NOTES on the GEOLOGY of the RHODE ISLAND SHORELINE from SAMP BEGINNINGS to NOW

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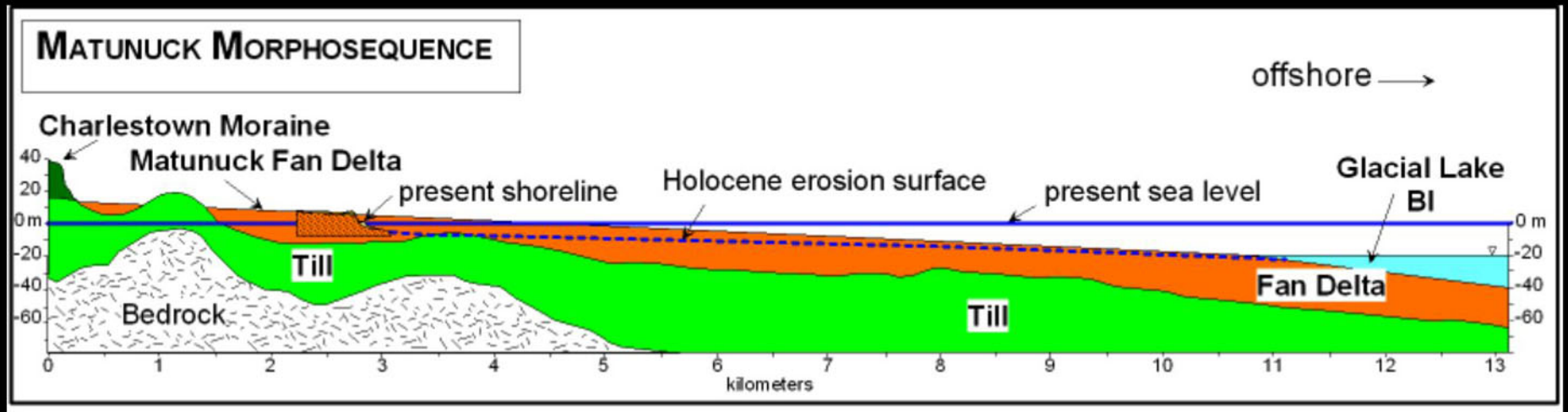
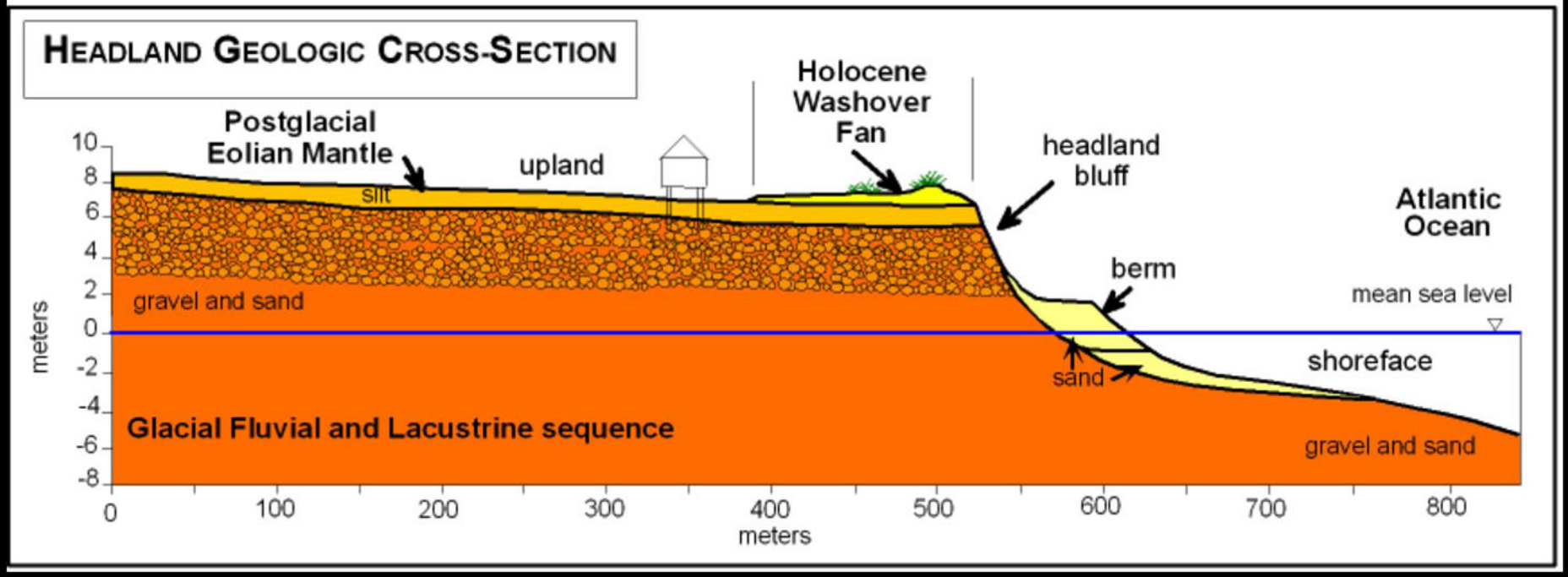
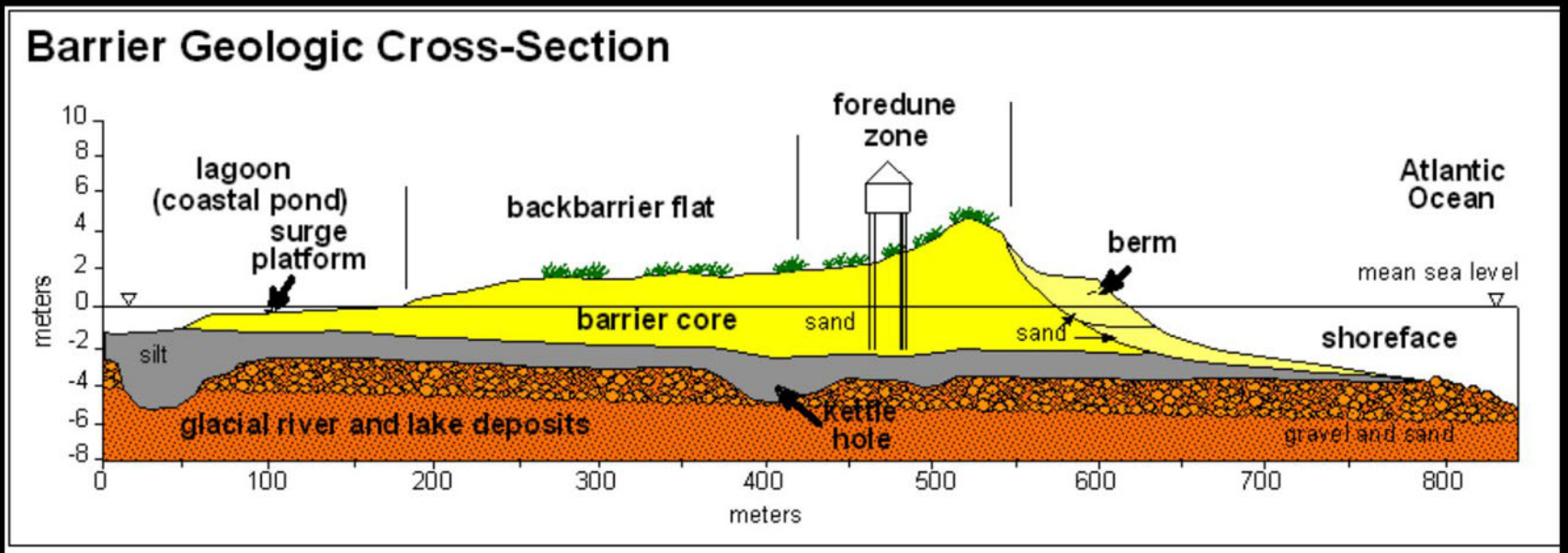
GEOLOGICAL SURVEY RHODE ISLAND

COASTAL HAZARDS GROUP
GEOSCIENCES Univ RI


MATUNUCK MORPHOSEQUENCE
offshore
Charlestown Moraine
Matunuck Fan Delta
present shoreline
Holocene erosion surface
present sea level
Glacial Lake
BI
Till
Bedrock
Till
Fan Delta
40
20
0 m
-20
-40
-60
0 m
-20
-40
-60
0
1
2
3
4
5
6
7
8
9
10
11
12
13
kilometers


HEADLAND GEOLOGIC CROSS-SECTION
Postglacial
Eolian Mantle
upland
Holocene
Washover
Fan
headland
bluff
Atlantic
Ocean
silt
gravel and sand
berm
mean sea level
shoreface
sand
Glacial Fluvial and Lacustrine sequence
gravel and sand
meters
10
8
6
4
2
0
-2
-4
-6
-8
0
100
200
300
400
500
600
700
800
meters



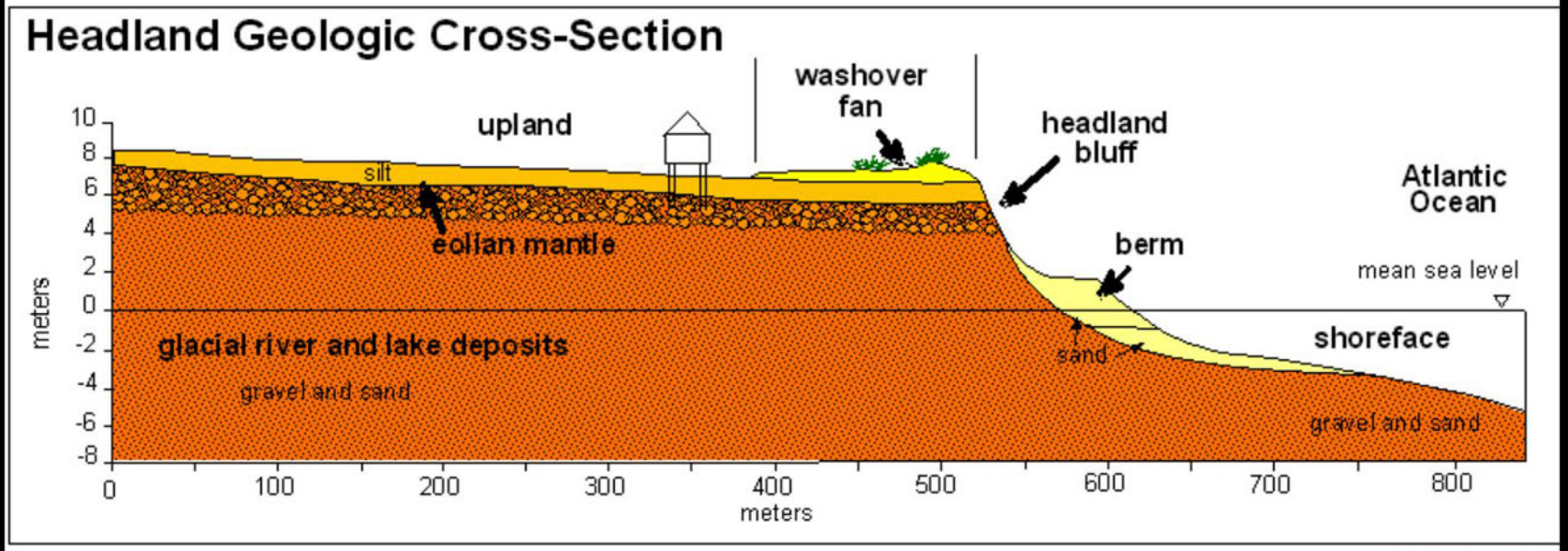
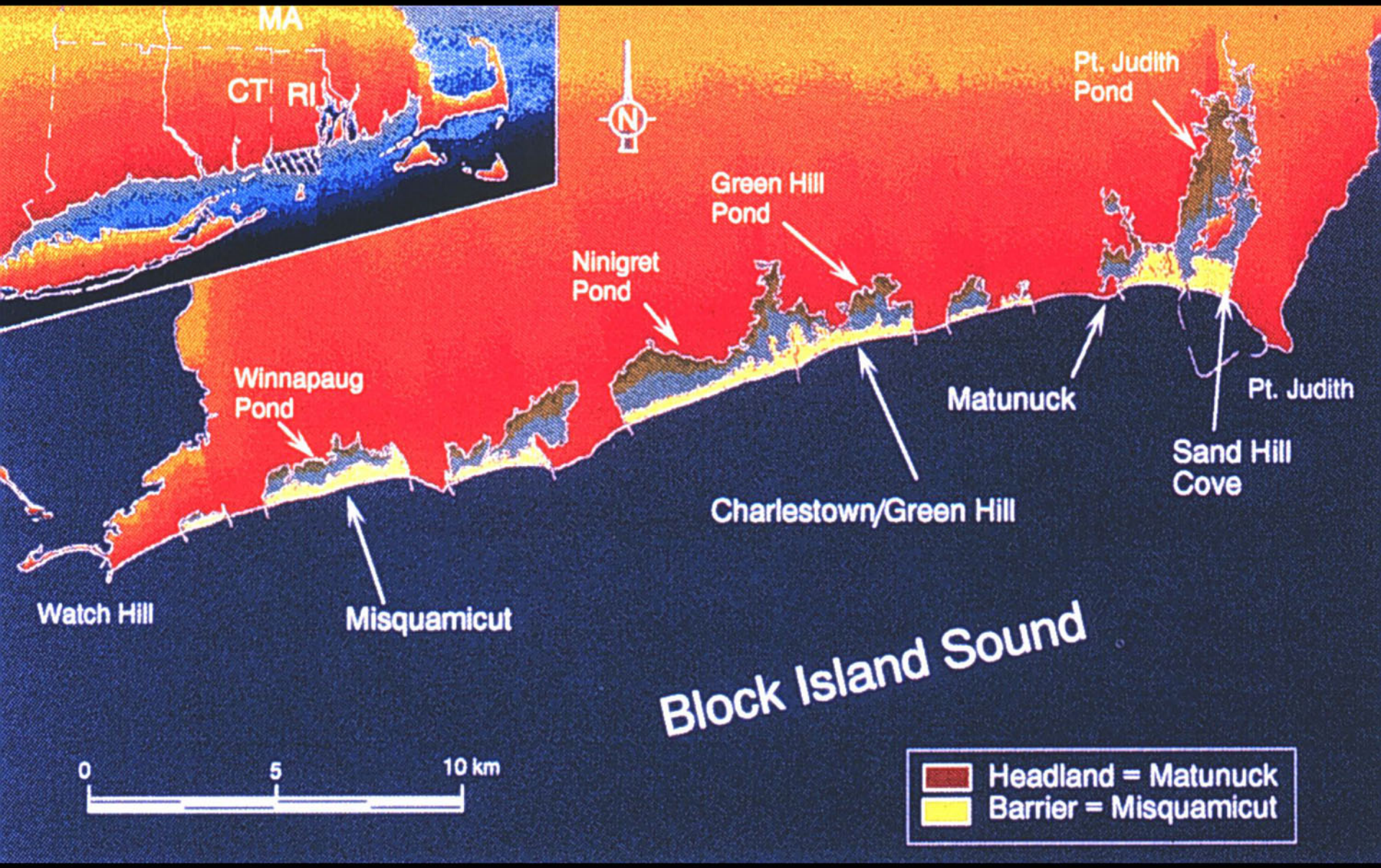


