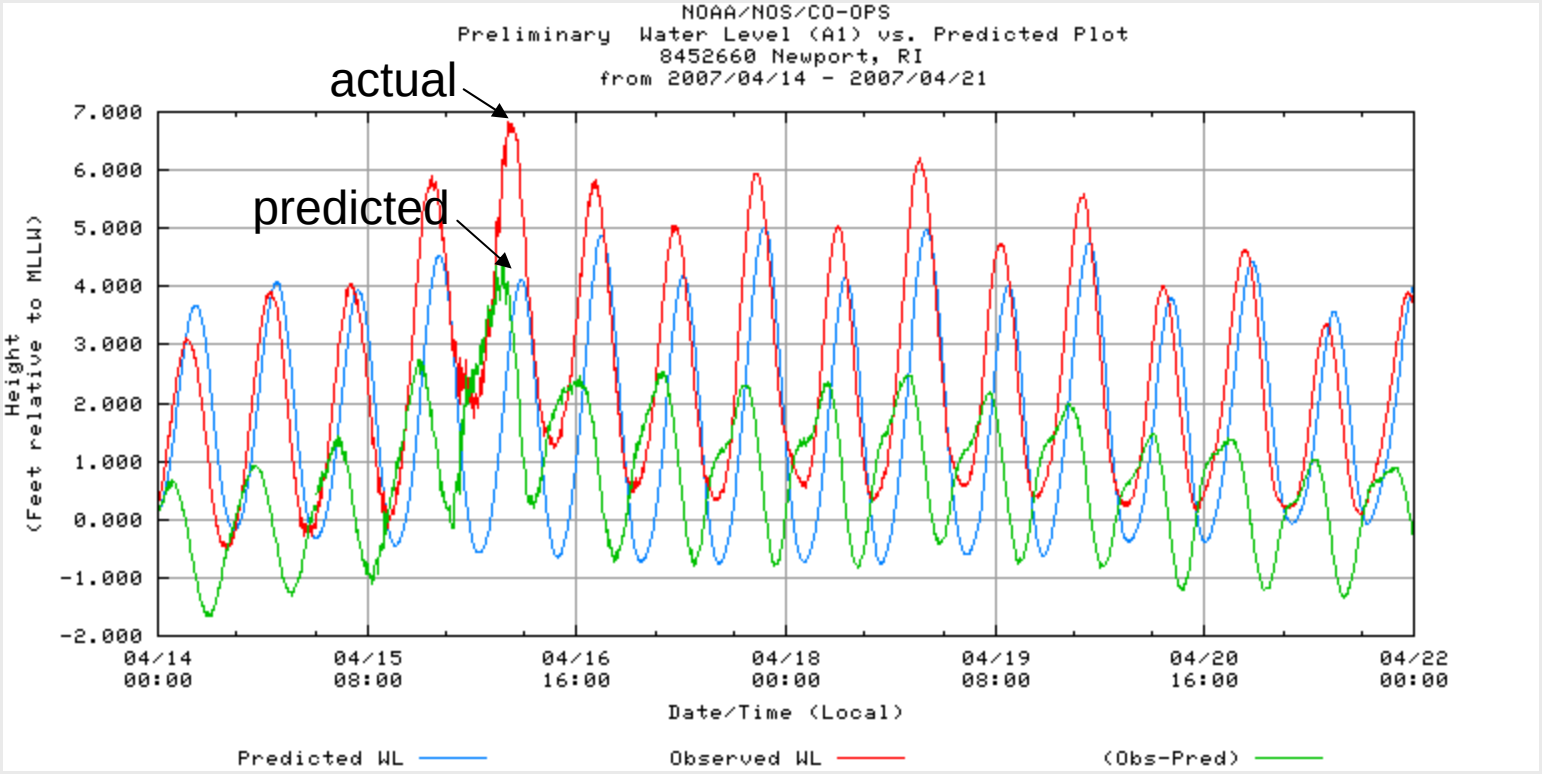


NOAA/NOS


NINIGRET
POND
EAST BEACH BARRIER
September 1938 Hurricane
3 Days After
Washover
Fan
Surge Channel
Chimney
Swash Bar
Road
Seawall
QUONOCHONTAUG

From: New England Hurricane, Written and Compiled by Members of the Federal Writers Project of the Works Progress Administration, 1938

Storm Surge Overwash


NOAA/NOS/CO-OPS
Preliminary Water Level (A1) vs. Predicted Plot
8452660 Newport, RI
from 2007/04/14 - 2007/04/21
actual
predicted
Height
(Feet relative to MLLW)
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
-1.000
-2.000
04/14
00:00
04/15
08:00
04/16
16:00
04/18
00:00
04/19
08:00
04/20
16:00
04/22
00:00
Date/Time (Local)
Predicted WL
Observed WL
(Obs-Pred)

