SECTION 227

An Evaluation of Performance Measures for Prefabricated Submerged Concrete Breakwaters:

Section 227
Cape May Point, New Jersey
Demonstration Project

2.5 Year Results

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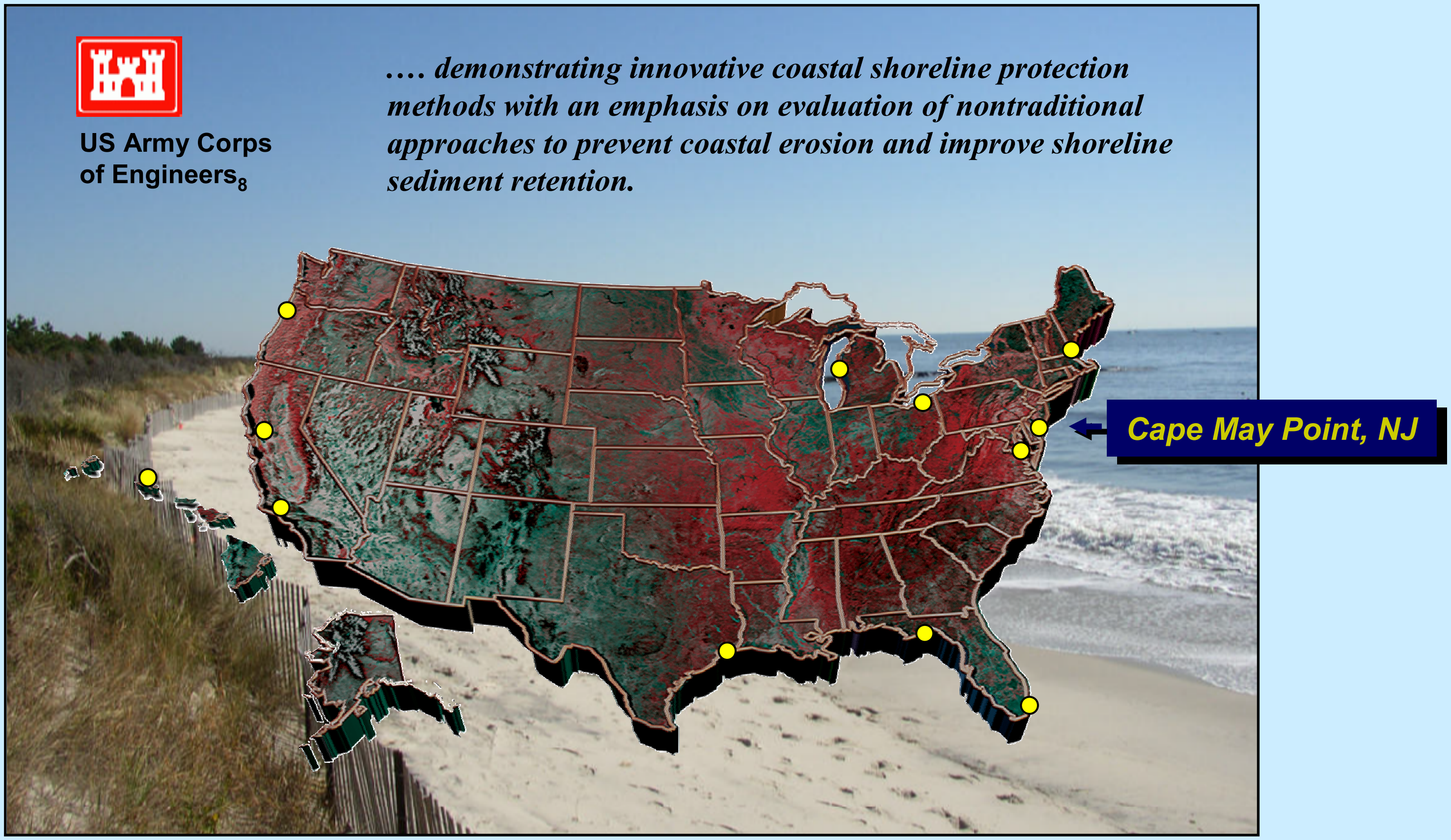
National Shoreline Erosion Control Demonstration and Development Program