Figure 4-2

COASTAL HAZARDS GROUP
GEOLOGY Univ RI

Boothroyd & Galagan, 1998

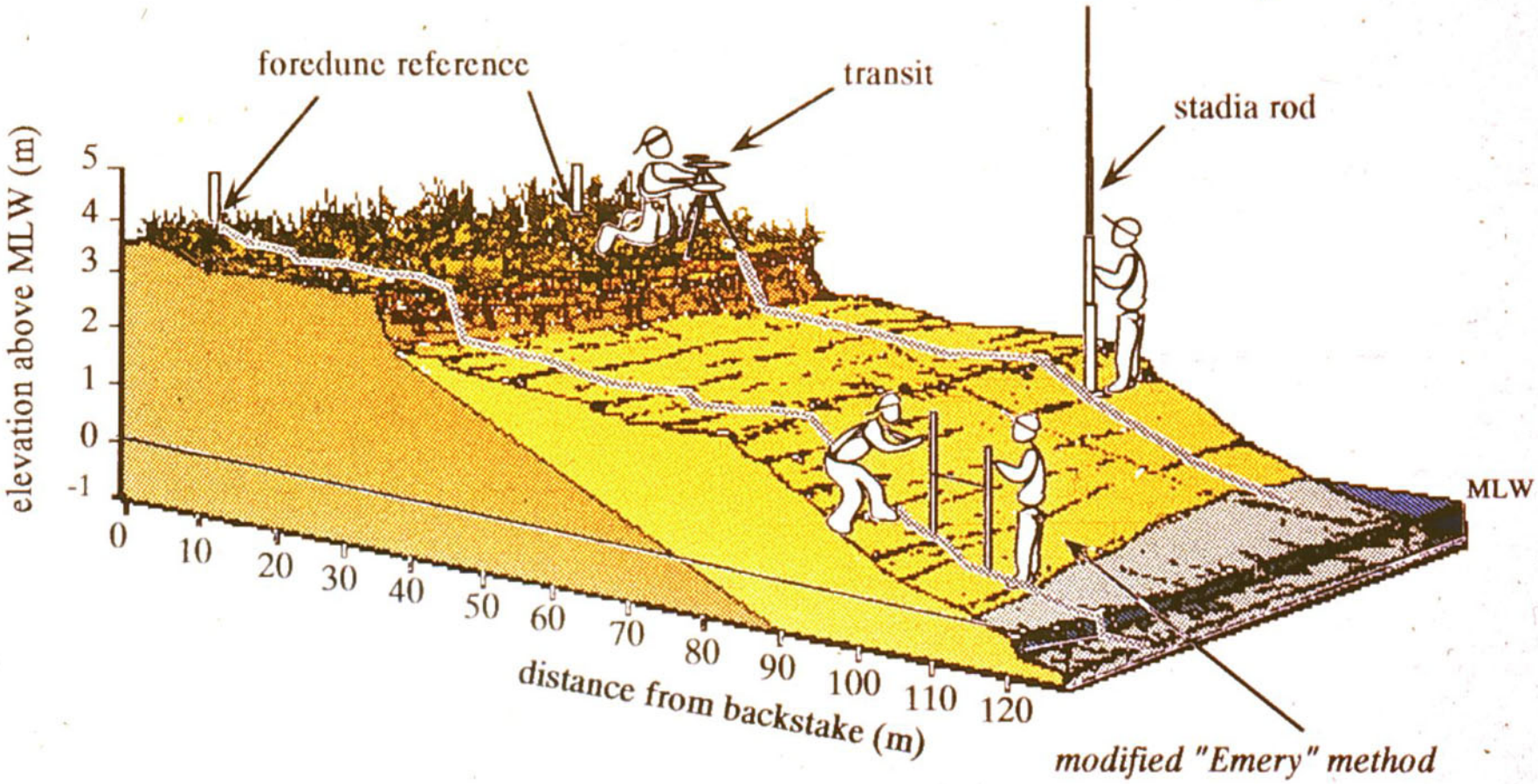

MA
CT
RI
N
Pt. Judith Pond
Green Hill Pond
Ninigret Pond
Winnapaug Pond
Matunuck
Pt. Judith
Sand Hill Cove
Charlestown/Green Hill
Watch Hill
Misquamicut
Block Island Sound
0
5
10 km
Headland = Matunuck
Barrier = Misquamicut

GEOLOGIC HISTORY of the SOUTHERN RHODE ISLAND SHORELINE

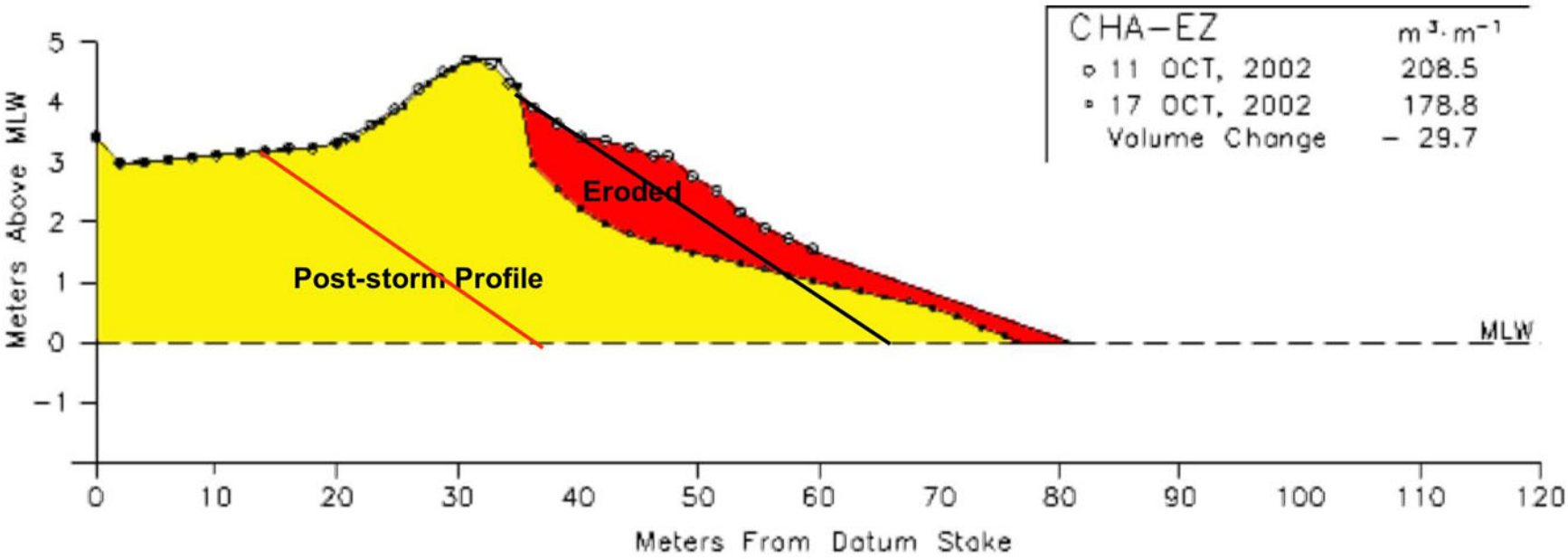
PROCESSES and DEP ENVIRONMENTS

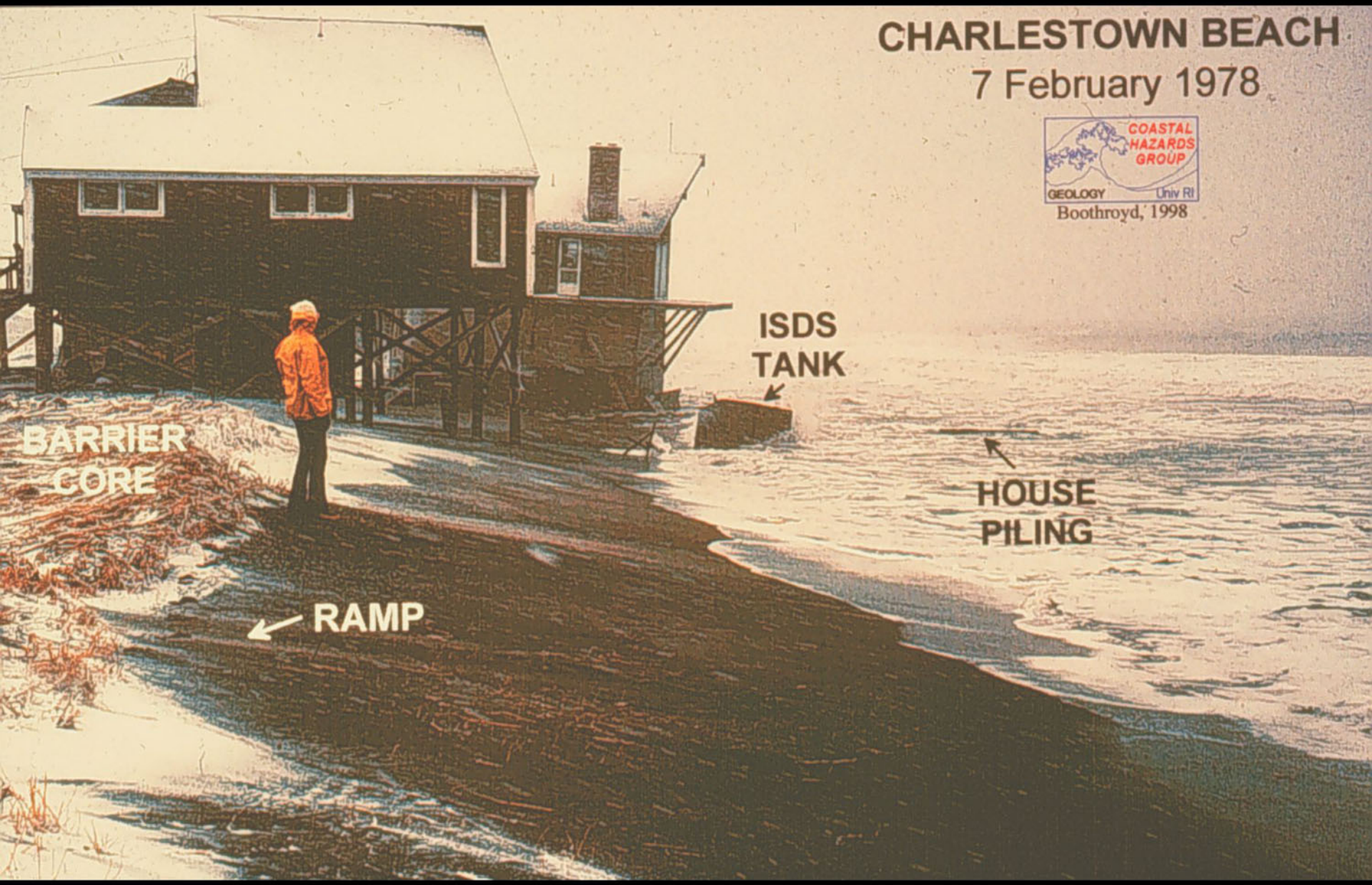
- **Beach Cycles and Long-Term Monitoring**
- **Shoreline Retreat**
- **Flood-Tidal Delta Growth**