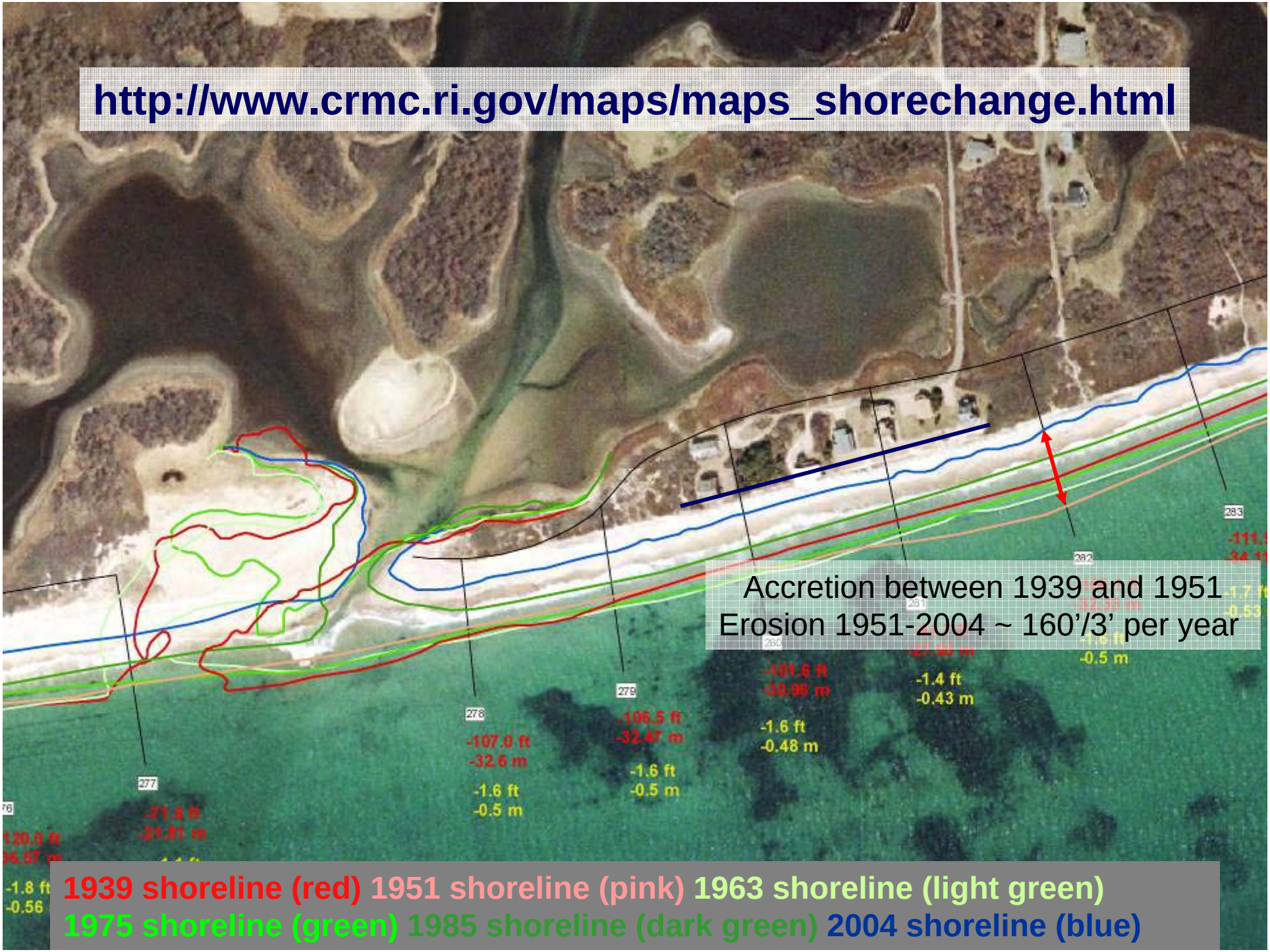

C R M C
COASTAL RESOURCES MANAGEMENT COUNCIL


C R M C
COASTAL RESOURCES MANAGEMENT COUNCIL


C R M C
COASTAL RESOURCES MANAGEMENT COUNCIL

Frontal Erosion

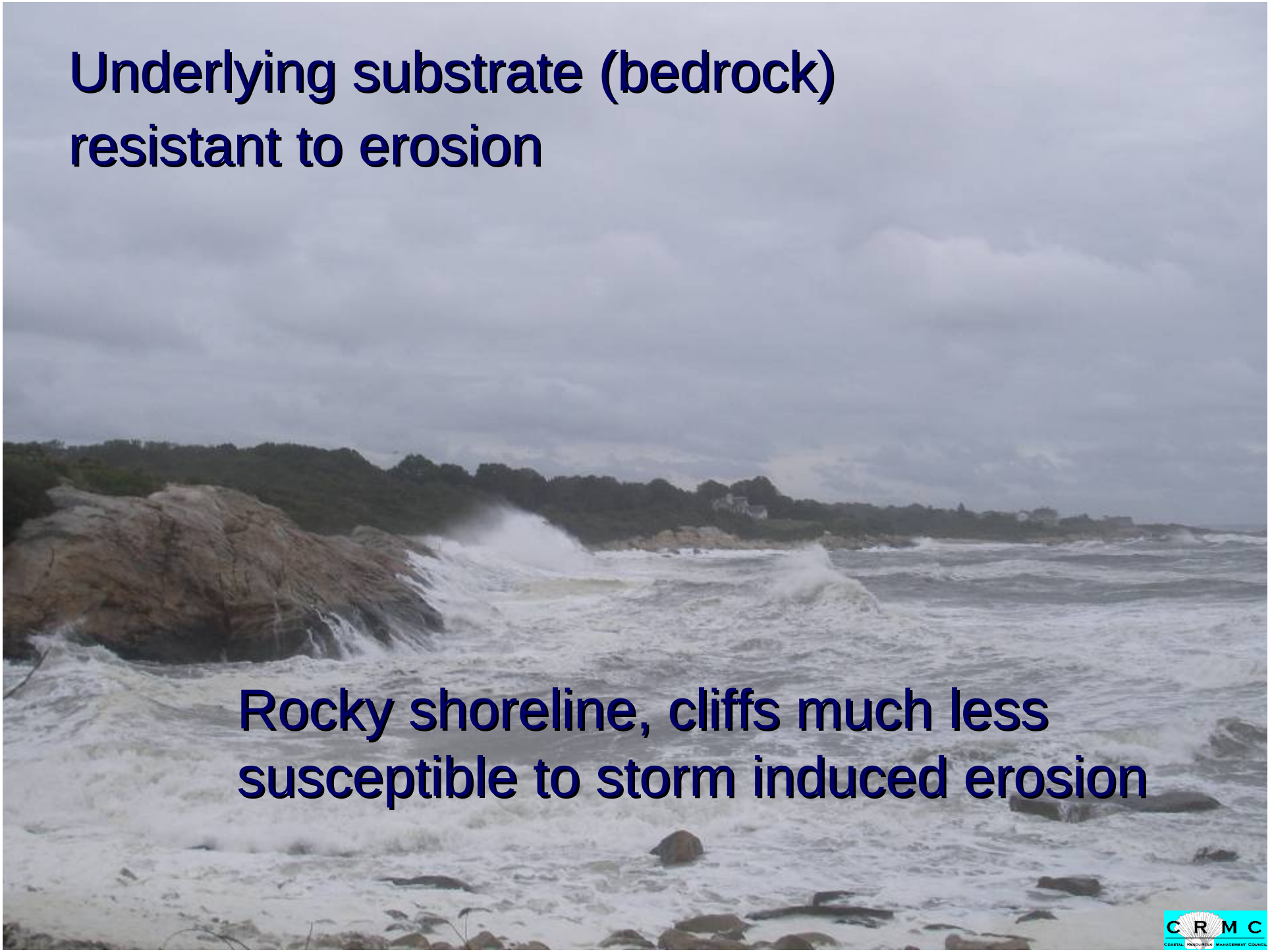
“Soft” Erosion Control


http://www.crmc.ri.gov/maps/maps_shorechange.html
Accretion between 1939 and 1951
Erosion 1951-2004 ~ 160'/3' per year
1939 shoreline (red) 1951 shoreline (pink) 1963 shoreline (light green)
1975 shoreline (green) 1985 shoreline (dark green) 2004 shoreline (blue)

GEOLOGIC SHORE ZONE TYPES

Shoreline Type	Length Coast		% Coast
	km	mi	
Beach plain and barrier spit	95	59	22
Stratified glacial material bluff	34	21	8
Till bluff	98	61	23
Metamorphosed sedimentary bedrock	40	25	9
Igneous and other meta bedrock	22	14	5
Discontinuous bedrock	10	6	2
Shoreline protection structure	125	78	30