OBJECTIVES

SECTION 227

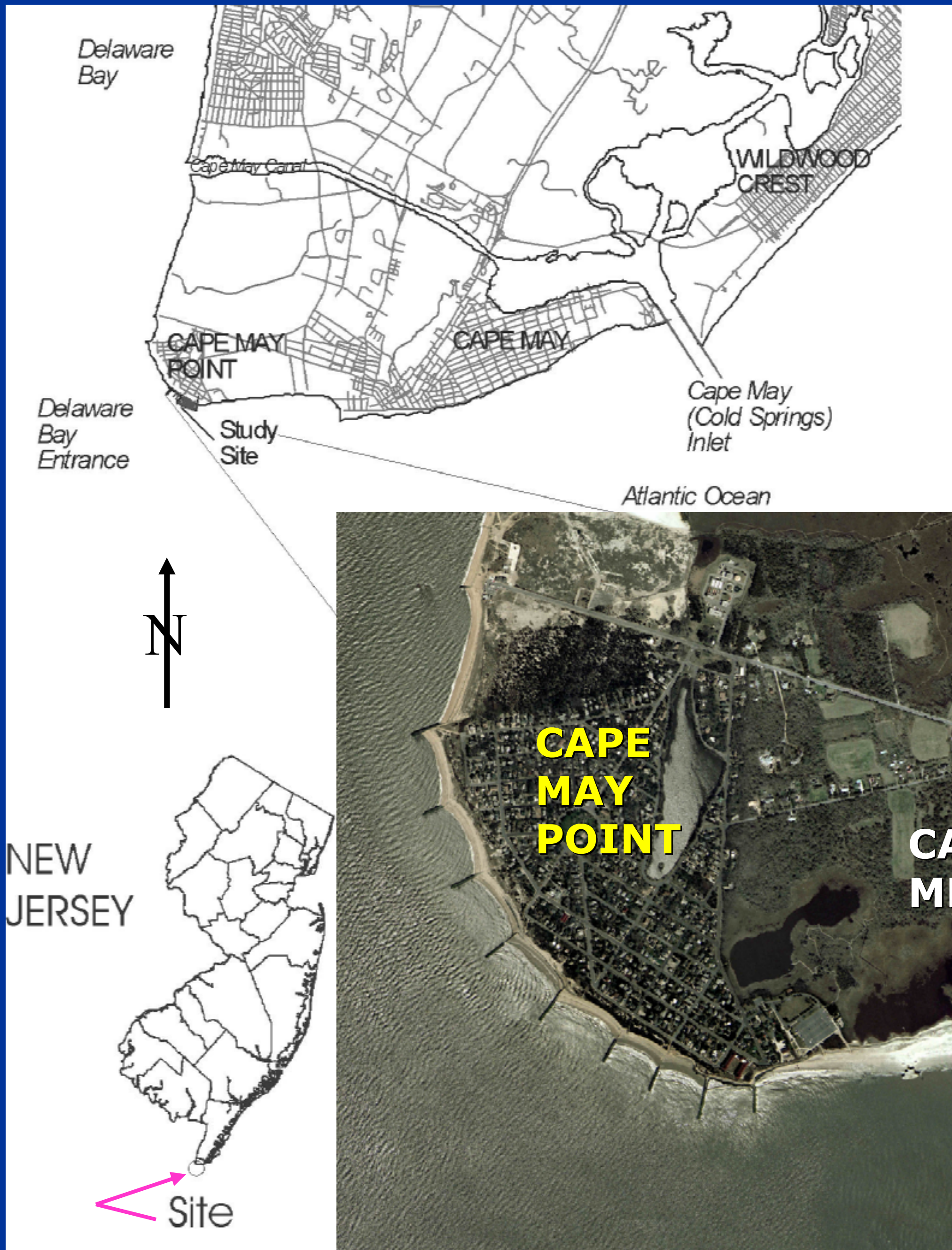
1) To evaluate the effectiveness of the two submerged structures in retaining sand on the beach as compared with unprotected groin compartments

2) Compare the effectiveness of the more costly *Beachsaver Reef* with the less costly *Double-T Sill* in retaining sand in groin compartments