Beach surveying techniques employed in the Long-term Profile Monitoring Project

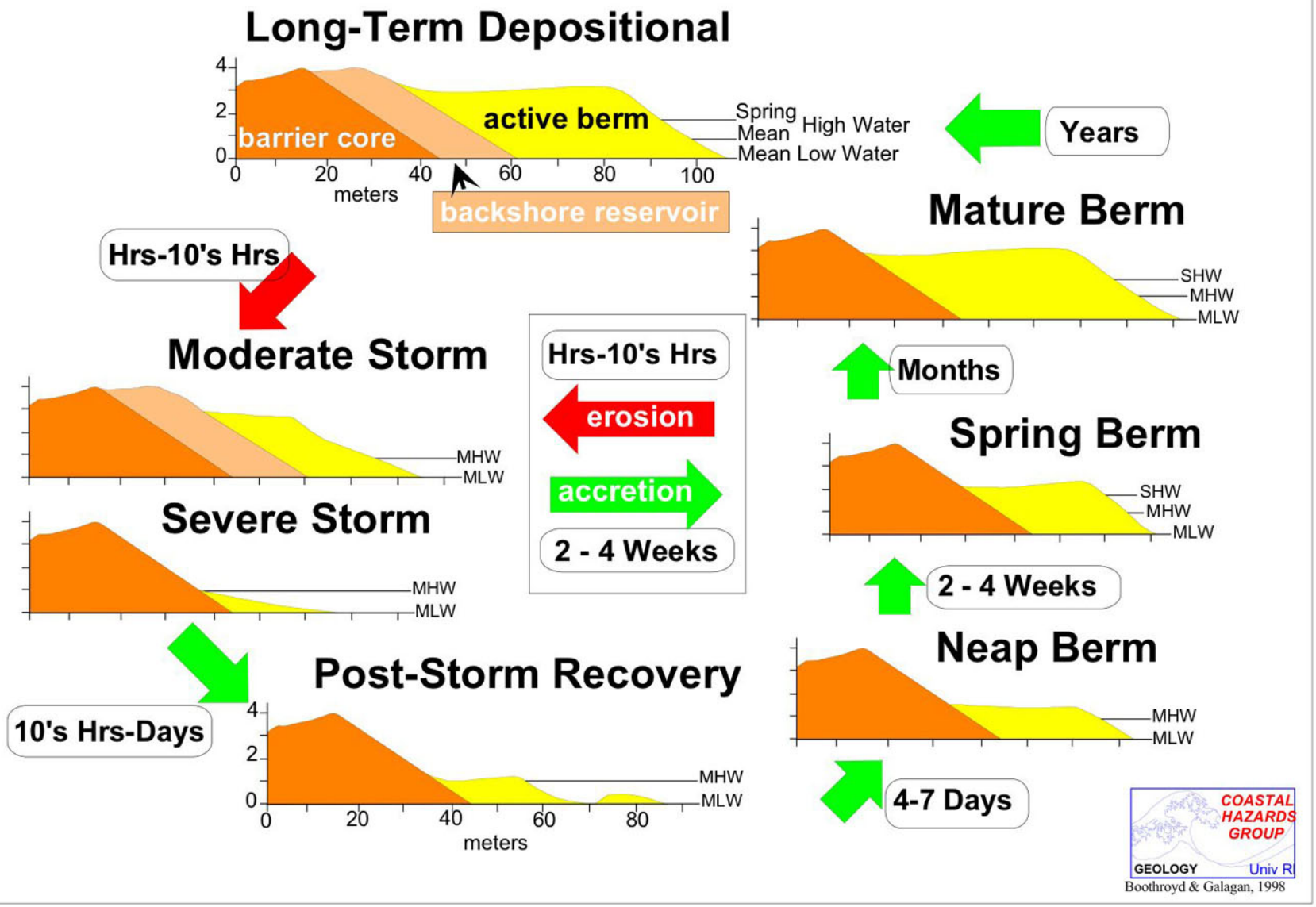


2
6
10
14
18
22
26
30
34
38
42
46
50


CHA–EZ
m³·m⁻¹
11 OCT, 2002 208.5
17 OCT, 2002 178.8
Volume Change – 29.7
Eroded
Post-storm Profile
MLW
Meters Above MLW
Meters From Datum Stake
5
4
3
2
1
0
–1
0
10
20
30
40
50
60
70
80
90
100
110
120


CHARLESTOWN BEACH
7 February 1978
COASTAL HAZARDS GROUP
GEOLOGY
Univ RI
Boothroyd, 1998
ISDS TANK
BARRIER CORE
HOUSE PILING
RAMP

BEACH CYCLES Rhode Island Microtidal Shoreline



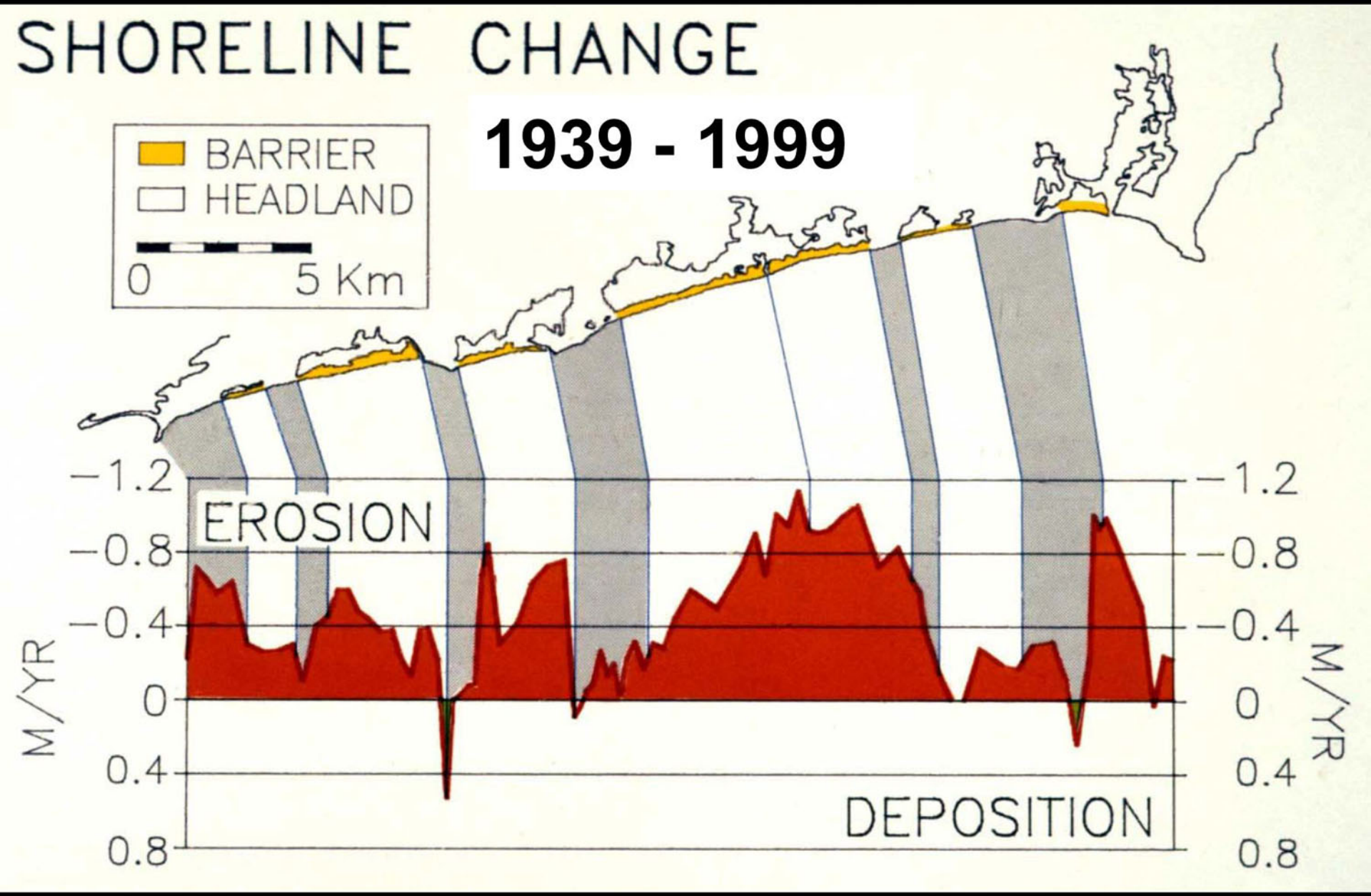
Boothroyd & Galagan, 1998

GEOLOGIC HISTORY of the SOUTHERN RHODE ISLAND SHORELINE

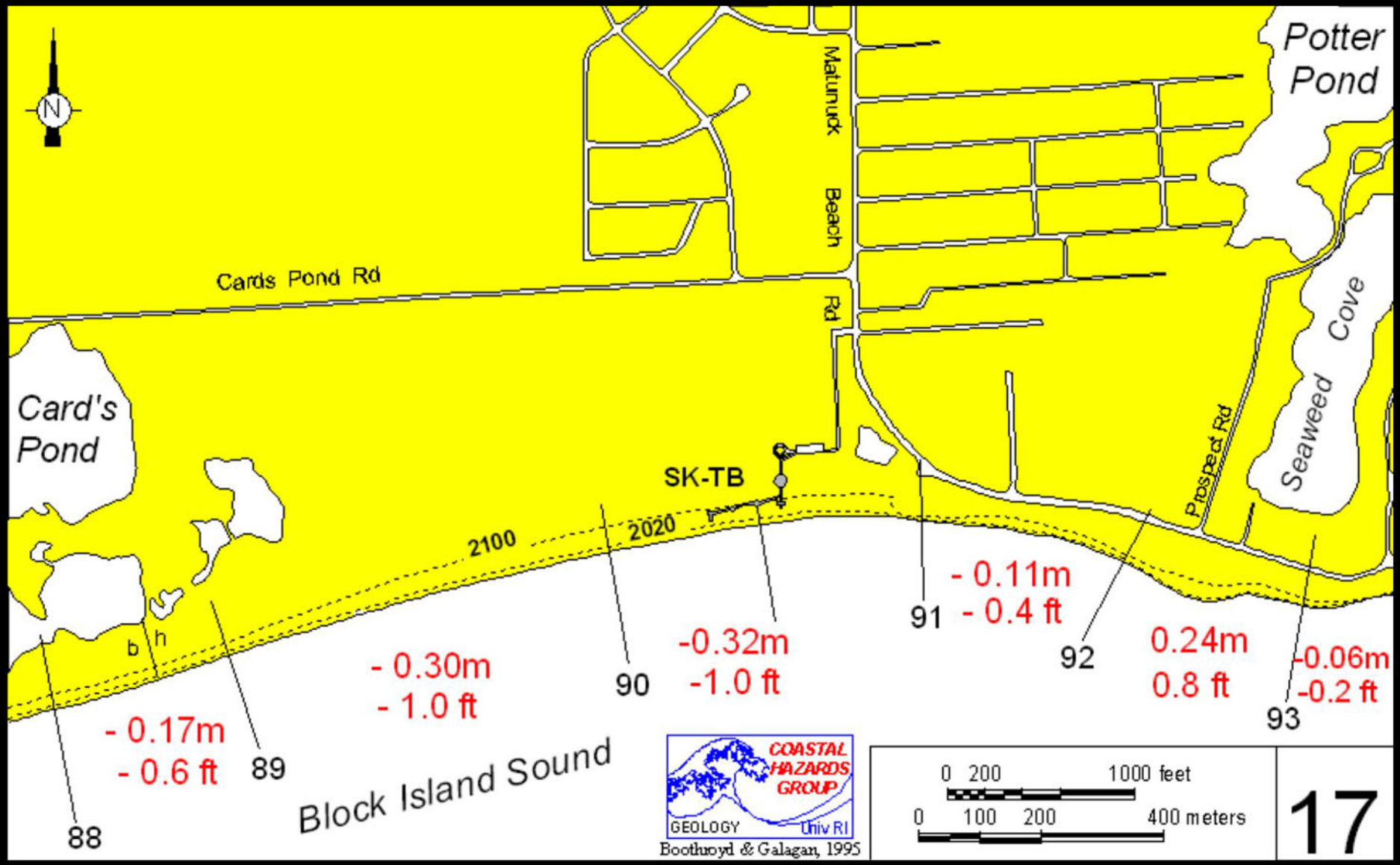
Jon C Boothroyd *jon_boothroyd@uri.edu*

PROCESSES and DEP ENVIRONMENTS

- **Beach Cycles and Long-Term Monitoring**
- **Shoreline Retreat**
- **Flood-Tidal Delta Growth**


SHORELINE CHANGE
1939 - 1999
BARRIER
HEADLAND
0
5 Km
EROSION
DEPOSITION
−1.2
−0.8
−0.4
0
0.4
0.8
M/YR

Wetted Beach
June 1999


Potter Pond
Matunuck Beach Rd
Cards Pond Rd
Card's Pond
Seaweed Cove
Prospect Rd
SK-TB
2100
2020
b
h
- 0.17m
- 0.6 ft
88
89
- 0.30m
- 1.0 ft
90
-0.32m
-1.0 ft
91
- 0.11m
- 0.4 ft
92
0.24m
0.8 ft
93
-0.06m
-0.2 ft
Block Island Sound
COASTAL HAZARDS GROUP
GEOLOGY
Univ RI
Boothroyd & Galagan, 1995
0 200 1000 feet
0 100 200 400 meters
17