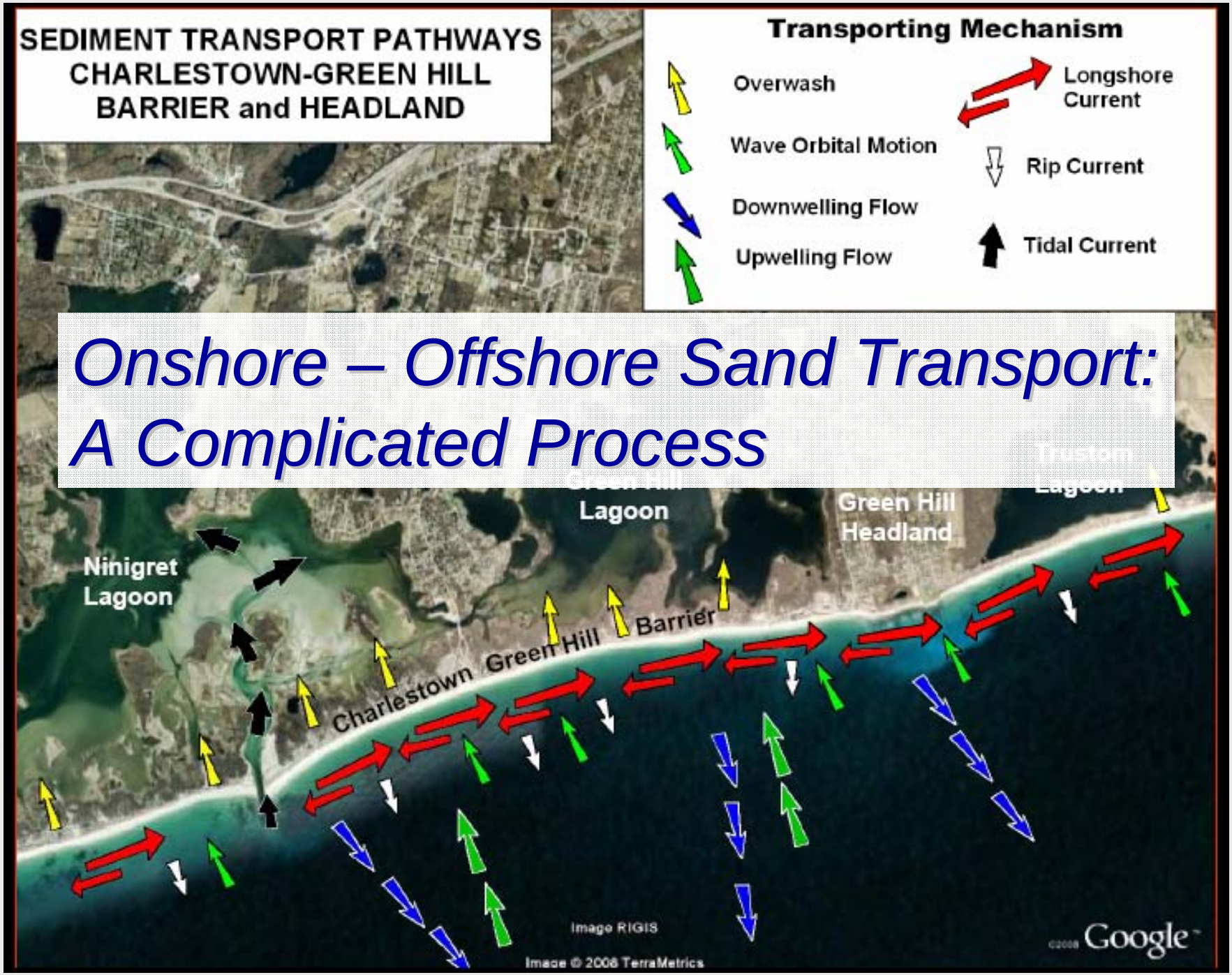
Boothroyd and Al-Saud, 1978; Hehre, 2007

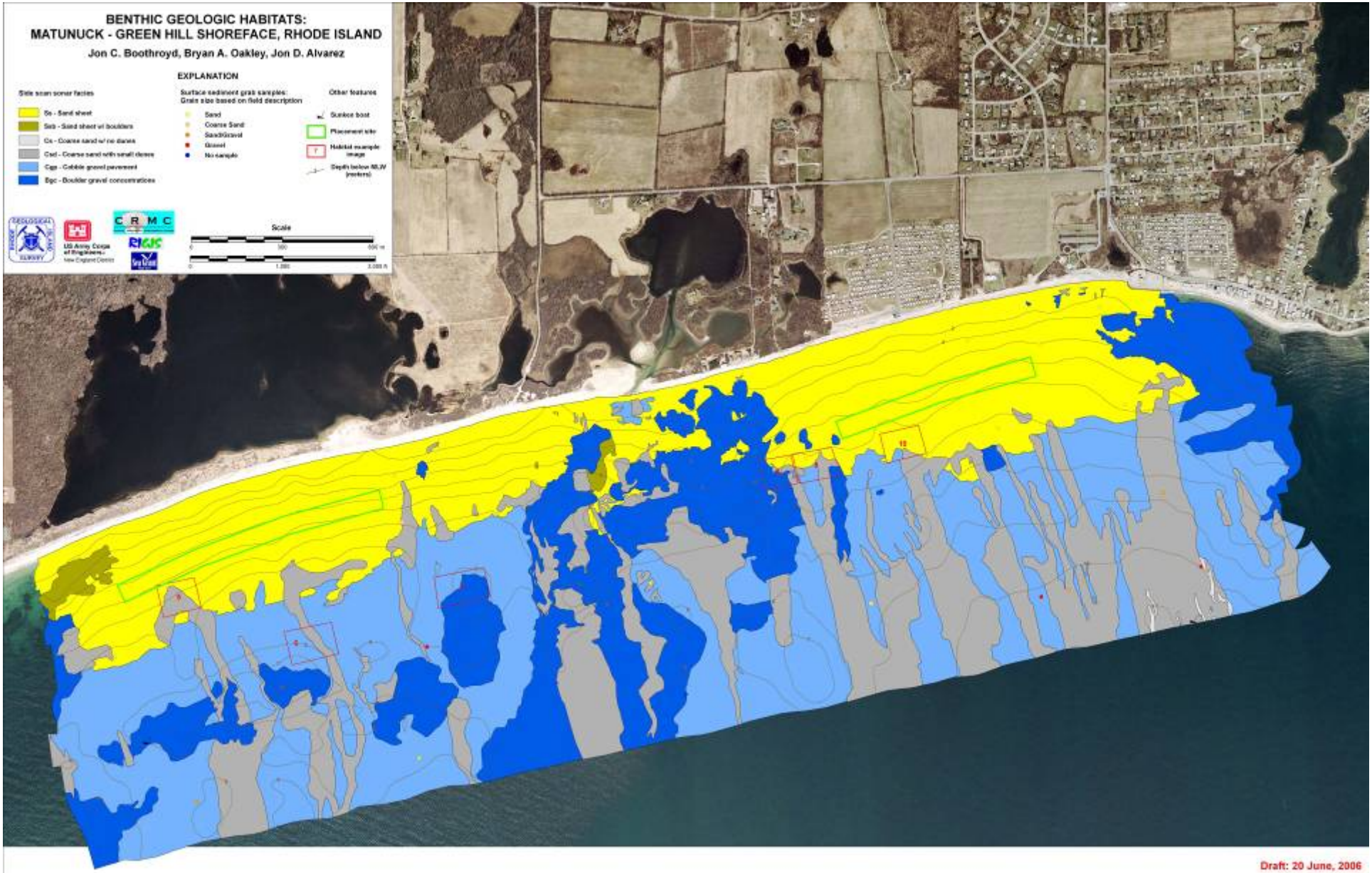

Underlying substrate (bedrock) resistant to erosion
Rocky shoreline, cliffs much less susceptible to storm induced erosion