3) Evaluate ability of both structures to retain Beach Fill after placement

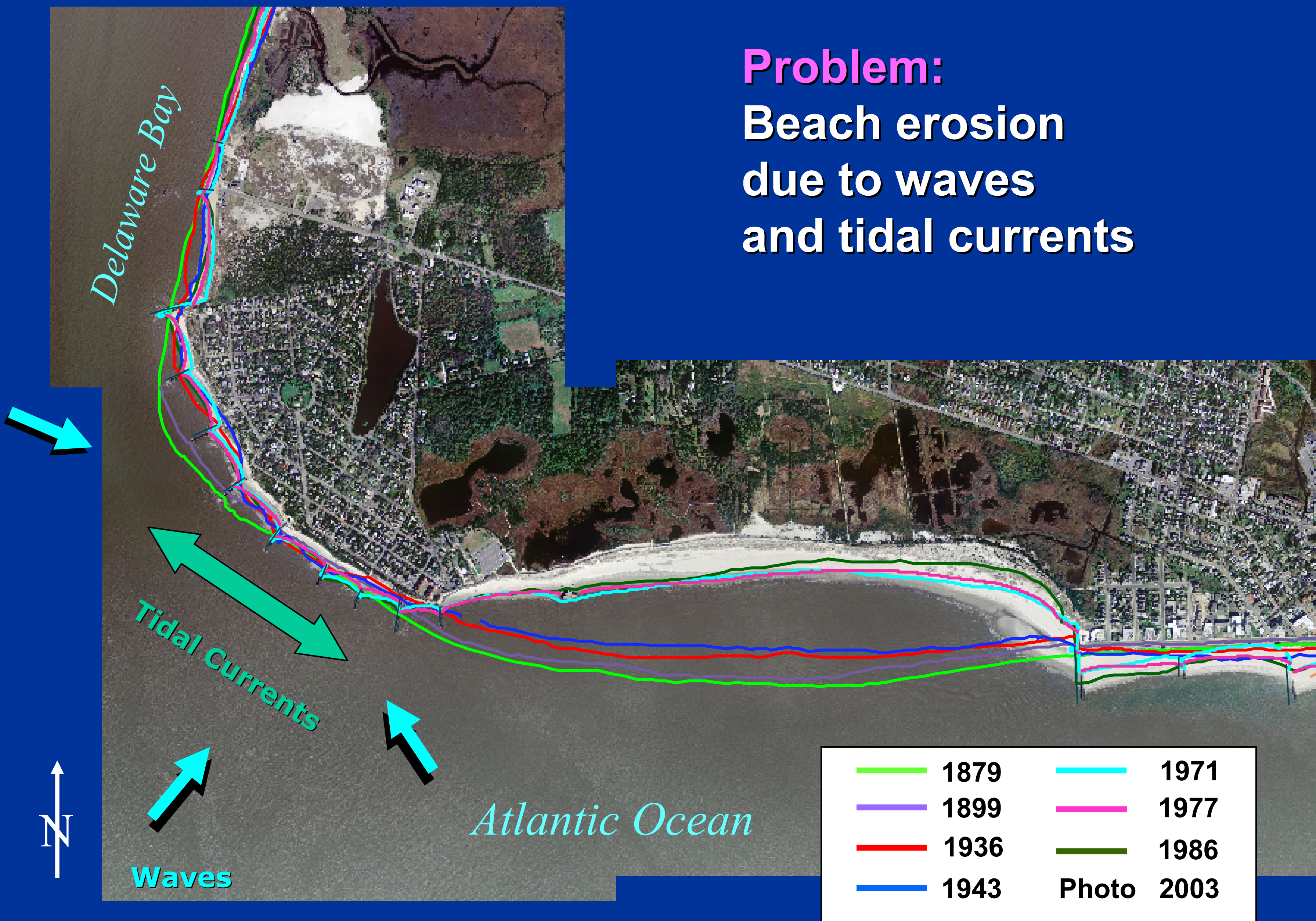
SITE LOCATION

CAPE MAY POINT is
southern most beach in
New Jersey at
entrance to Delaware Bay

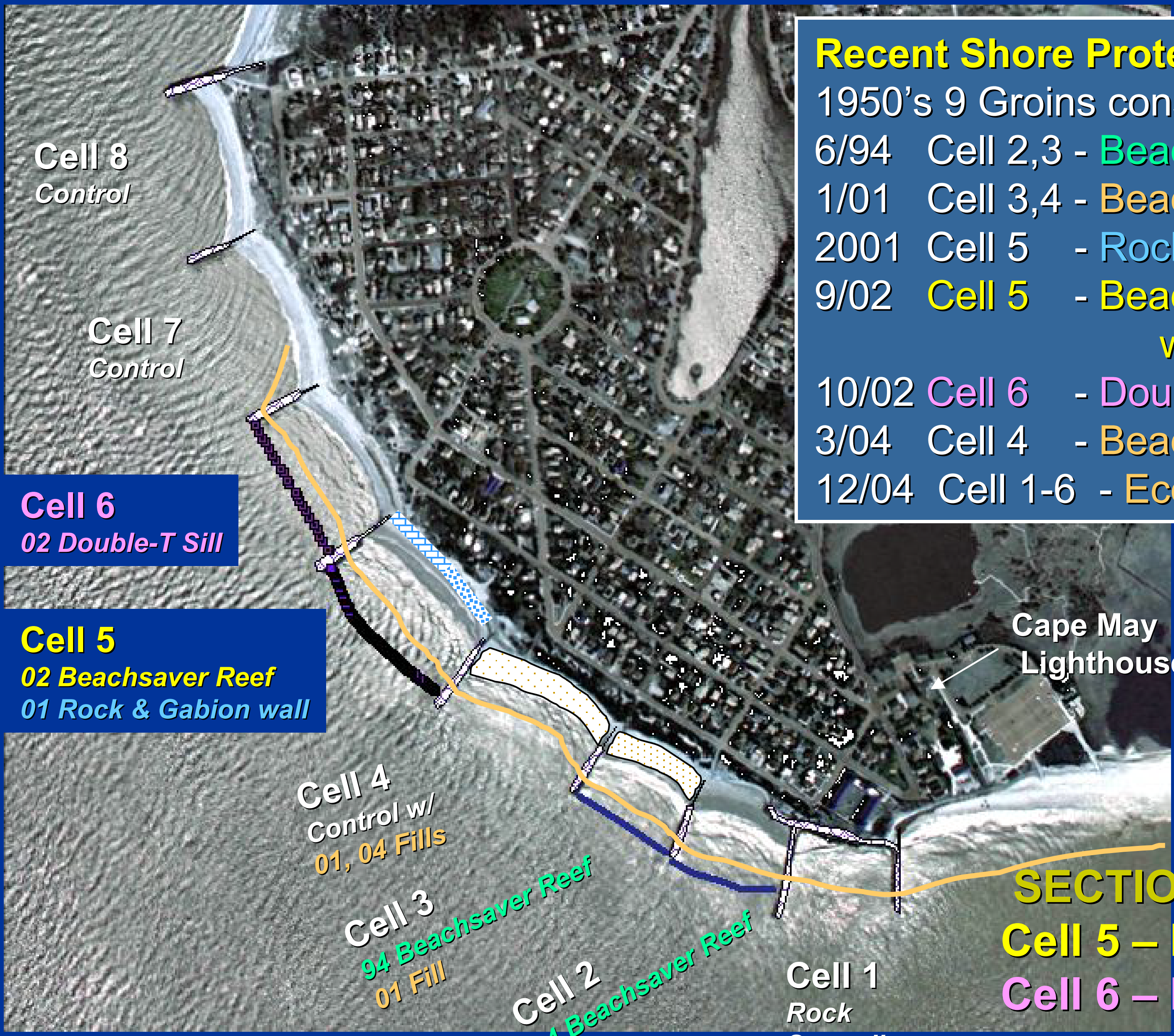


HISTORICAL SHORELINE CHANGE

Problem:
Beach erosion due to waves and tidal currents