GEOLOGIC HISTORY of the SOUTHERN RHODE ISLAND SHORELINE

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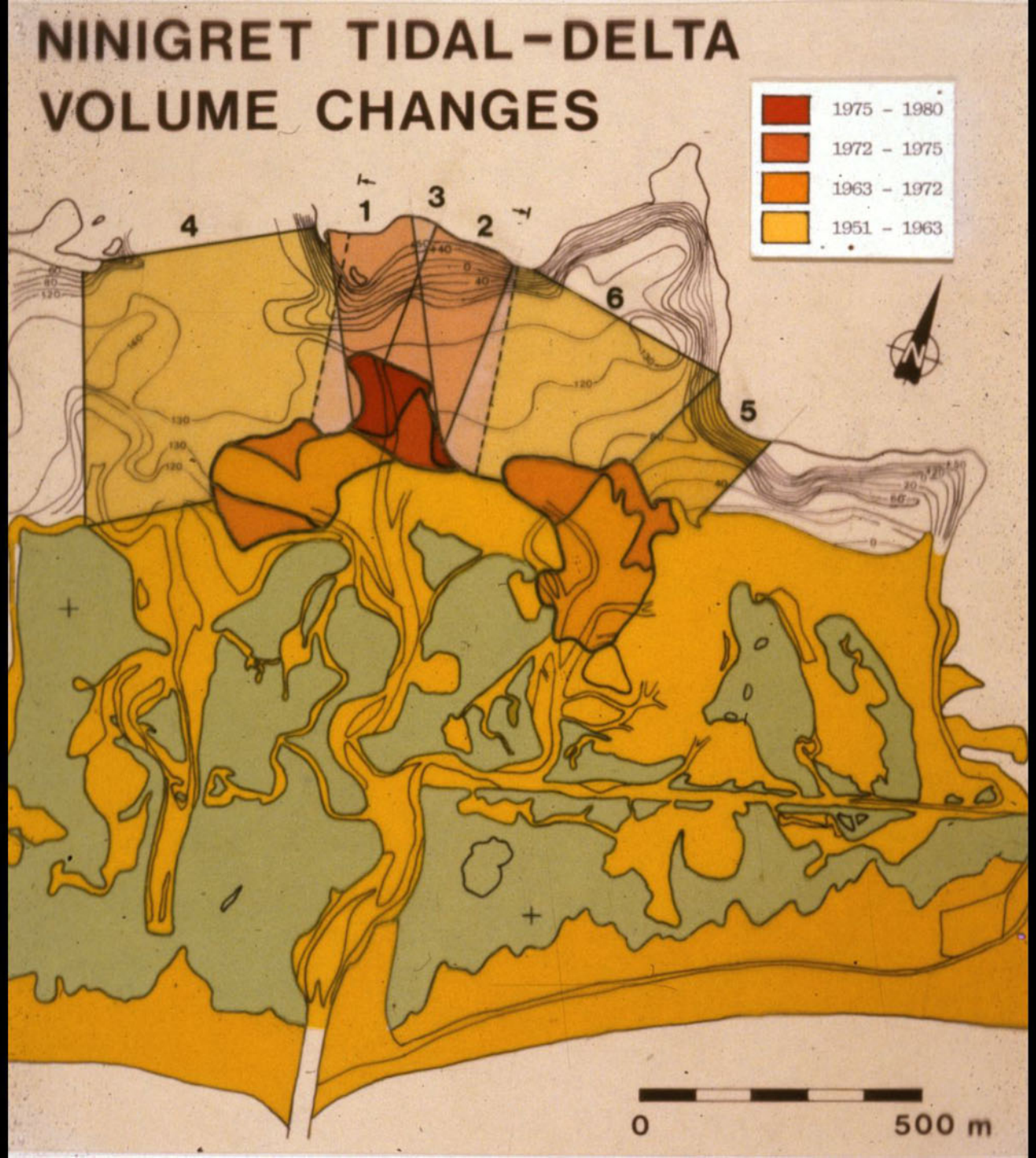
PROCESSES and DEP ENVIRONMENTS

- **Beach Cycles and Long-Term Monitoring**
- **Shoreline Retreat**
- **Flood-Tidal Delta Growth**

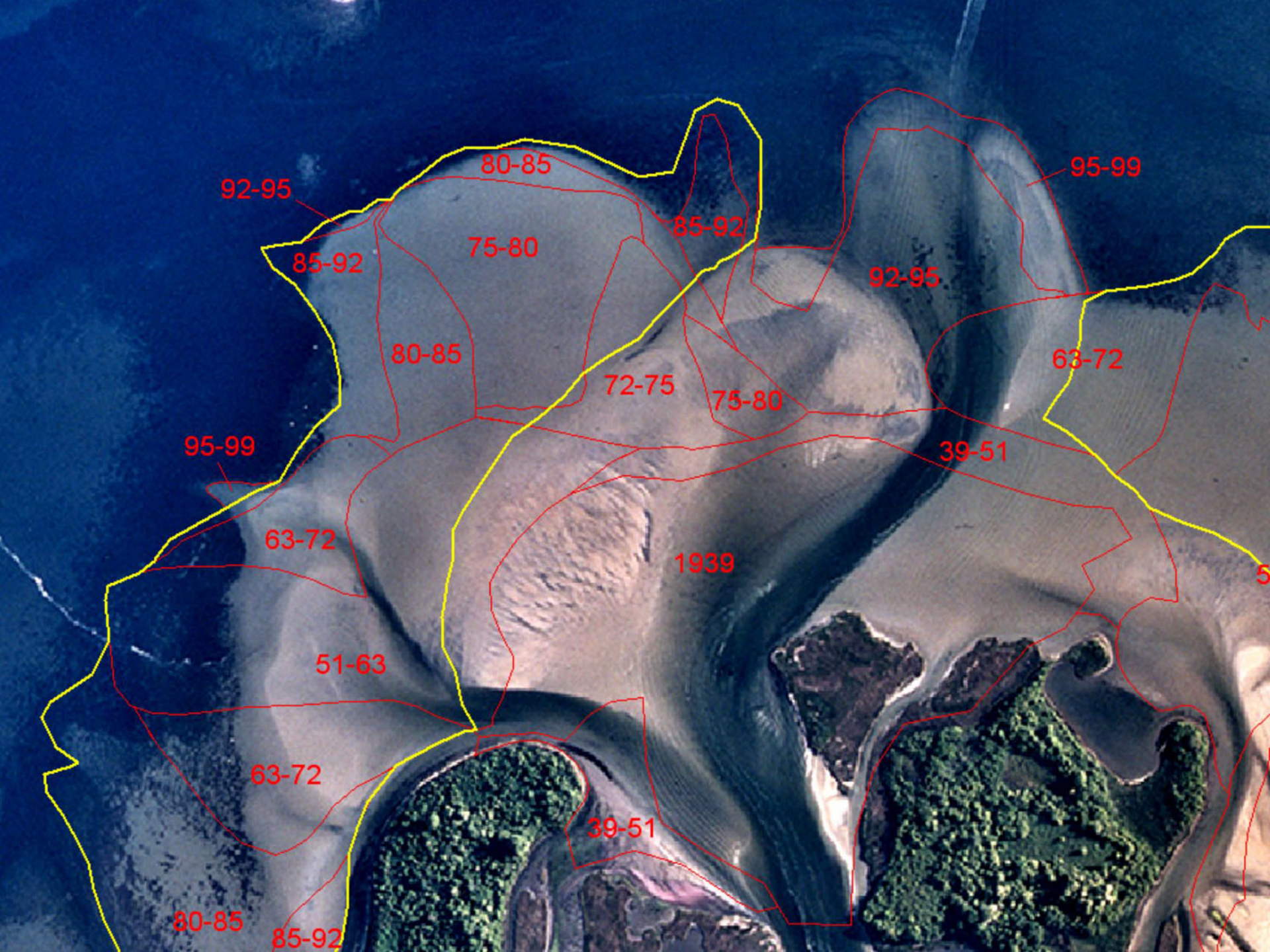
A VERY OLD SAMP ESTIMATE



17 Oct 1978

24 Oct 1982

WHAT REALLY HAPPENED


92-95
80-85
85-92
75-80
85-92
95-99
92-95
80-85
72-75
75-80
63-72
95-99
39-51
63-72
1939
51-63
63-72
39-51
80-85
85-92

RIGIS 2004

EPA 12july2005

GEOLOGIC HISTORY of the SOUTHERN RHODE ISLAND SHORELINE

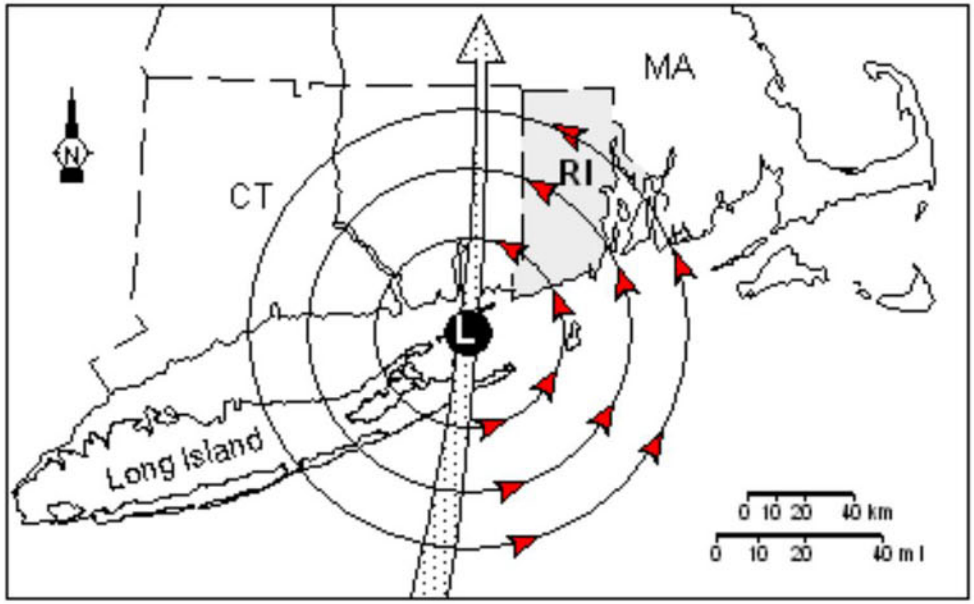
Jon C Boothroyd *jon_boothroyd@uri.edu*

STORMS AS MODIFYING AGENTS IN THE COASTAL ENVIRONMENT

- **Storm Intensity**
- **Storm Duration**
- **Tidal phase**
- **Time Between Storms**
- **Path of Storm with Respect to the Shoreline**

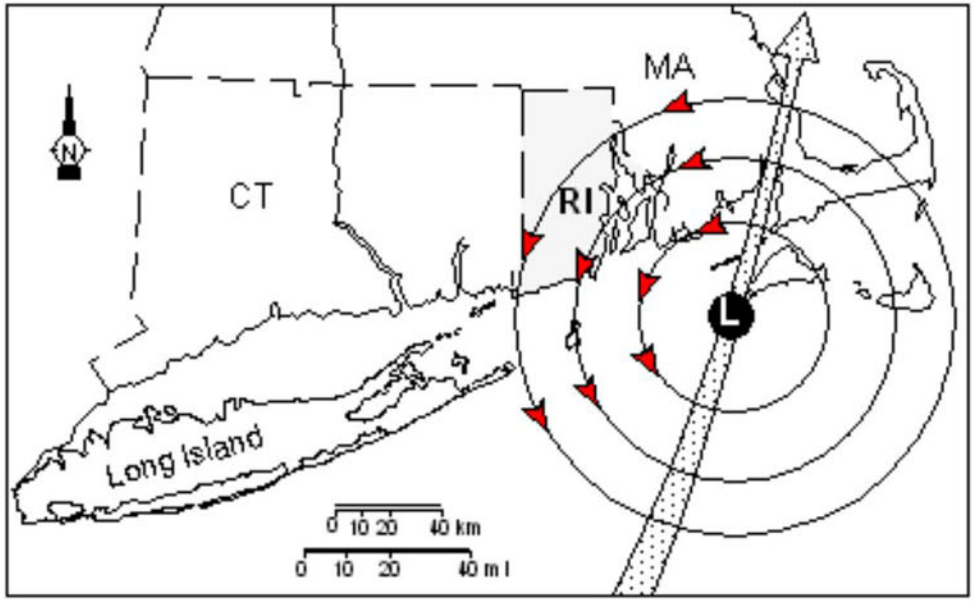
Hayes and Boothroyd, 1969

HURRICANE and EXTRATROPICAL STORM PATHS and ASSOCIATED WIND PATTERNS



PASSAGE TO THE WEST

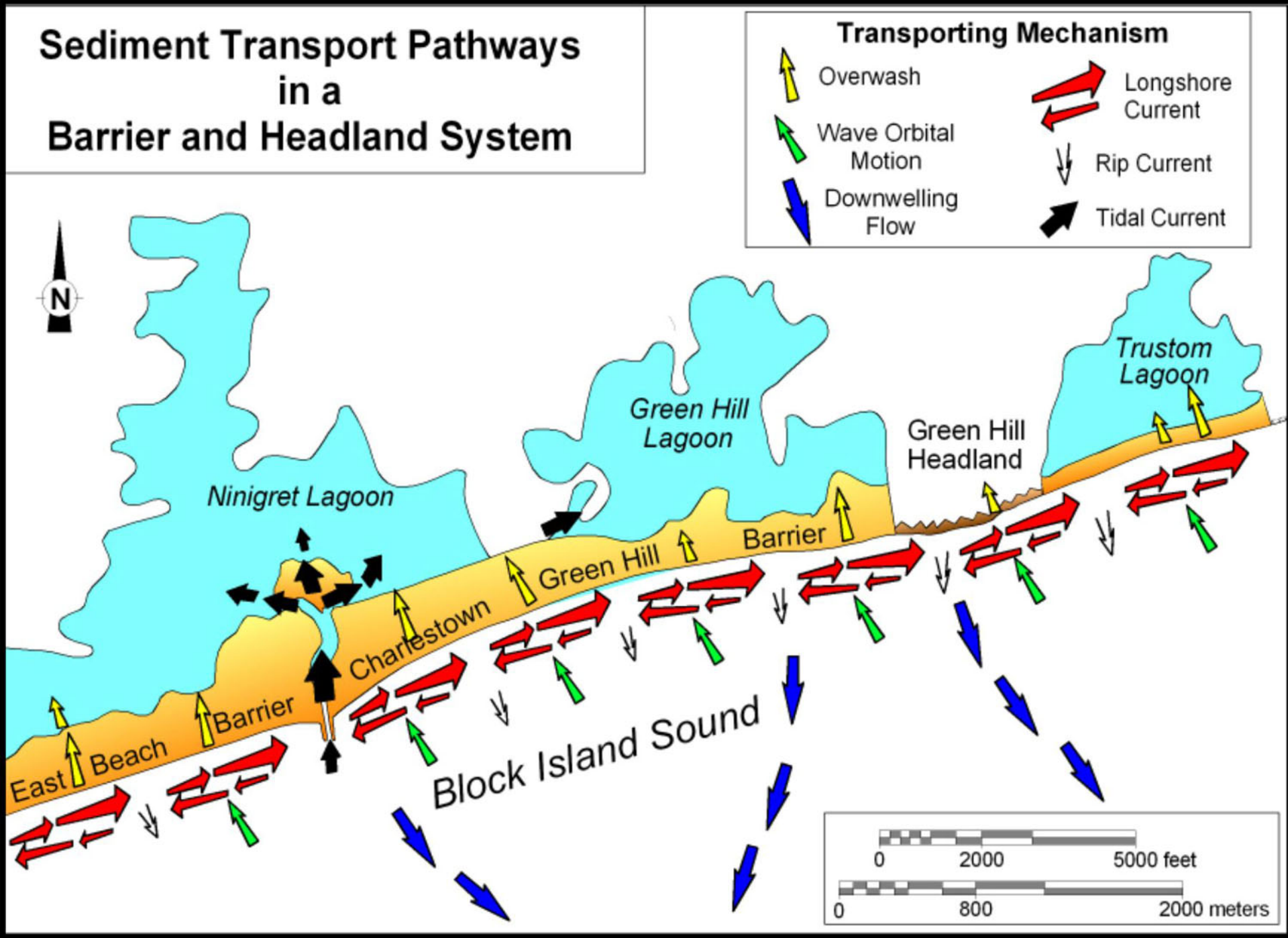
- Maximum Onshore Wind
- Severe Storm-Surge Flooding