Sediment type


Slump block


Slump block


SEDIMENT TRANSPORT PATHWAYS
CHARLESTOWN-GREEN HILL
BARRIER and HEADLAND
Transporting Mechanism
Overwash
Longshore Current
Wave Orbital Motion
Rip Current
Downwelling Flow
Tidal Current
Upwelling Flow
Onshore – Offshore Sand Transport:
A Complicated Process
Lagoon
Green Hill Headland
Ninigret Lagoon
Charlestown Green Hill Barrier
Image RIGIS
Image © 2008 TerraMetrics
Google


BENTHIC GEOLOGIC HABITATS:
MATUNUCK - GREEN HILL SHOREFACE, RHODE ISLAND
Jon C. Boothroyd, Bryan A. Oakley, Jon D. Alvarez
EXPLANATION
Side scan sonar facies
Surface sediment grab samples:
Grain size based on field description
Other features
Scale
Draft: 20 June, 2006

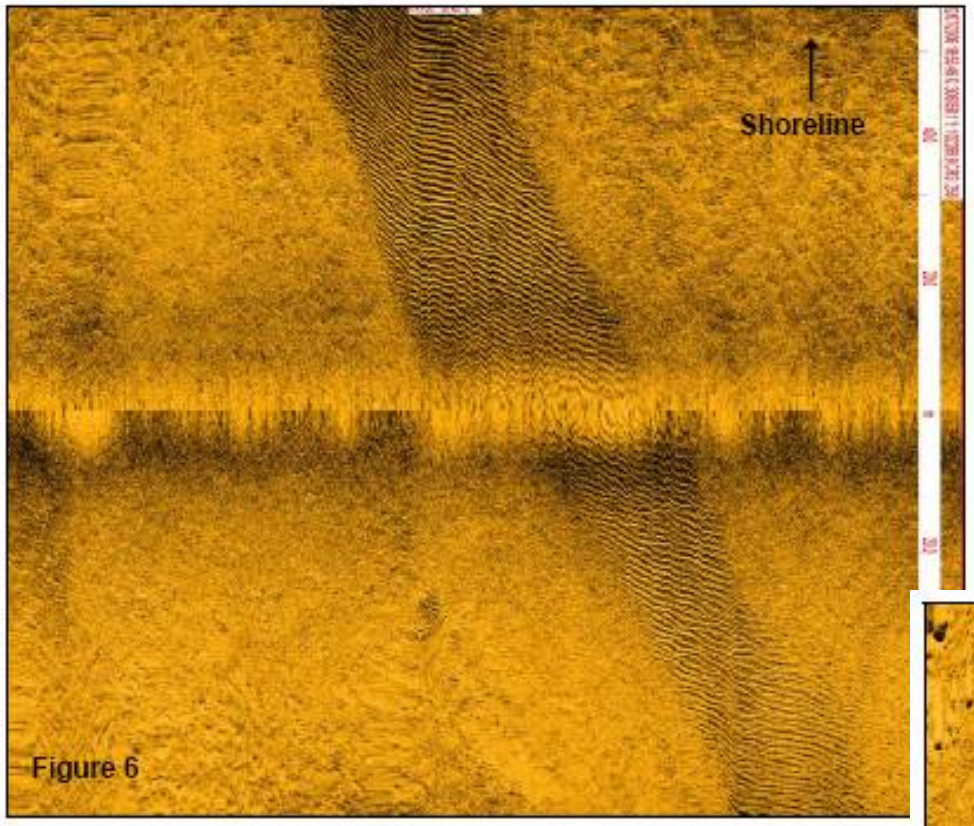


Figure 6

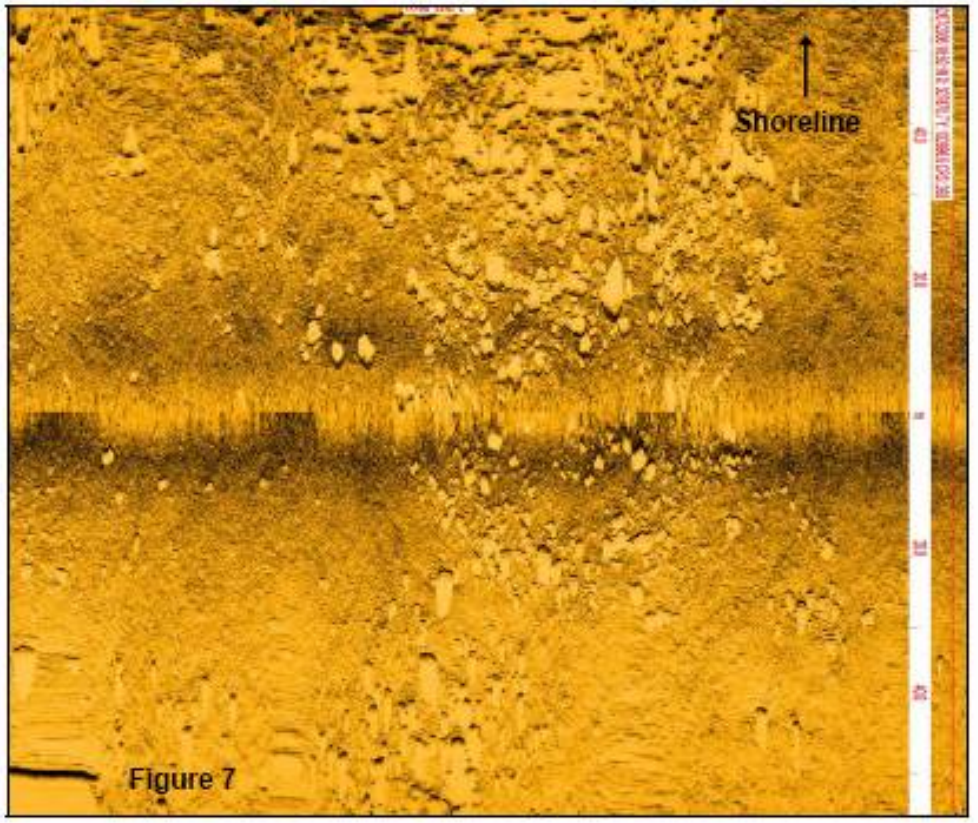
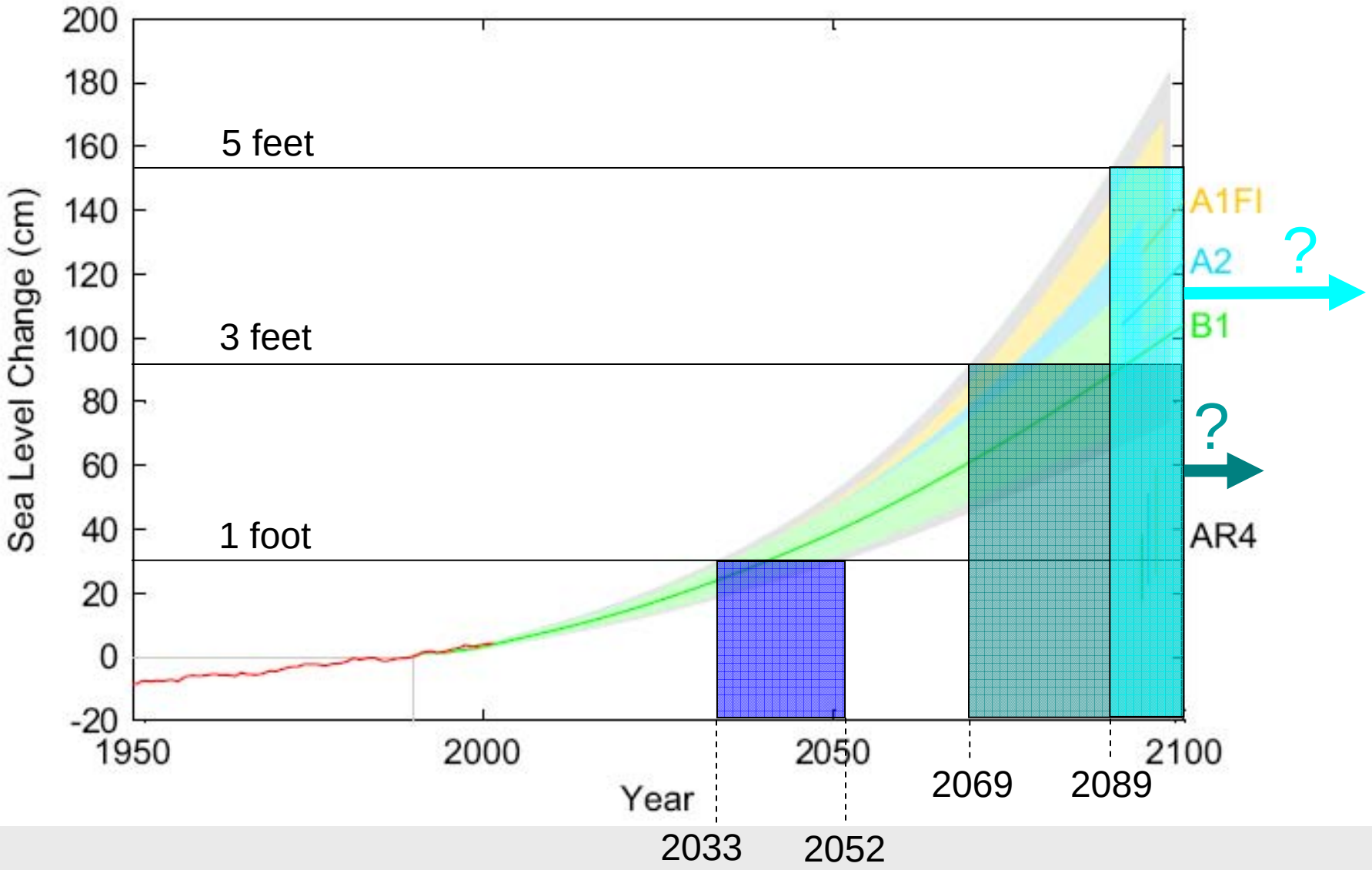