CAPE MAY POINT SITE LAYOUT



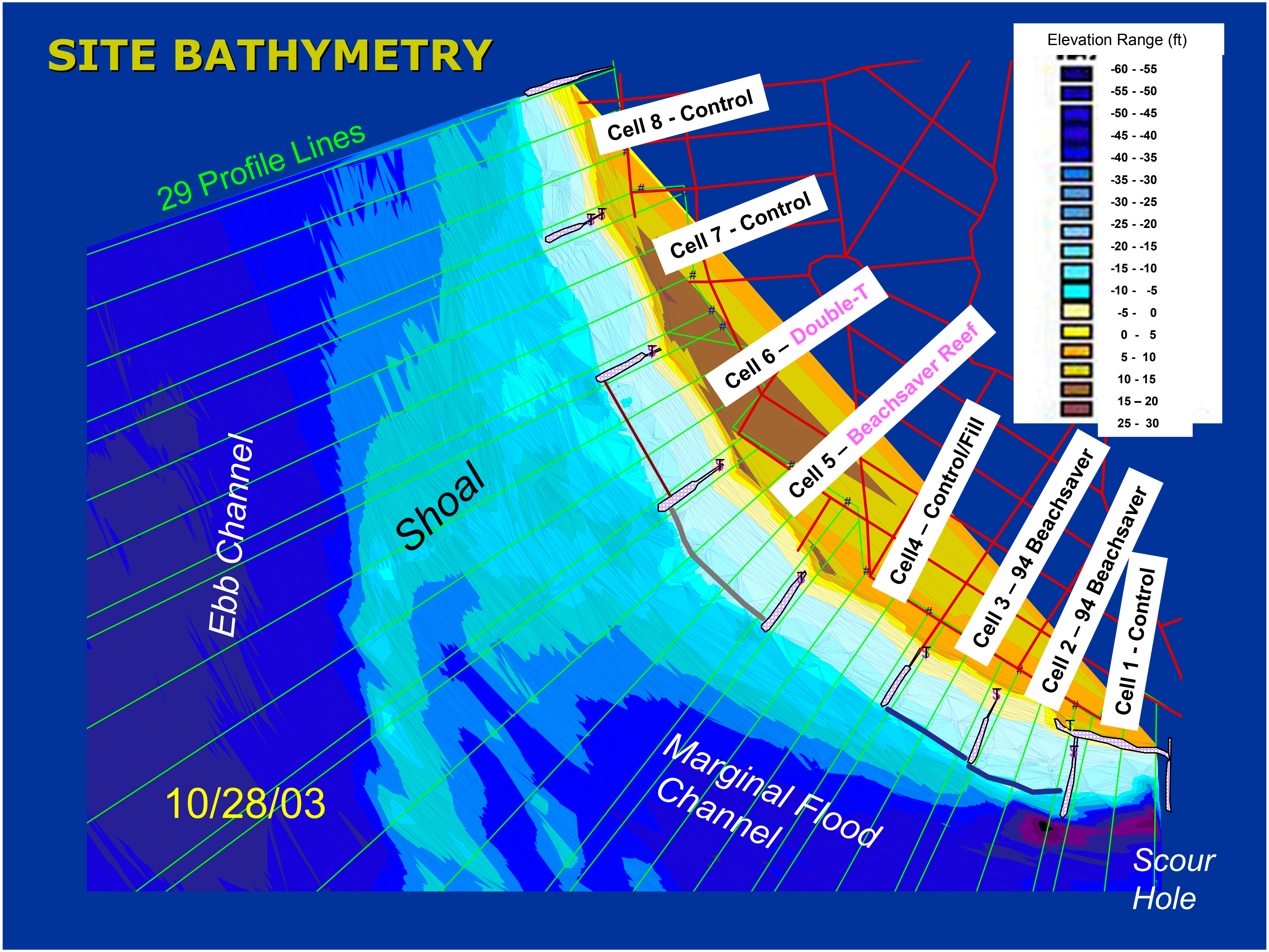
Recent Shore Protection History:

1950's 9 Groins constructed
6/94 Cell 2,3 - Beachsaver Reef
1/01 Cell 3,4 - Beach fill
2001 Cell 5 - Rock & Gabion wall
9/02 Cell 5 - Beachsaver Reef w/ filter
10/02 Cell 6 - Double-T Sill
3/04 Cell 4 - Beach Fill
12/04 Cell 1-6 - Eco Res. Beach Fill