PASSAGE TO THE EAST

- Offshore Wind
- Minimum Storm-Surge Flooding

From Wright and Sullivan, 1982


Sediment Transport Pathways
in a
Barrier and Headland System
Transporting Mechanism
Overwash
Wave Orbital Motion
Downwelling Flow
Longshore Current
Rip Current
Tidal Current
N
Ninigret Lagoon
Green Hill Lagoon
Trustom Lagoon
Green Hill Headland
East Beach
Barrier
Charlestown
Green Hill
Barrier
Block Island Sound
0
2000
5000 feet
0
800
2000 meters

Charlestown Beach

7 Feb 1978

Charlestown Beach

South Kingstown Town Beach

Charlestown Beach

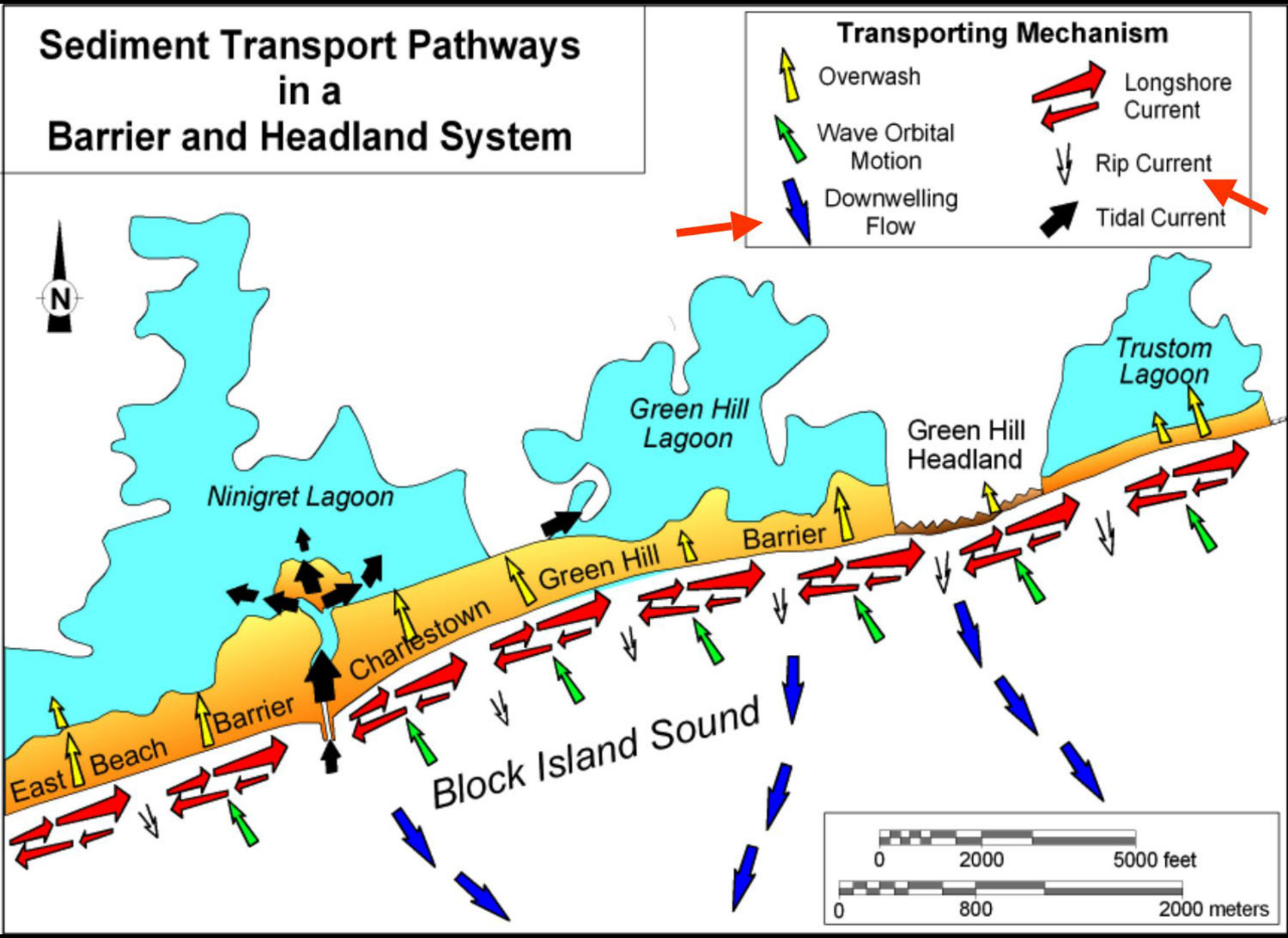
7 Feb 1978

Charlestown Beach

7 Feb 1978

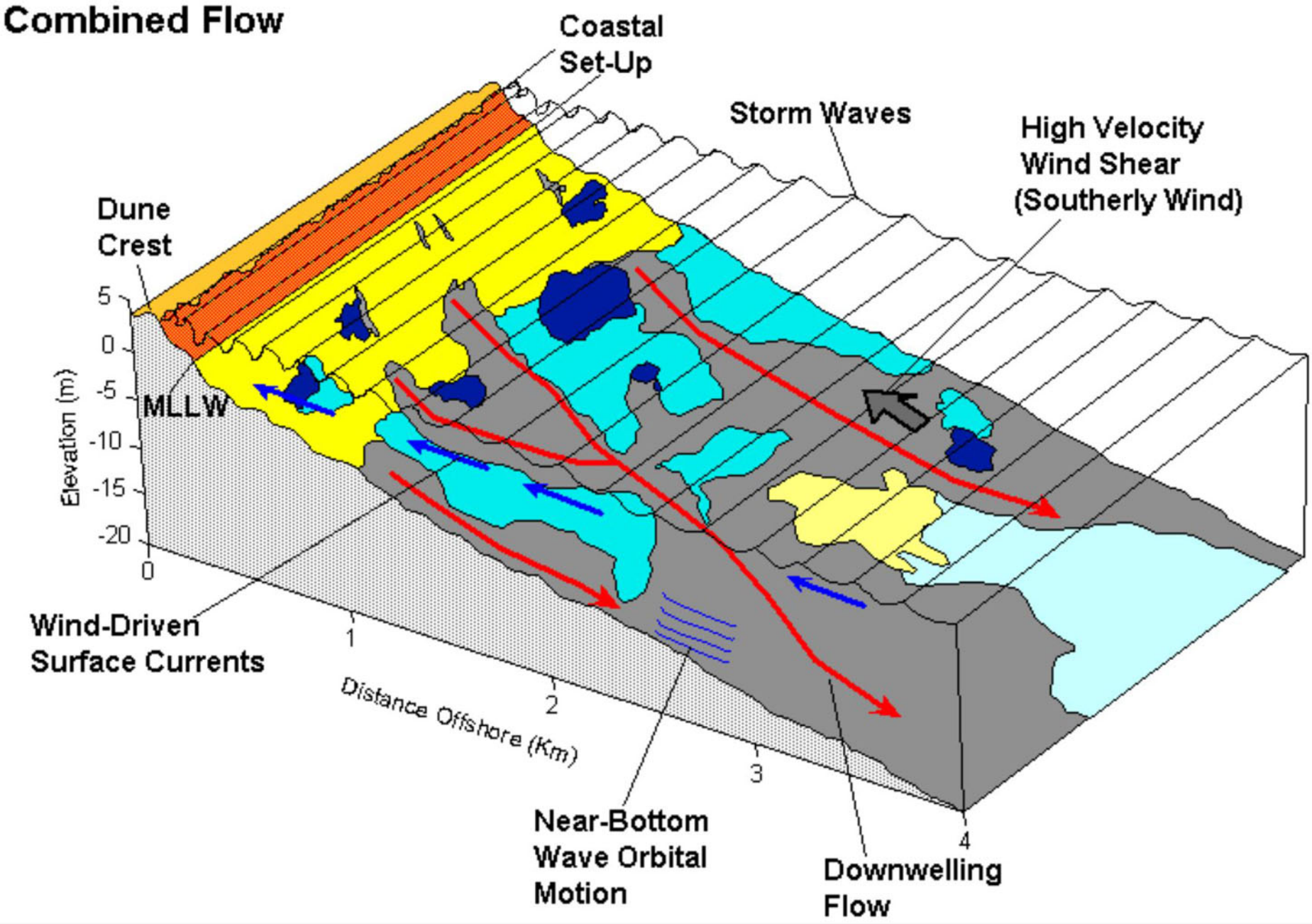
Charlestown Beach

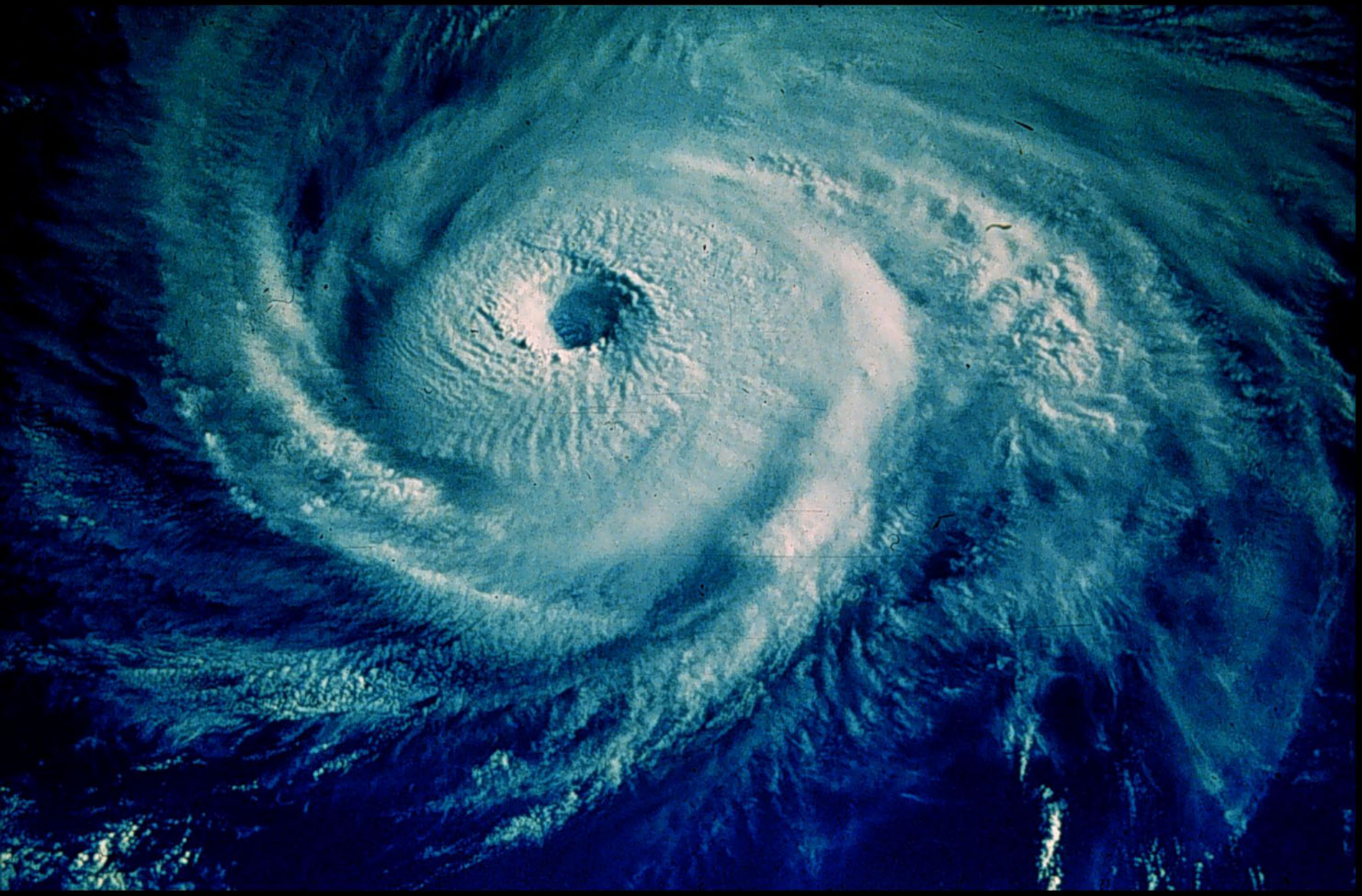
Charlestown Beach


Sediment Transport Pathways
in a
Barrier and Headland System
Transporting Mechanism
Overwash
Wave Orbital Motion
Downwelling Flow
Longshore Current
Rip Current
Tidal Current
N
Ninigret Lagoon
Green Hill Lagoon
Trustom Lagoon
Green Hill Headland
East Beach
Barrier
Charlestown
Green Hill
Barrier
Block Island Sound
0
2000
5000 feet
0
800
2000 meters