Figure 7

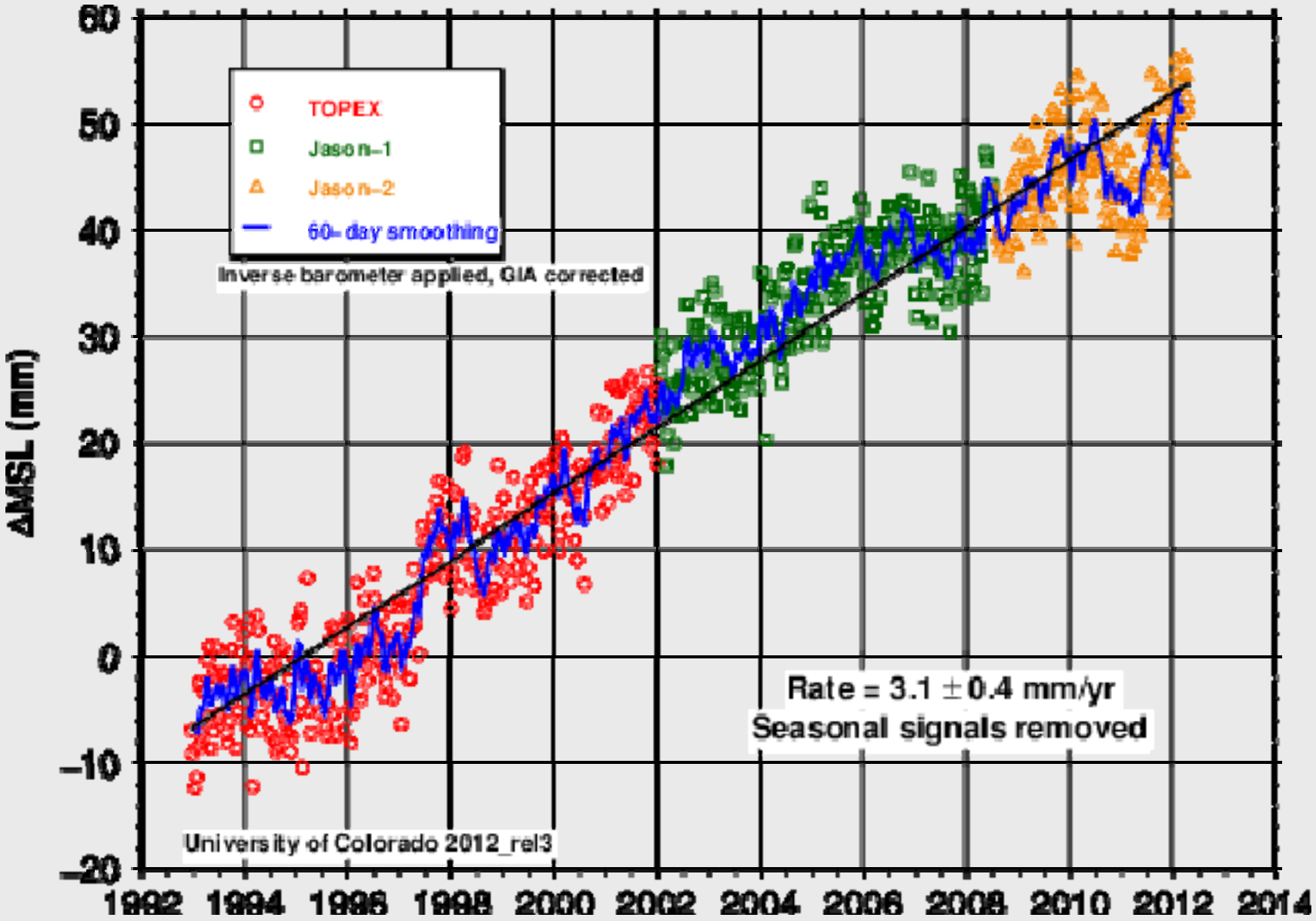
Climate is changing

Some effects of climate change and sea level rise

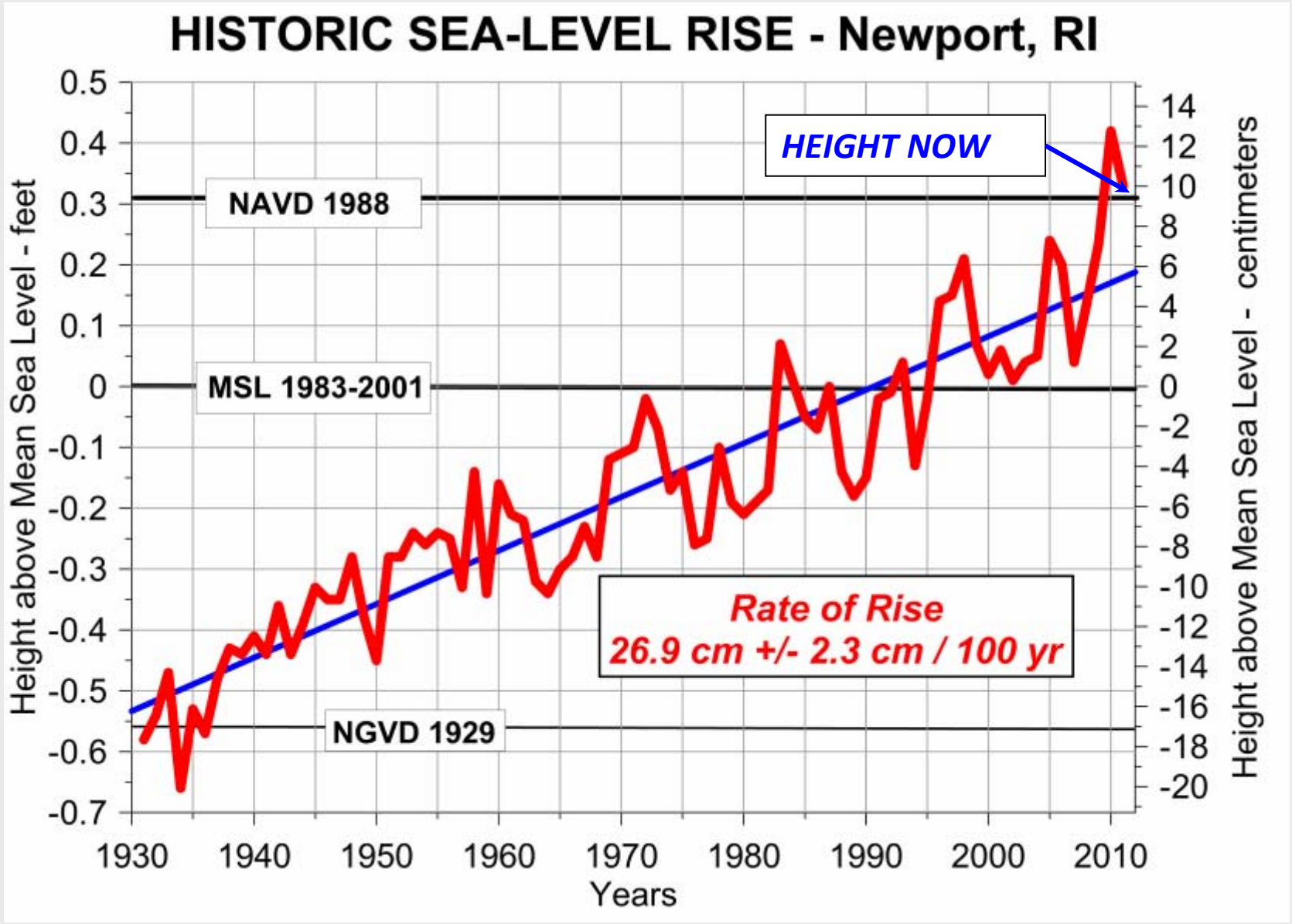
- **daily flooding at high tide**
  - **– low topography**
- **higher storm surges**
- **increased storm intensity**
  - **(when it rains it pours)**