SECTION 227 PROJECT

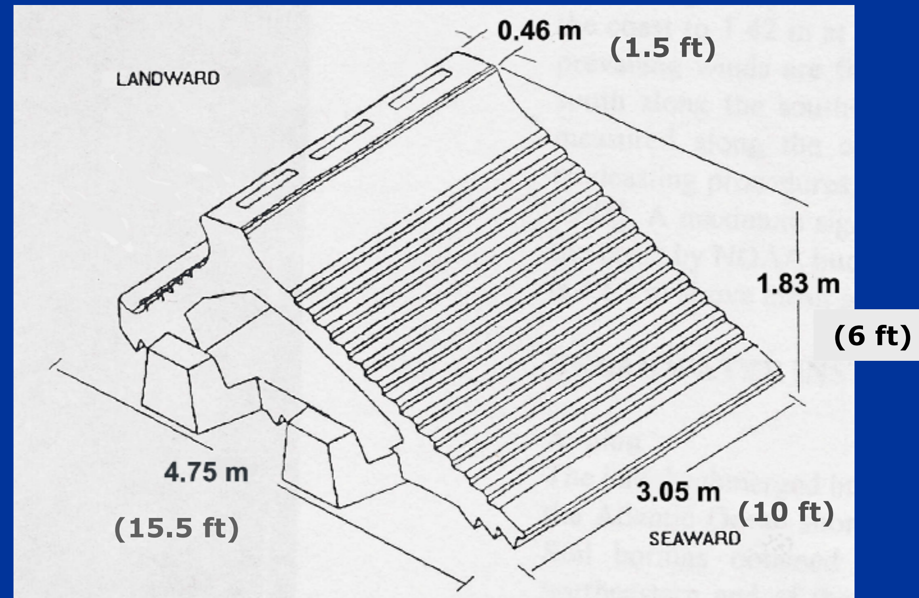
Cell 5 – Beachsaver Reef

Cell 6 – Double-T Sill

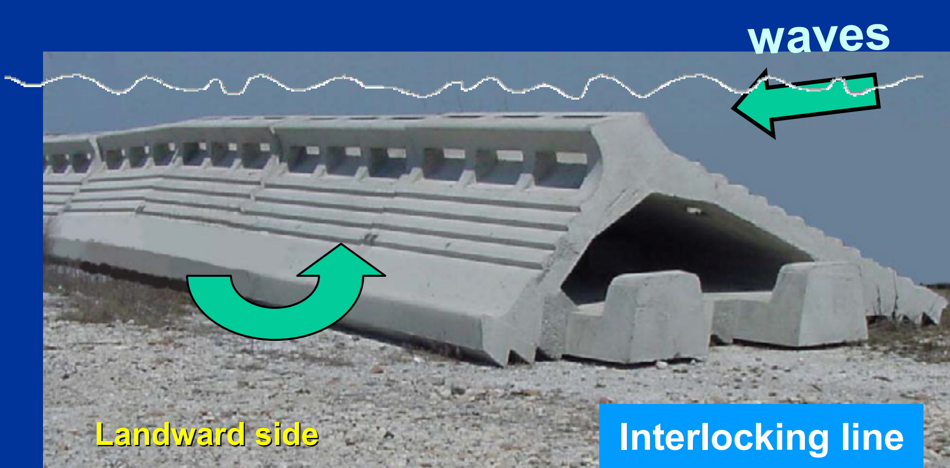

SITE BATHYMETRY
Elevation Range (ft)
-60 - -55
-55 - -50
-50 - -45
-45 - -40
-40 - -35
-35 - -30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
0 - 5
5 - 10
10 - 15
15 – 20
25 - 30
29 Profile Lines
Cell 8 - Control
Cell 7 - Control
Cell 6 – Double-T
Cell 5 – Beachsaver Reef
Cell4 – Control/Fill
Cell 3 – 94 Beachsaver
Cell 2 – 94 Beachsaver
Cell 1 - Control
Ebb Channel
Shoal
Marginal Flood Channel
Scour Hole
10/28/03

BEACHSAVER REEF

Three reef units placed over
each filter fabric scour prevention layer

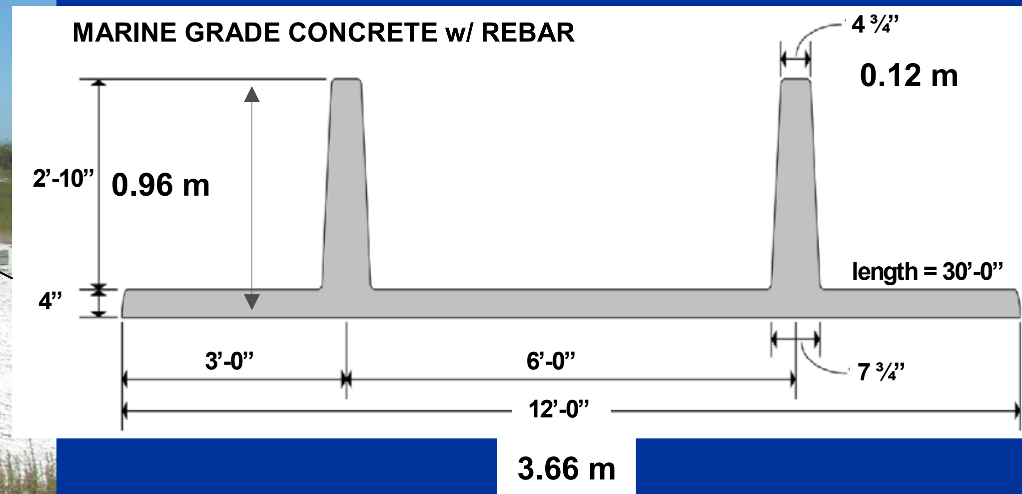


Placed in ~ -9 ft NAVD of water
~ -2.7 m NAVD
Top of reef just below water line at Low water

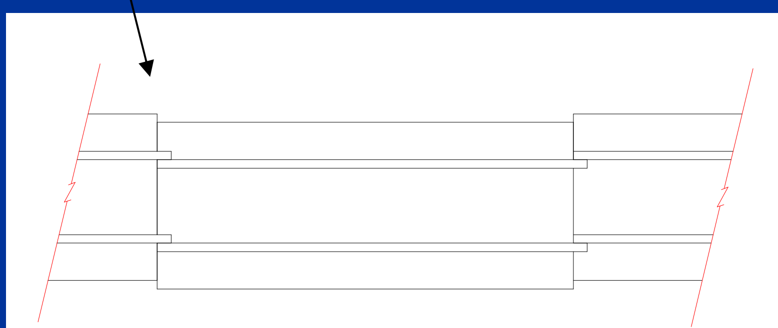


DOUBLE – T SILL

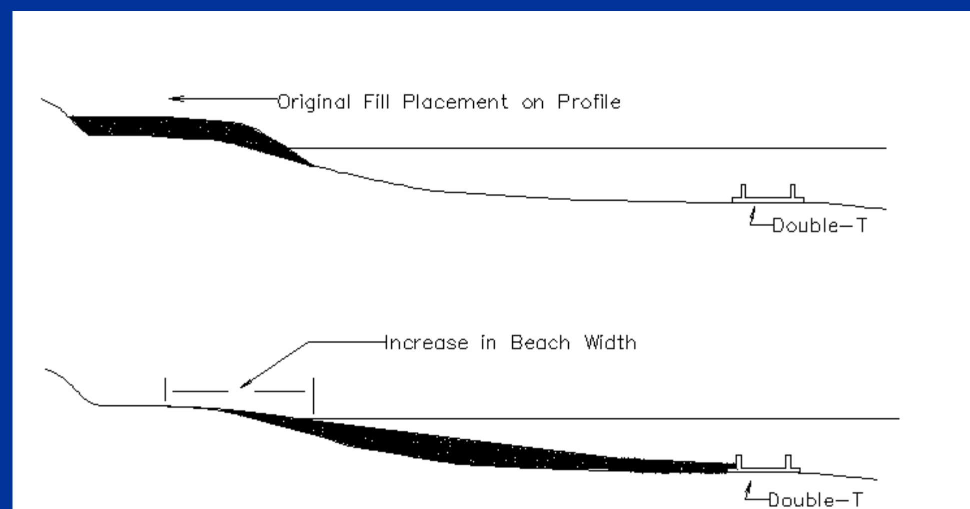
Units placed on sand (no filter cloth)
At ~ -9 ft NAVD w/ crest at –6 ft at low water
At ~ -2.7 m NAVD w/crest at –1.8 m at low water