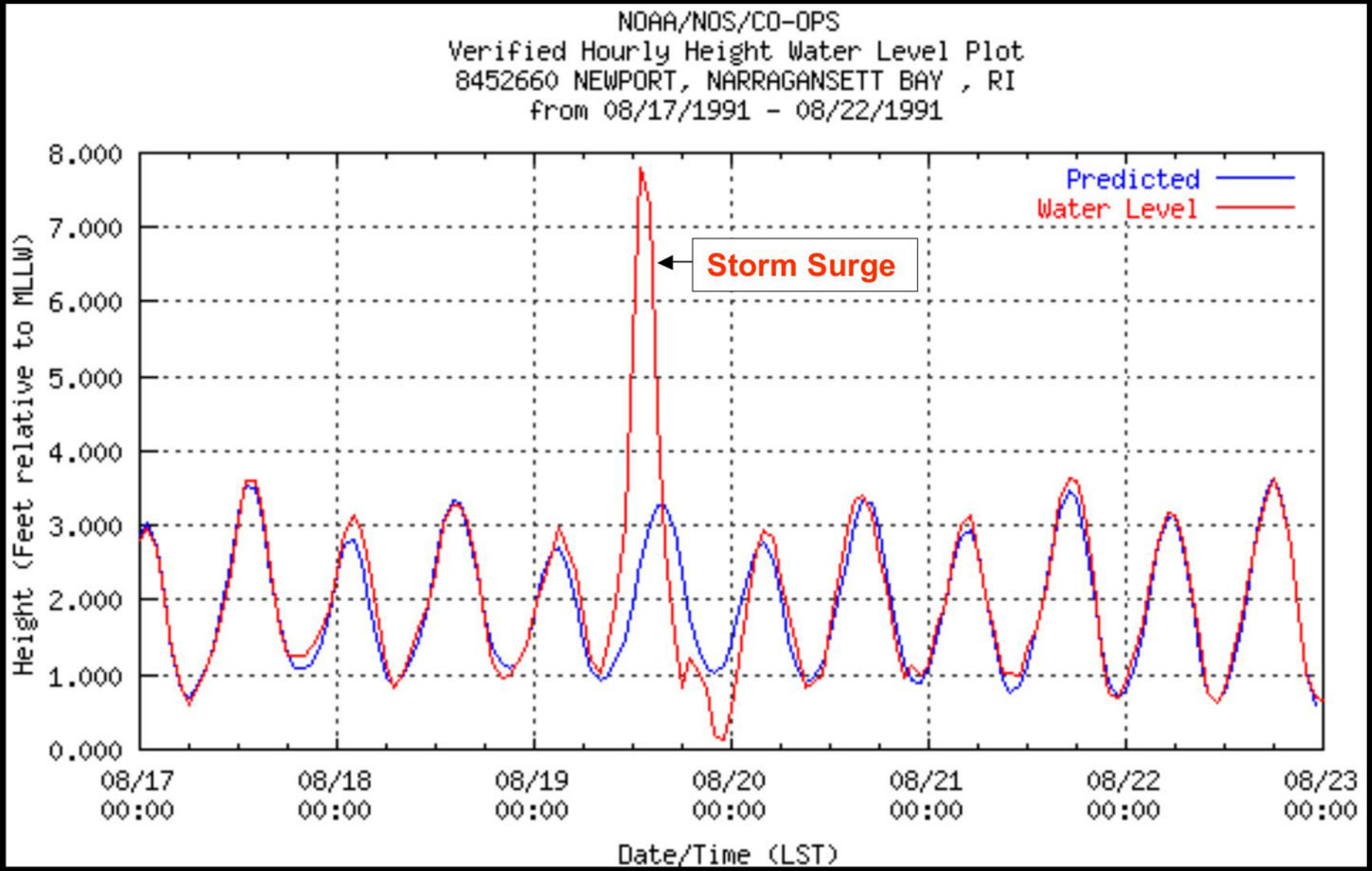
South Kingstown Town Beach

South Kingstown Town Beach


Combined Flow
Coastal Set-Up
Storm Waves
High Velocity Wind Shear (Southerly Wind)
Dune Crest
MLLW
Elevation (m)
5
0
-5
-10
-15
-20
0
1
2
3
4
Distance Offshore (Km)
Wind-Driven Surface Currents
Near-Bottom Wave Orbital Motion
Downwelling Flow