Vermeer and Rahmstorf, 2009

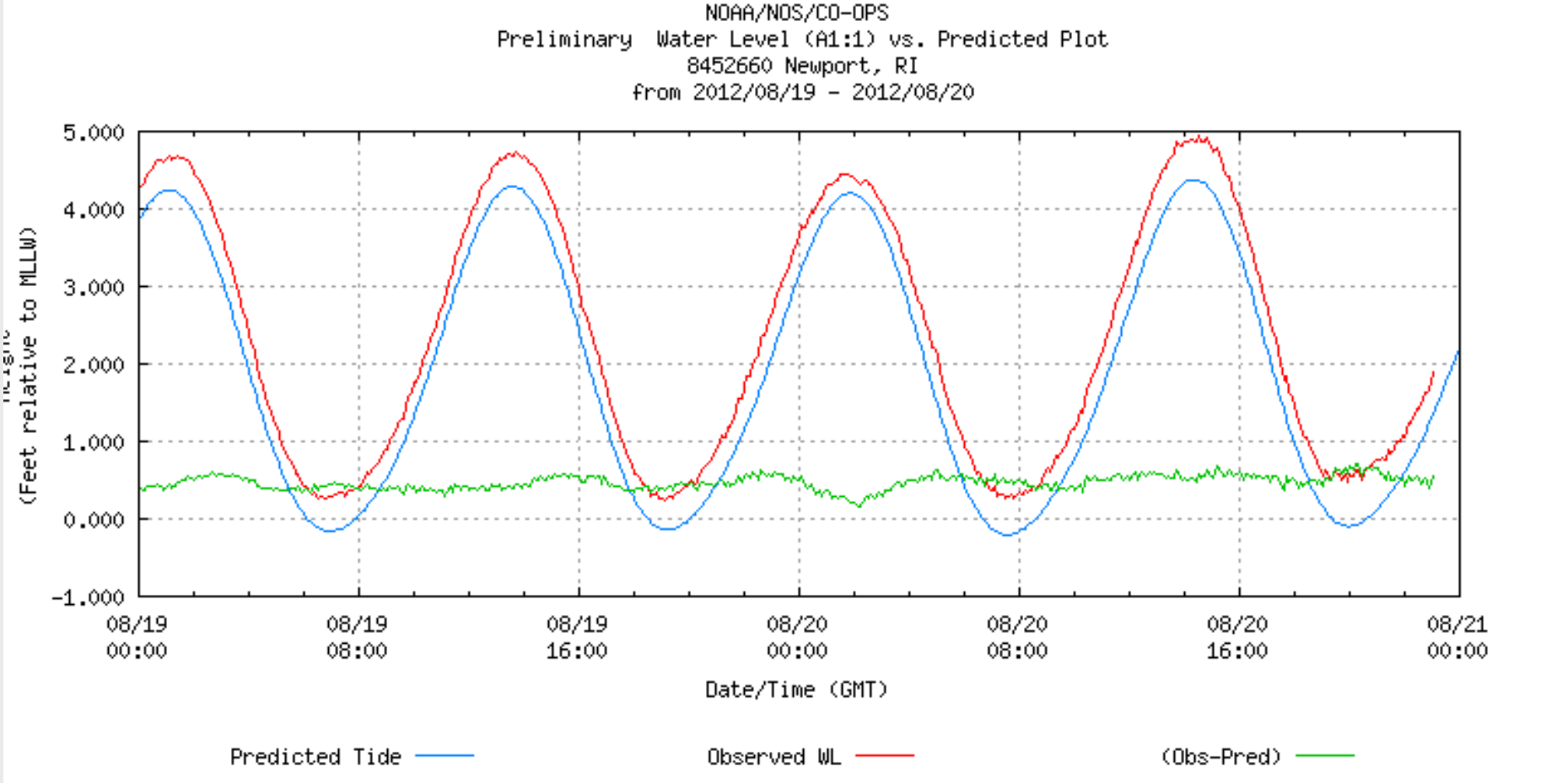


CU Sea Level Rise Research Group – University of Colorado http://sealevel.colorado.edu/



Adapted from:
http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8452660%20Newport,%20RI

Boothroyd 2012



http://tidesandcurrents.noaa.gov/data_menu.shtml?stn=8452660%20Newport,%20RI&type=Tide%20Data

Senate Resolution S2922A

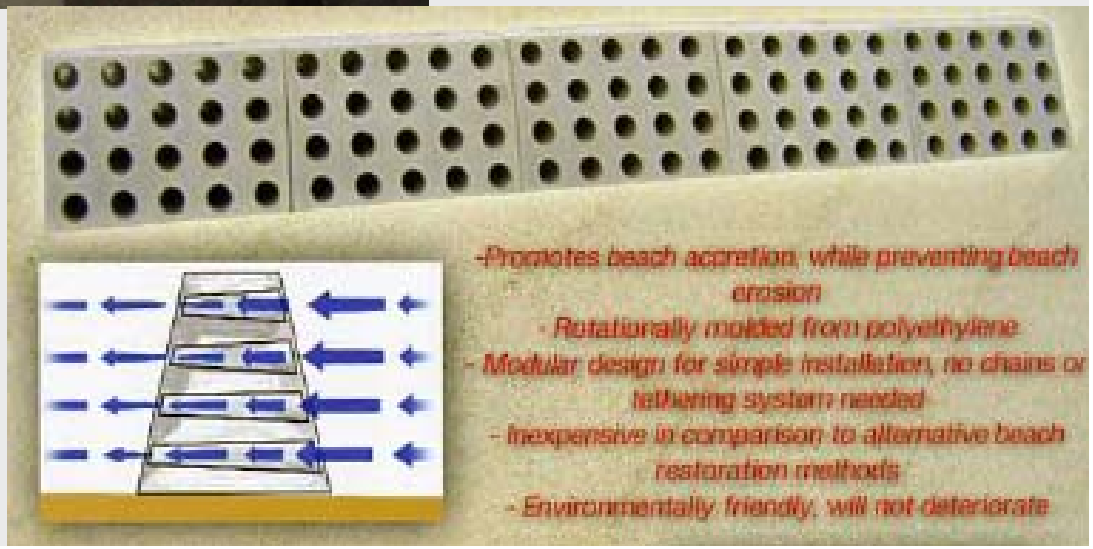
1. Approval of Town-proposed sheet pile wall
2. Experimental erosion control areas