Interlocking End



Alignment - Plan View



Sill Concept

MONITORING PROJECT PERFORMANCE

SECTION 227

- **Functional Performance**

  Sand Retention - Volume Change
  Change in MHW Shoreline Position

- **Economic Performance**

  Reduction in Renourishment Quantities & Lengthening Fill Cycle - Improve Protection
  Reduce Uncertainty
  Reduce Costs

- **Structural Performance**

  Structural Stability - Change in Structure Crest Elevation
  Alongshore Integrity
  Depth of Scour

PERFORMANCE CRITERIA

Structure vs. Non-Structured Cells
Beachsaver Reef vs. Double-T Sill

SECTION 227

- **Functional Performance –** Sand Retention: *A) Sand Volume*
  B) Dry Beach Width

A1. Structure successful if retains >30% sand volume than non-structured cell
A2. Structure outperforms competing design if retains >30% sand volume
B1. Structure successful if retains >30% dry beach width than non-structured cell
B2. Structure outperforms competing design if retains >30% dry beach width

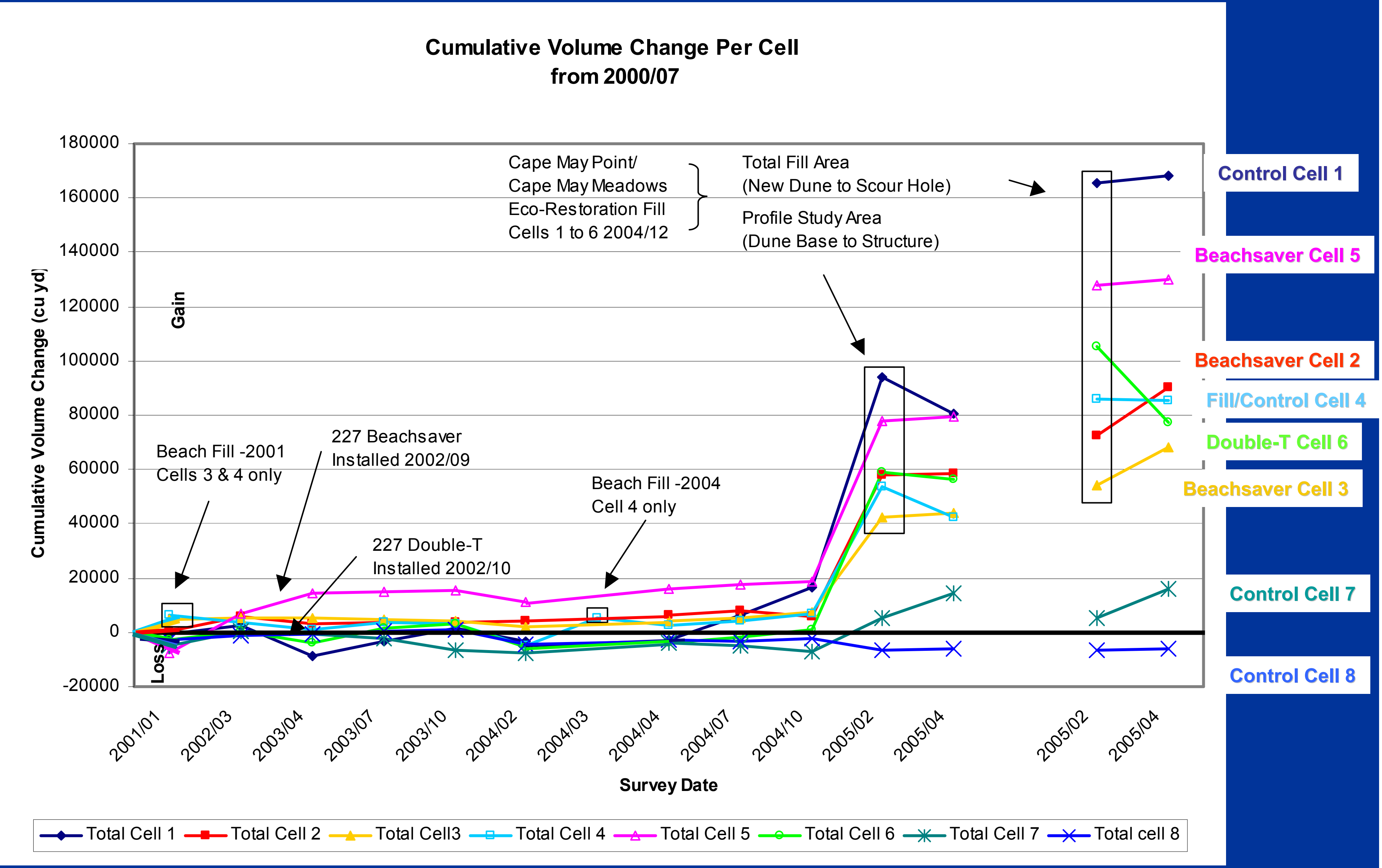
- **Economic Performance –** *A) Reduction in Renourishment Quantities*
  B) Lengthening Fill Cycle