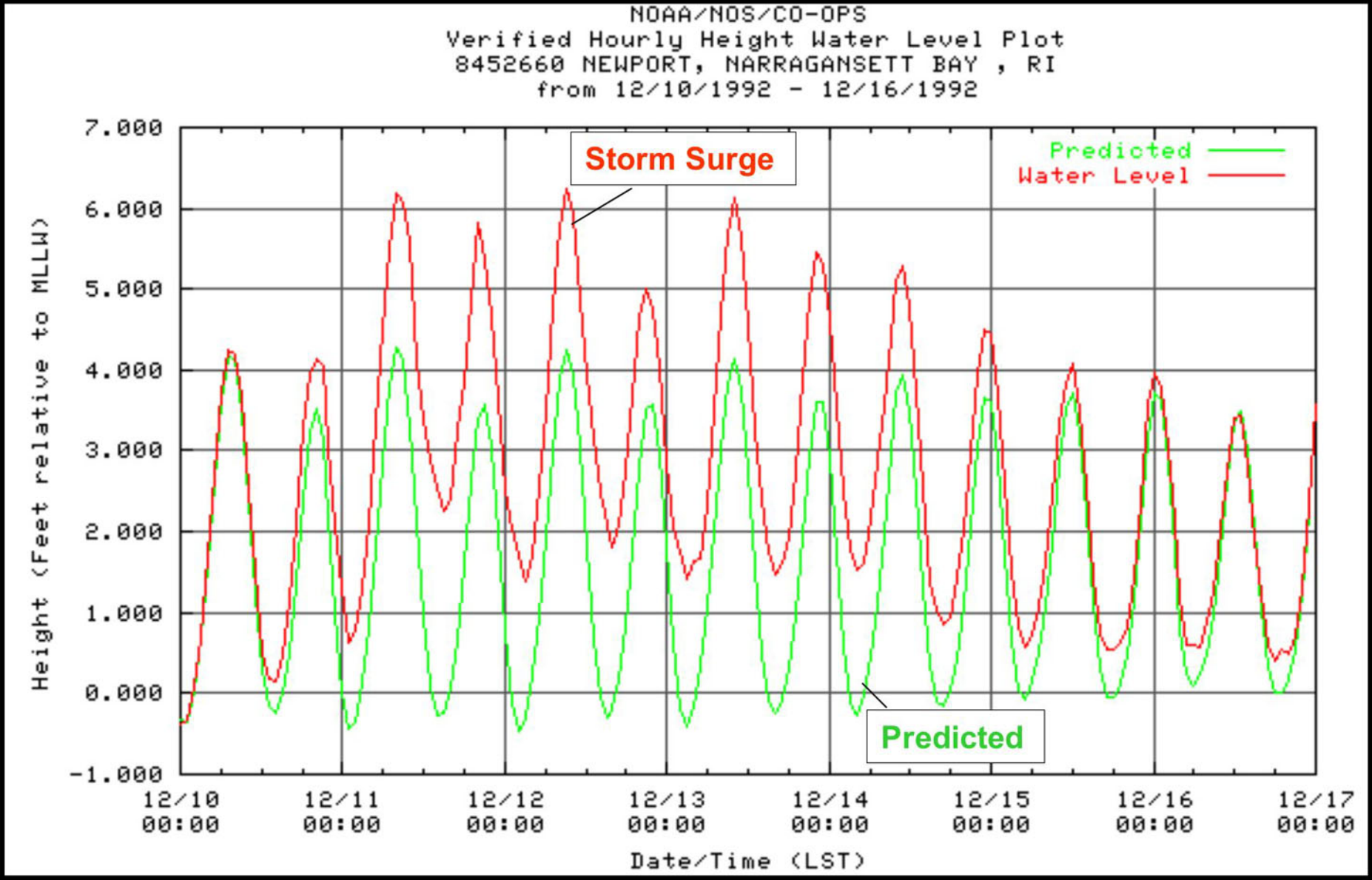


HURRICANE BOB 1991



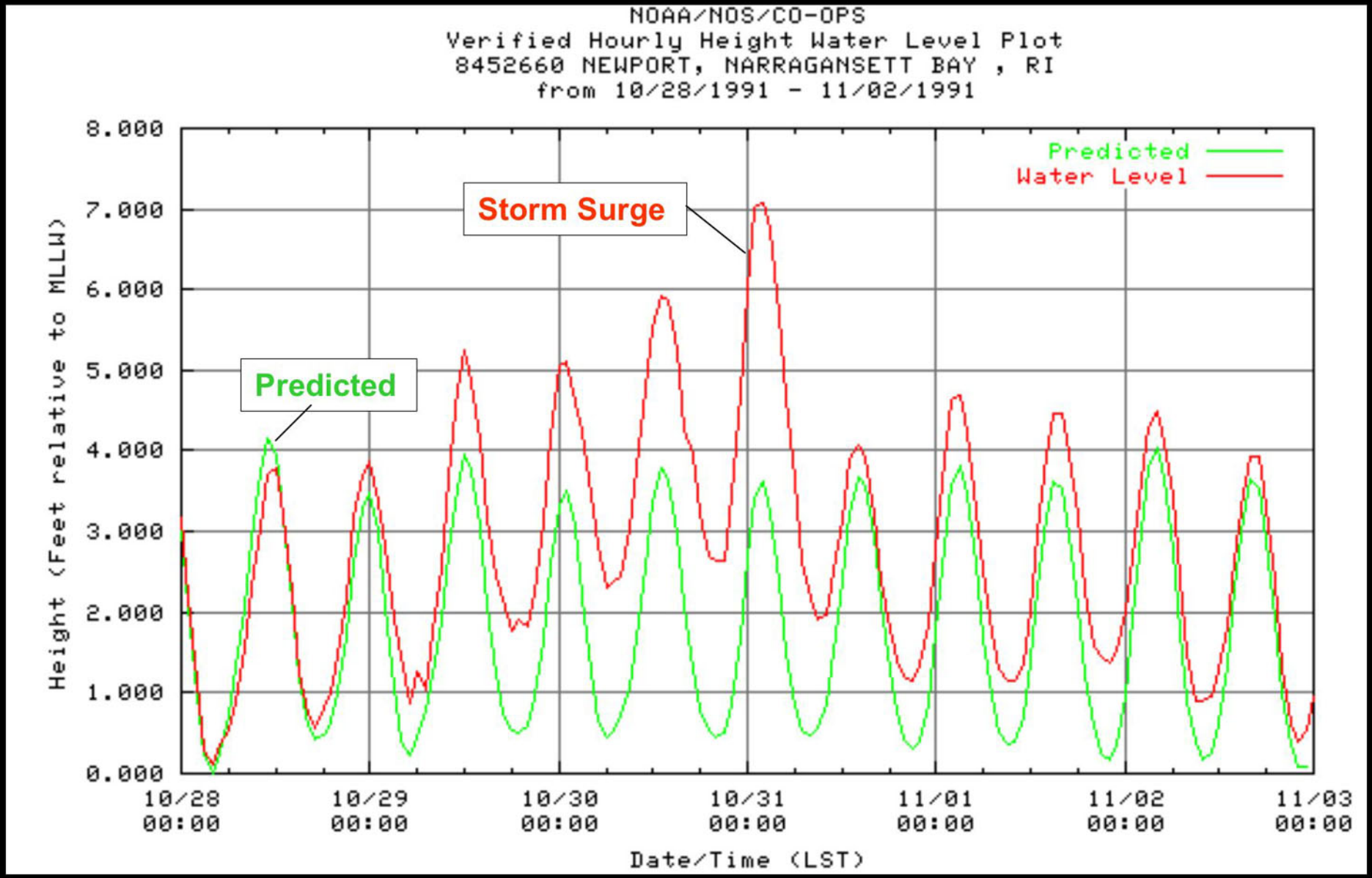
NOAA/NOS/CO-OPS

BLIZZARD – DEC 1992



http://co-ops.nos.noaa.gov/

PERFECT STORM – OCT-NOV 1991



http://co-ops.nos.noaa.gov/

Providence Journal, 1938

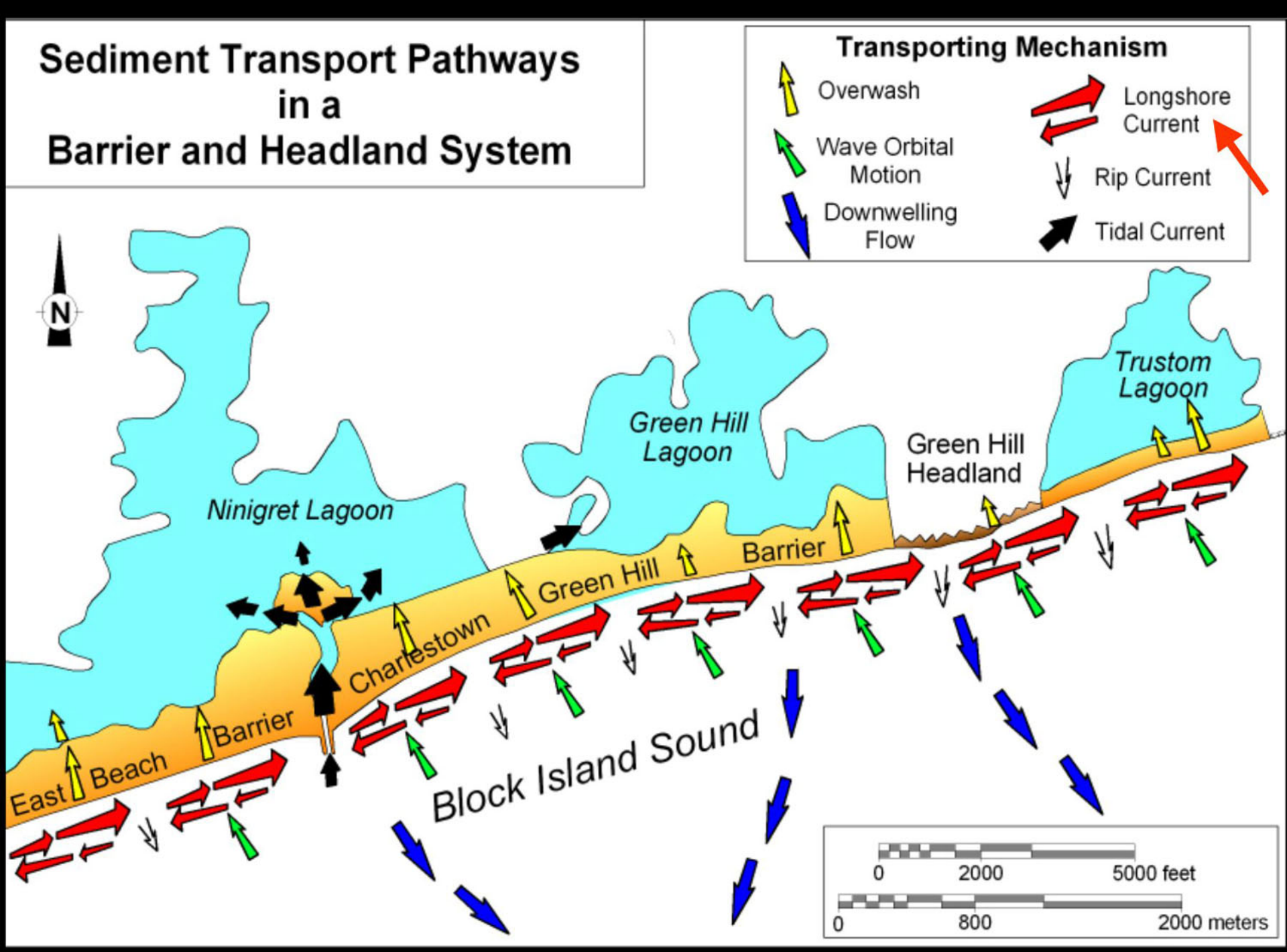
Providence Journal, 1938

MISQUAMICUT – US 1A

Providence Journal, 1938

GULFPORT, MS – 2 Sept 2005

http://www.nicholas.duke.edu/psds/Katrina/gulfport/


Sediment Transport Pathways
in a
Barrier and Headland System
Transporting Mechanism
Overwash
Wave Orbital Motion
Downwelling Flow
Longshore Current
Rip Current
Tidal Current
N
Ninigret Lagoon
Green Hill Lagoon
Trustom Lagoon
Green Hill Headland
East Beach Barrier
Charlestown
Green Hill Barrier
Block Island Sound
0 2000 5000 feet
0 800 2000 meters

23 May 1978

South Kingstown Town Beach

August 1994

SOUTH KINGSTOWN TOWN BEACH

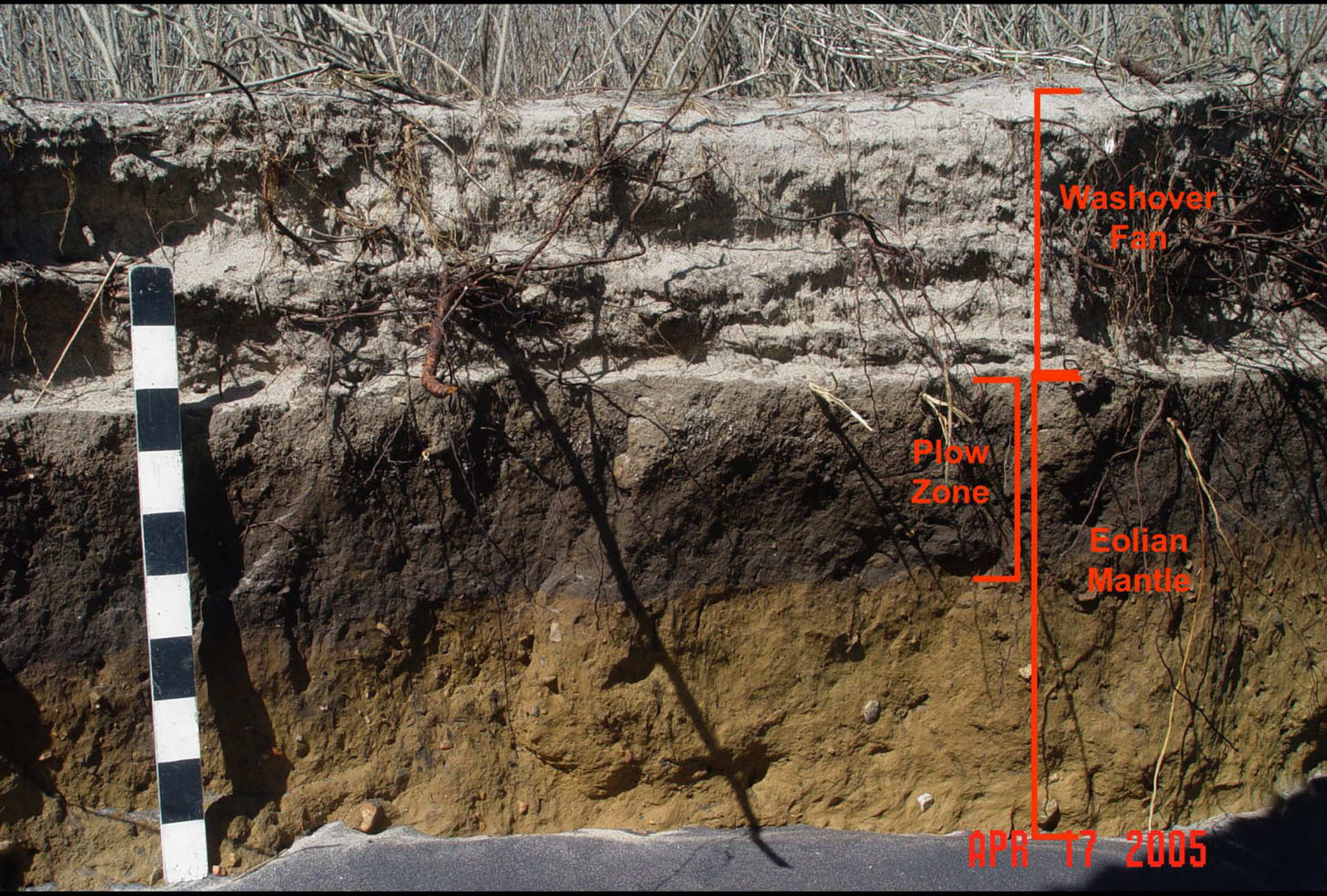
COASTAL HAZARDS GROUP
GEOLOGY Univ RI

Boothroyd, 1998

SOUTH KINGSTOWN
TOWN BEACH
APR 10 2005

South Kingstown Town Beach

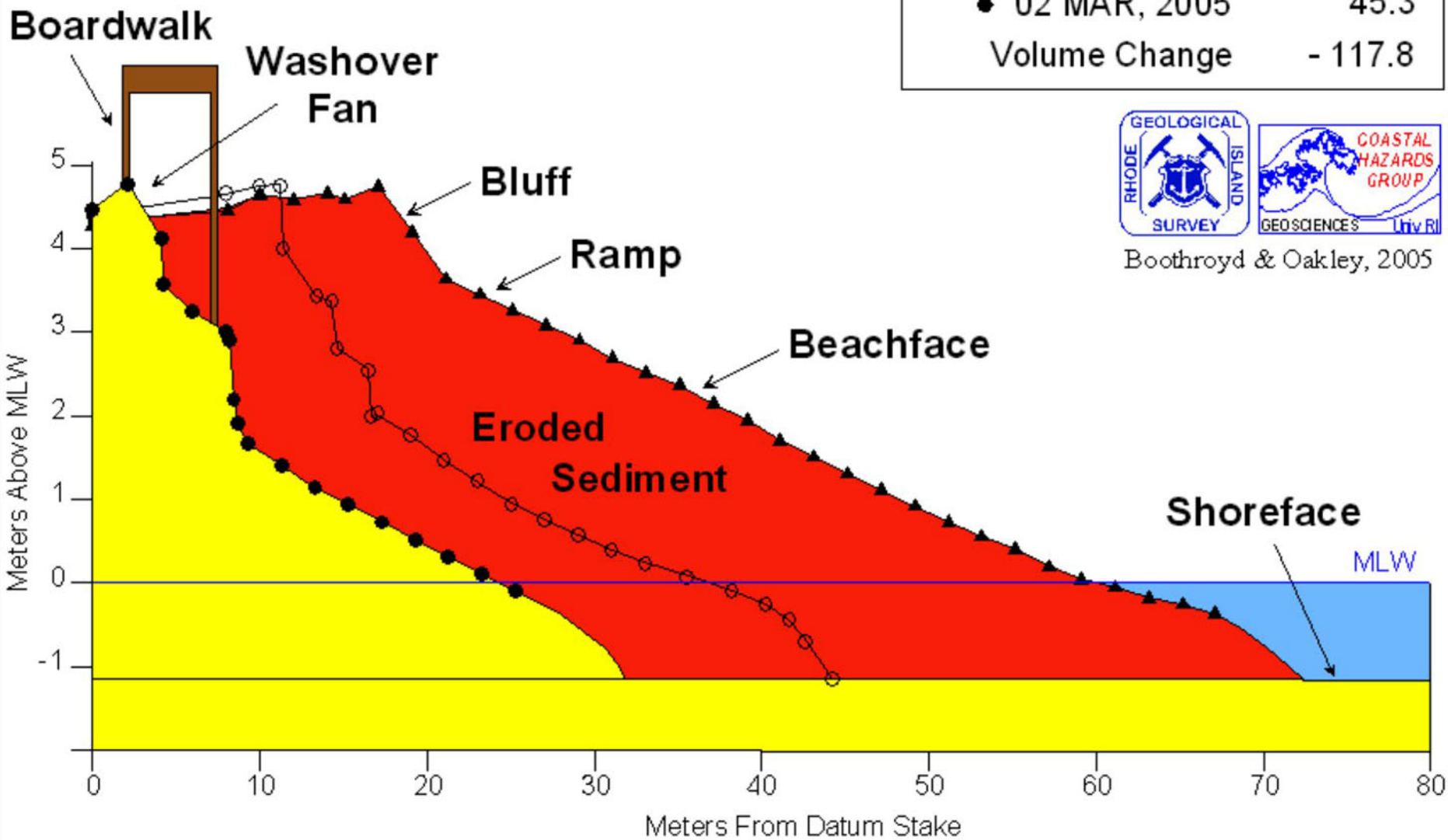
South Kingstown Town Beach



South Kingstown Town Beach

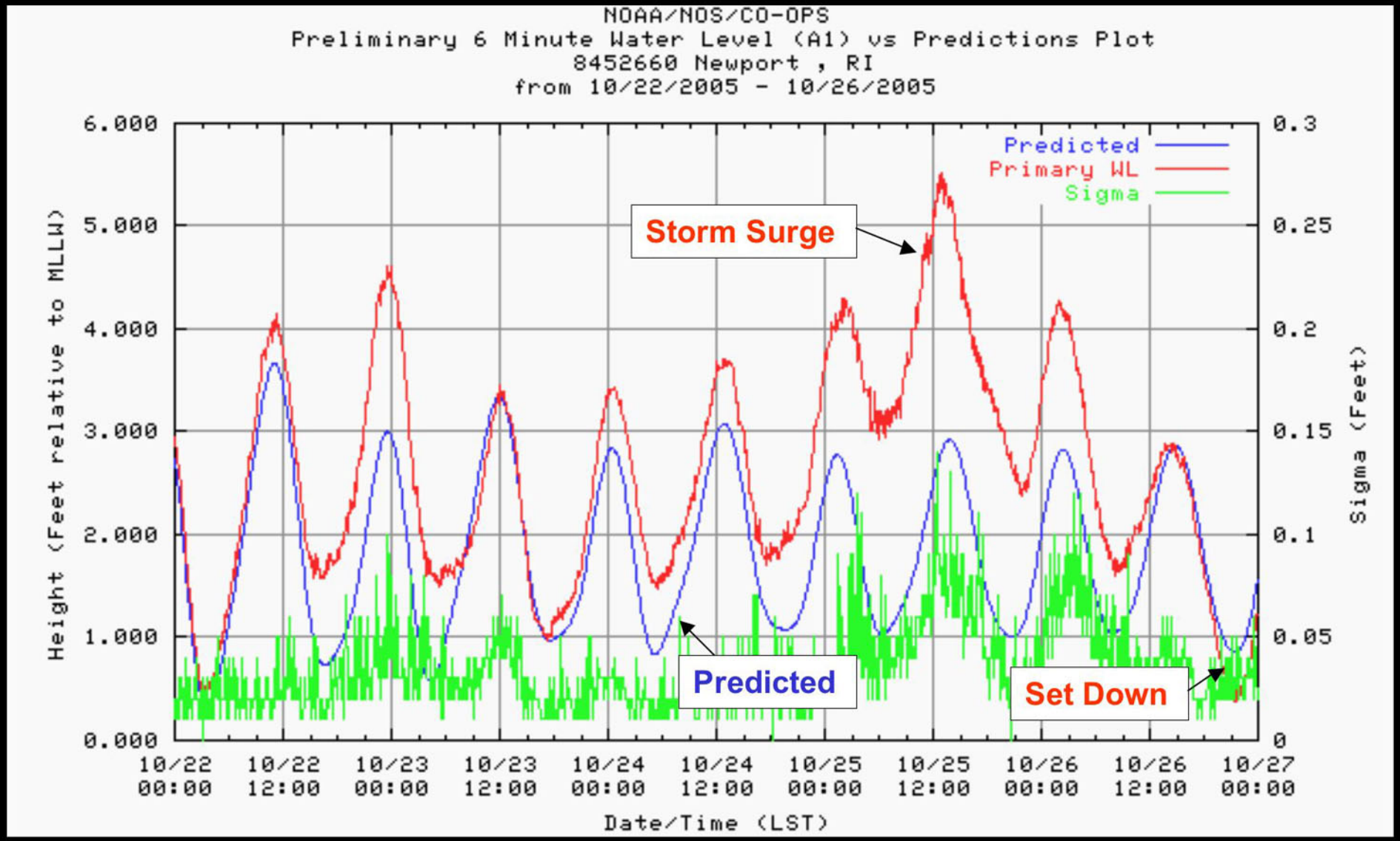
An Eroding Bluff Shoreline

Profile Volume	$m^3\ m^{-1}$
▲ 20 AUG, 1996	163.1
○ 10 MAR, 1998	86.7
● 02 MAR, 2005	45.3
Volume Change	- 117.8