3. Comprehensive analysis and recommendations (Erosion and Inundation SAMP)
4. Enforcement

Experimental Erosion Control Area

Experimental Erosion Control Area

Geo-mattress and Geo-grids

Wave Attenuators coupled with beach replenishment



Erosion and Inundation Special Area Management Plan

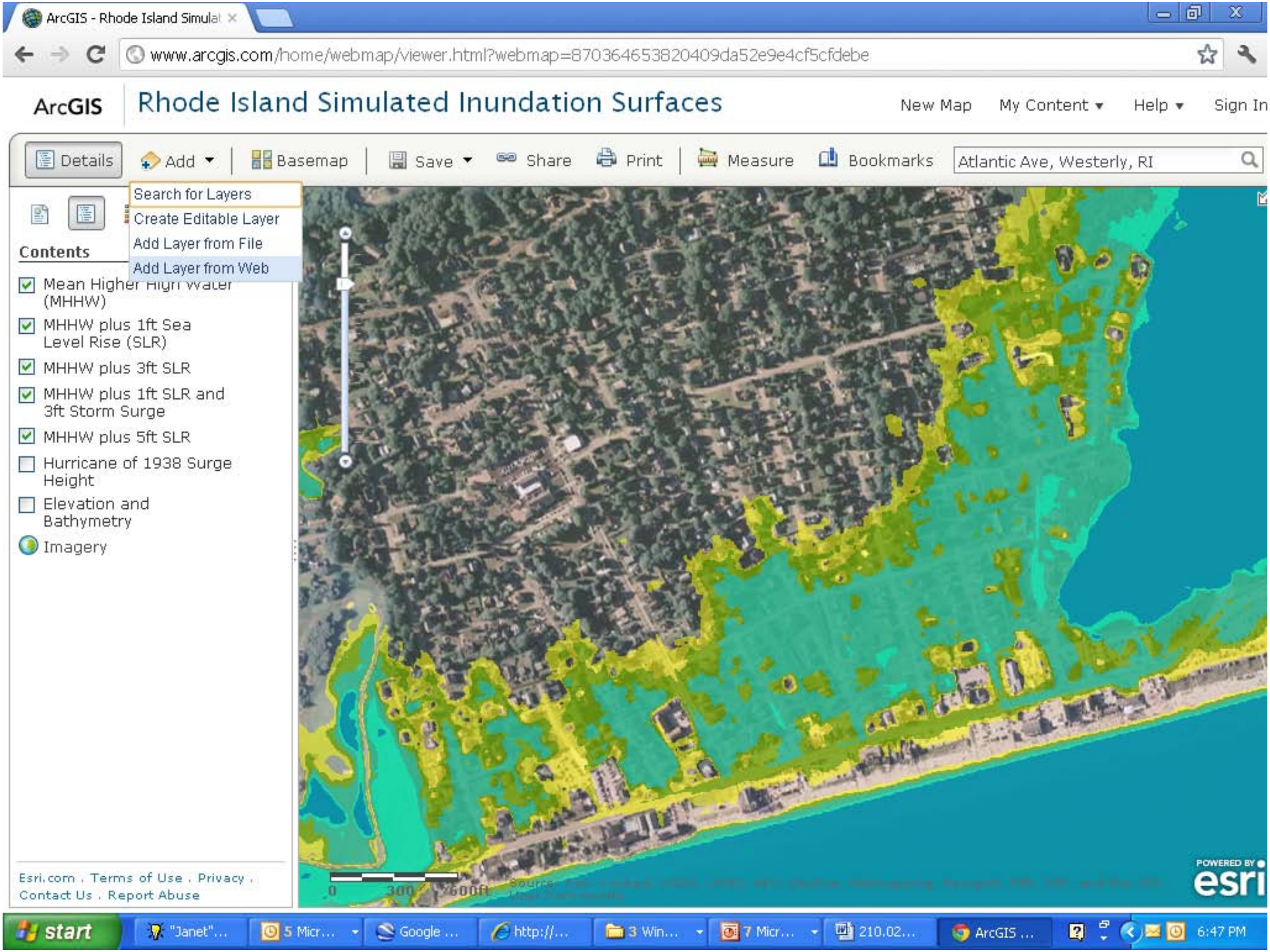
- Science Based
- Three Phases
  - Napatree Point to Point Judith and Block Island
  - East facing Narragansett Shoreline, Aquidneck Island and Little Compton
  - Selected Areas of Narragansett Bay
- Public and Stakeholder Engagement