A1. Structure successful if average annual renourishment cost savings > average annual cost of structure
A2. Structure outperforms competing design if incremental renourishment cost savings > incremental structure costs
B1. Structure successful if average annual cost savings of longer renourishment cycle > average annual cost of structure
B2. Structure outperforms competing design if incremental cost savings of longer renourishment cycle > incremental structure costs

- **Structural Performance –** Structural Stability: *A) Crest Elevation*
  B) Alongshore Integrity
  C) Scour Depth

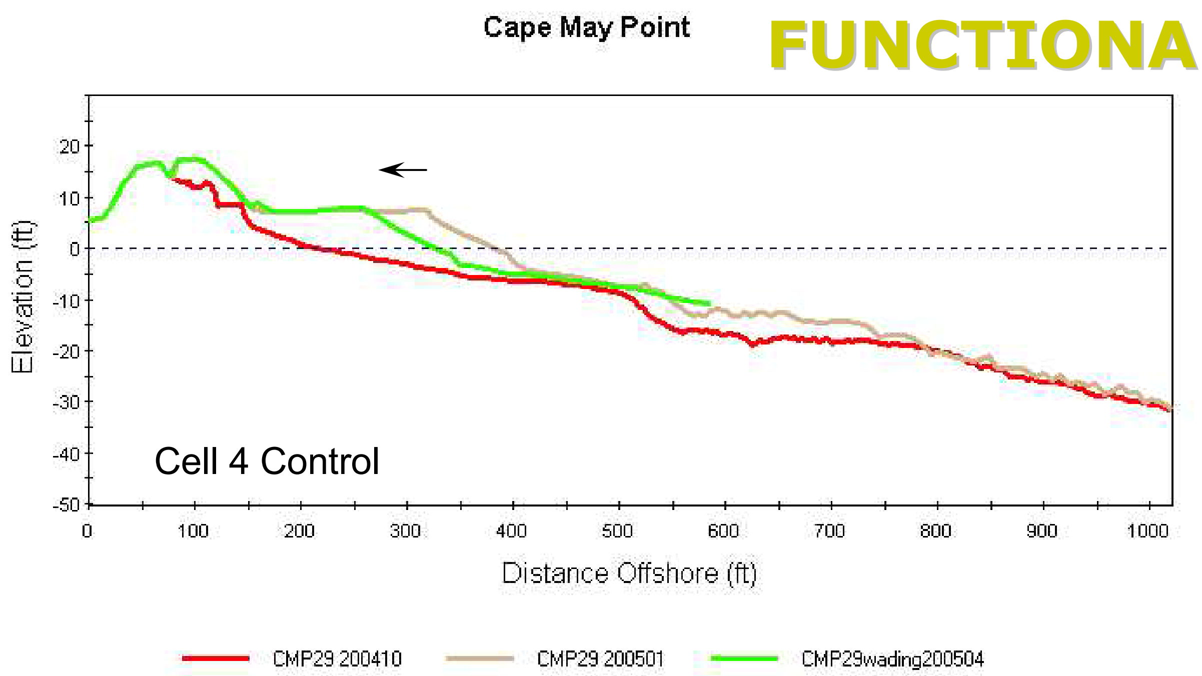
A1. Elevation Criteria: Successful if average lowering of crest elevation < 0.31 m (1 ft)
B1. Alongshore Integrity: Successful if no gaps form that result in localized sand loss through structure
C1. Scour: Successful if average scour is < 0.61 m (2 ft)