Boothroyd & Oakley, 2005

MODERATE STORM – Oct 2005



http://co-ops.nos.noaa.gov/

25 Oct 2005

25 Oct 2005

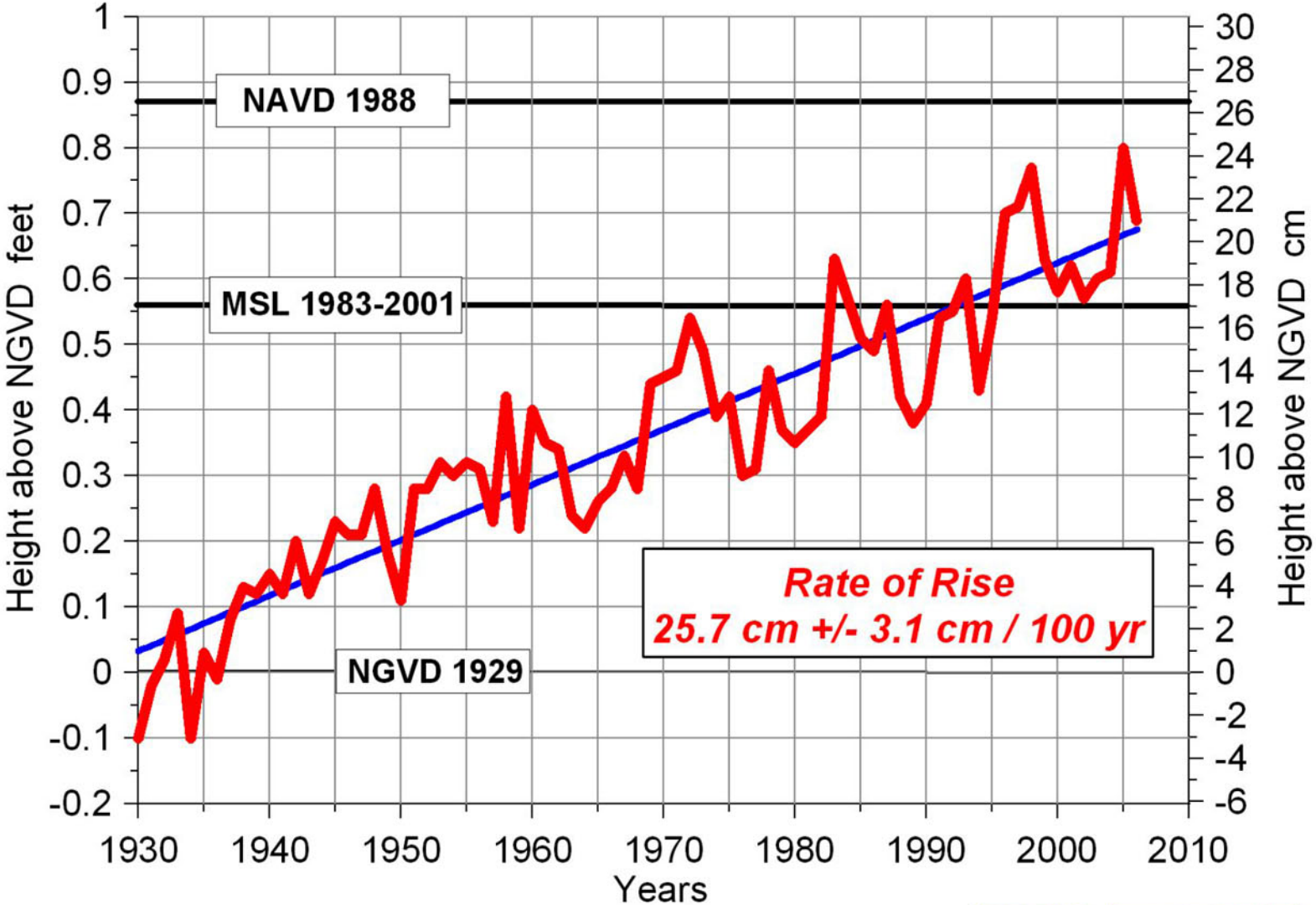
GEOLOGIC HISTORY of the SOUTHERN RHODE ISLAND SHORELINE

Jon C Boothroyd *jon_boothroyd@uri.edu*

SEA-LEVEL RISE

- **Historic Trend – Eustatic and Isostatic**
- **Accelerated Rise caused by Global Warming**
- **Forecasting for Rhode Island**

HISTORIC SEA-LEVEL RISE - Newport, RI



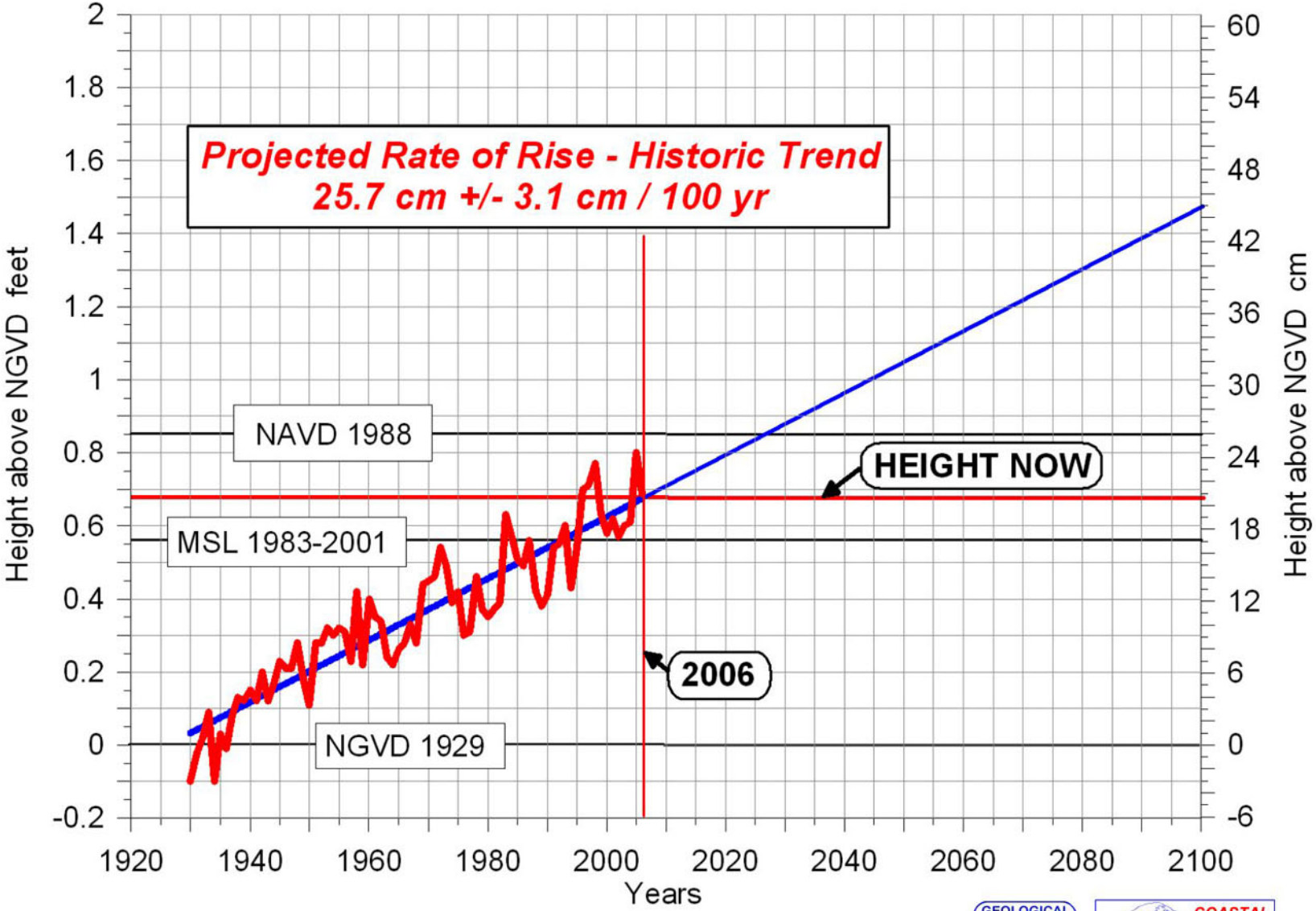
adapted from http://www.coops.nos.noaa.gov/sltrends

GEOLOGICAL RHODE ISLAND SURVEY

COASTAL HAZARDS GROUP GEOSCIENCES Univ RI

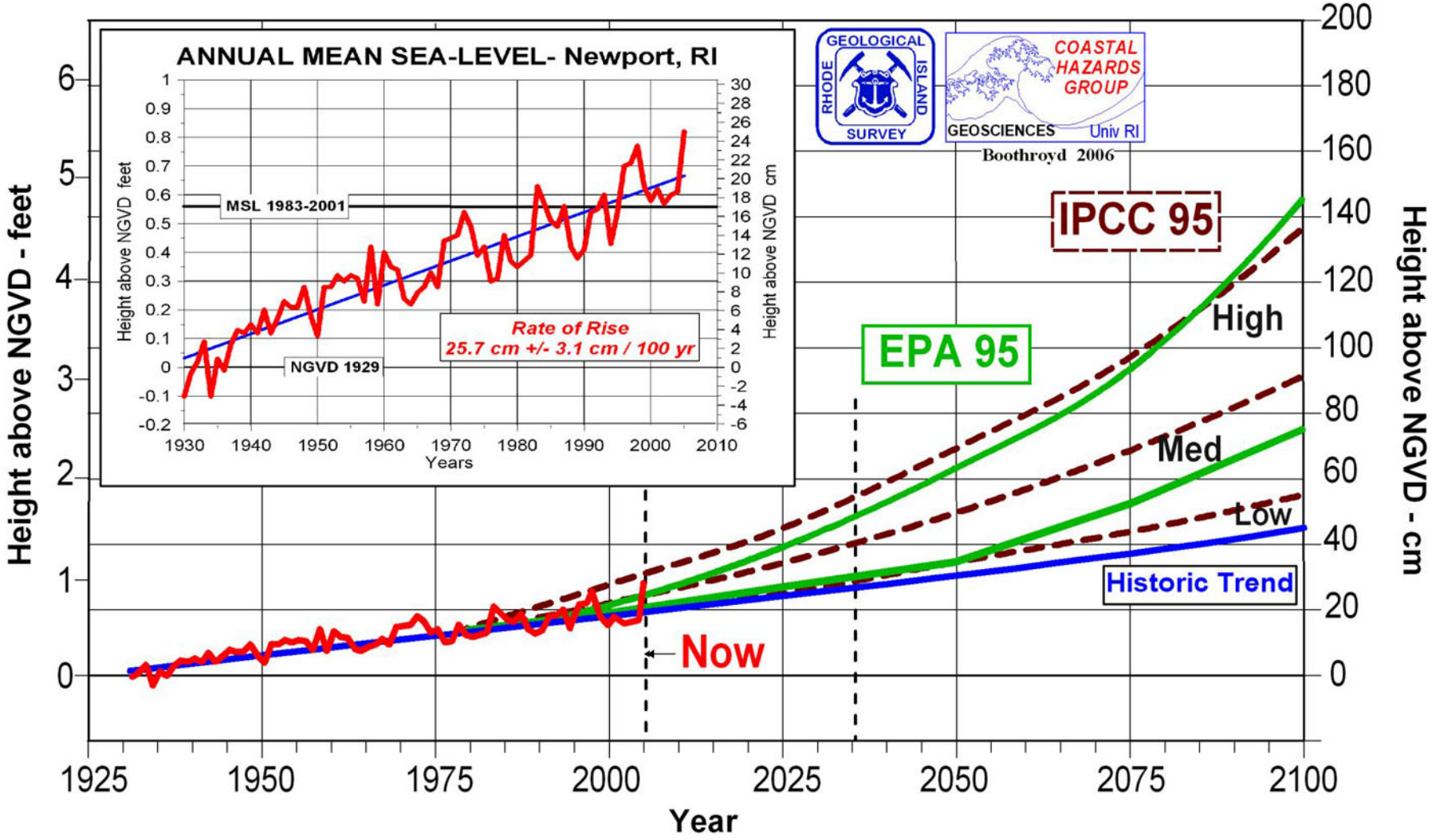
Boothroyd 2006

PROJECTED SEA-LEVEL RISE - Newport, RI



GEOLOGICAL SURVEY RHODE ISLAND

COASTAL HAZARDS GROUP GEOSCIENCES Univ RI

Boothroyd 2006

ACCELERATED SEA-LEVEL RISE at NEWPORT, RI