Identify Areas of Critical Concern

Existing infrastructure and property

Susceptible to frontal erosion

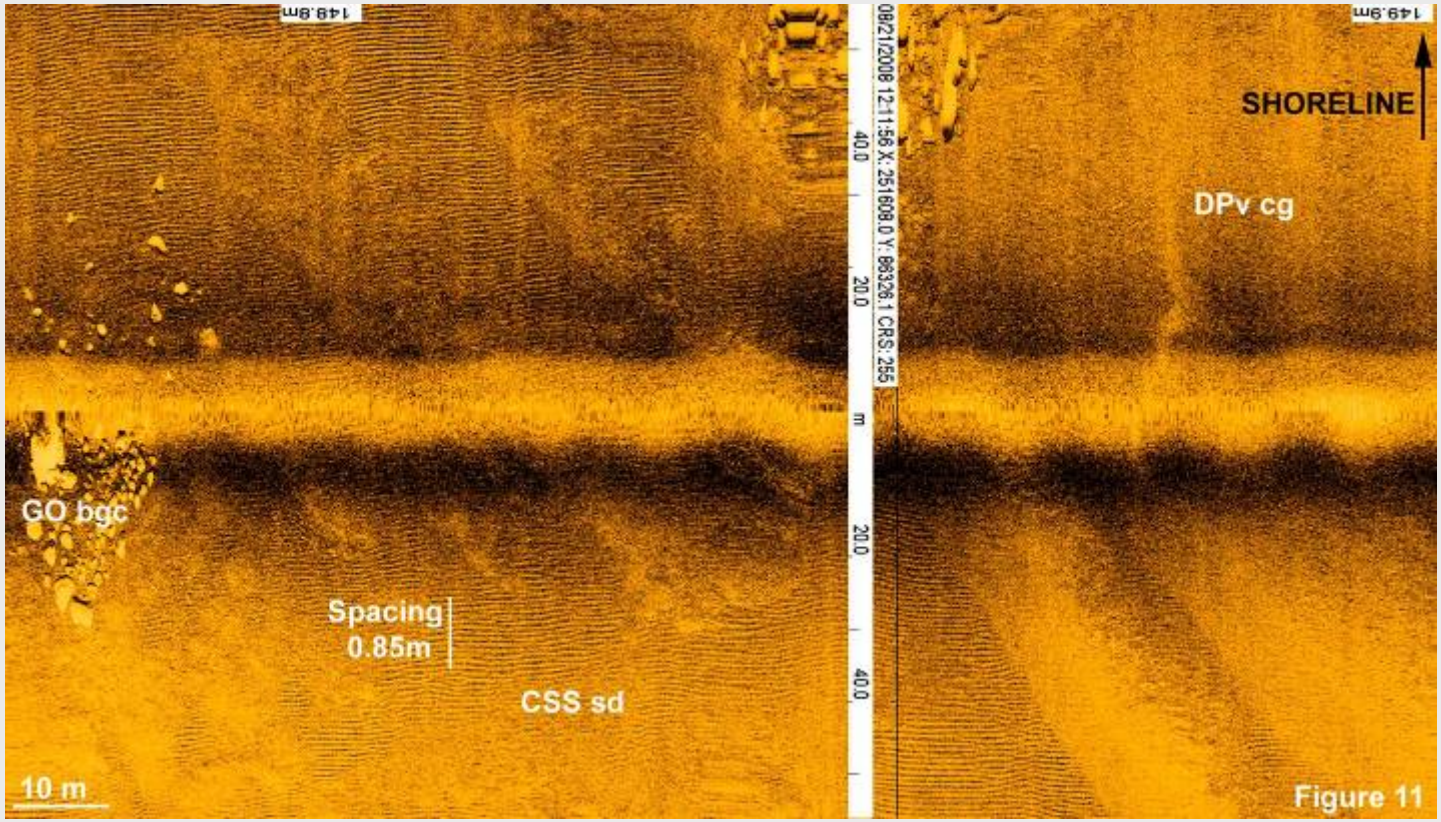
Inundated by projected sea level rise (2050 and 2100)


ArcGIS - Rhode Island Simulat
www.arcgis.com/home/webmap/viewer.html?webmap=870364653820409da52e9e4cf5cfdebe
ArcGIS
Rhode Island Simulated Inundation Surfaces
New Map
My Content
Help
Sign In
Details
Add
Basemap
Save
Share
Print
Measure
Bookmarks
Atlantic Ave, Westerly, RI
Search for Layers
Create Editable Layer
Add Layer from File
Add Layer from Web
Contents
Mean Higher High Water (MHHW)
MHHW plus 1ft Sea Level Rise (SLR)
MHHW plus 3ft SLR
MHHW plus 1ft SLR and 3ft Storm Surge
MHHW plus 5ft SLR
Hurricane of 1938 Surge Height
Elevation and Bathymetry
Imagery
Esri.com . Terms of Use . Privacy .
Contact Us . Report Abuse
0
300
600ft
POWERED BY esri
start
"Janet"...
5 Micr...
Google ...
http://...
3 Win...
7 Micr...
210.02...
ArcGIS ...
6:47 PM

Establish Link between Shoreface and Shoreline Change

sidescan mapping

update shoreline change rates



Analyses - depositional platform and shoreline change

Monitoring of Areas of Critical Concern

beach profiles (Emery and RTK)

wet/dry line using RTK

CRMC Undeveloped Barriers

• Westerly	240 acres
• Charlestown	415 acres
• South Kingstown	122 acres
• North Kingstown	42 acres
• Warwick	42 acres
• Barrington	87 acres
• Portsmouth	230 acres
• Tiverton	161 acres
• Little Compton	133 acres
• New Shoreham	225 acres
Total	1698 acres

Questions?

photo contest winner

Jacob Klinger 6-2-2012