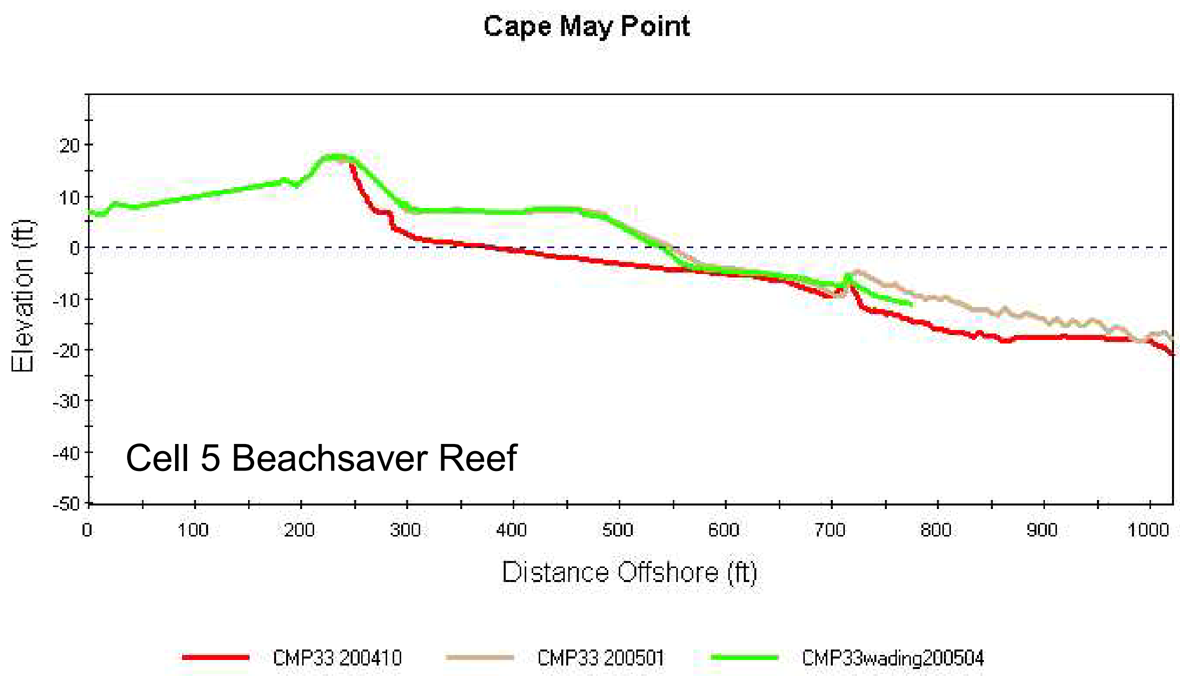
FUNCTION PERFORMANCE - Volume Change



FUNCTIONAL PERFORMANCE

Volume Change



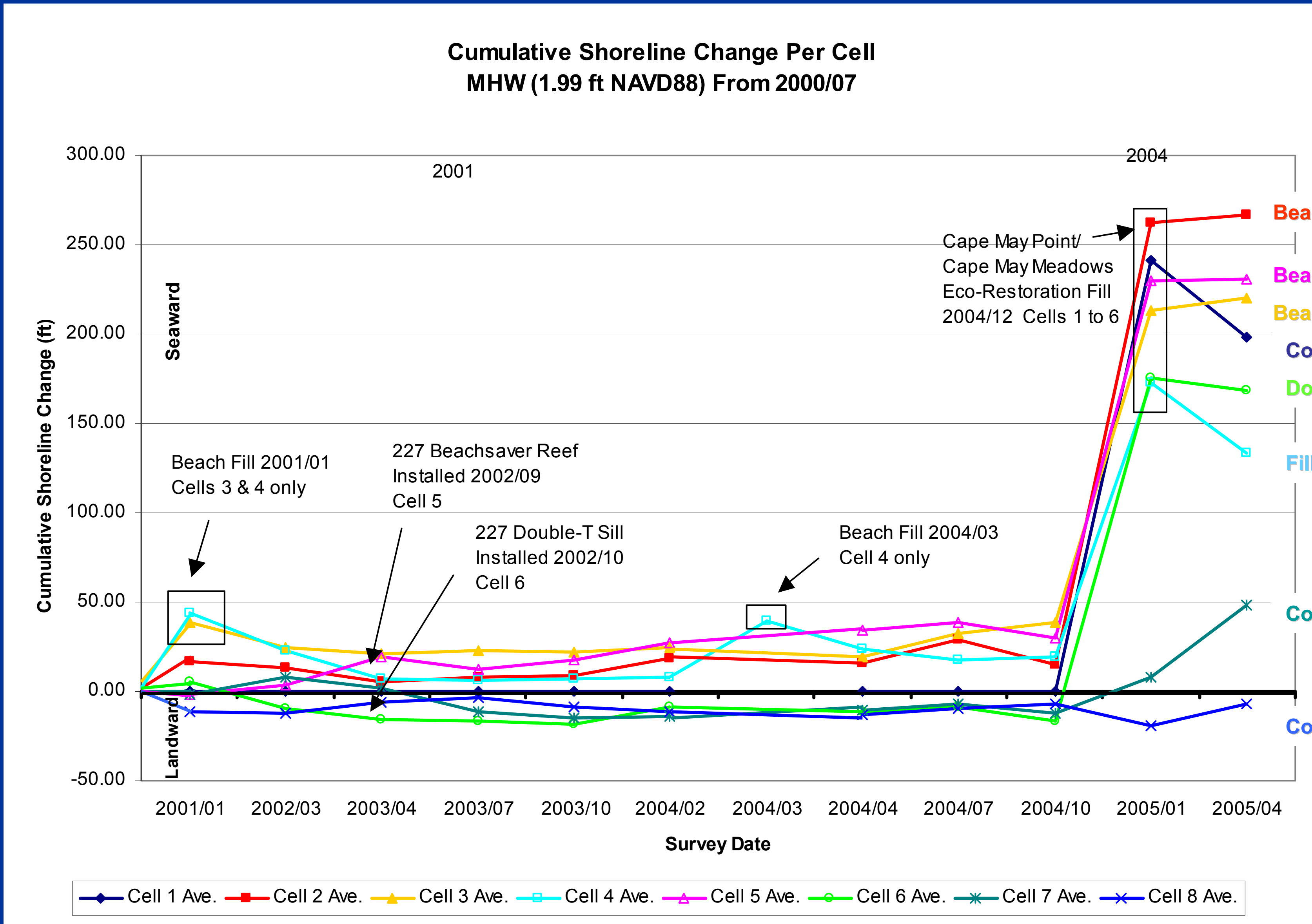


Pre -Fill

Post -Fill

4 Months

FUNCTION PERFORMANCE – MHW Shoreline Change




FUNCTIONAL PERFORMANCE
MHW Shoreline Change
Cell 6 - Double-T
Cell 5 - Beachsaver
Cell 4 - Control
Cell 3 - 94 Beachsaver
Cell 2 - 94 Beachsaver
Cell 1 - Control
Pre fill
Post-Fill
4 Months

ECONOMIC PERFORMANCE – Construction Costs

SECTION 227

Beachsaver Reef – 16 Aug to 25 Sep 02

➢5 weeks @cost of $1,440/lf

72 10-ft-long units covering 720 ft

- Filter cloth installation
- Excavation and fill required
- Placement of units w/ diver

Double-T Sill – 26 Sep to 2 Oct 02

➢4 days @ cost of $345/lf

22 30-ft-long units covering 660 ft

- NO Filter cloth installation
- Excavation and fill NOT required
- Placement of units w/ diver

(Cost of rock used in both cells to tie into groin tips not included in linear foot cost)

ECONOMIC PERFORMANCE -

SECTION

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Reduction in Renourishment Quantities & Lengthening Fill Cycle (Economic Performance/Life Cycle Cost Analysis)

Structures designed to act as a sill to retain sand within the groin compartment

2004 Cape May Meadows/Cape May Point Eco Restoration Project will document fill retention and extension of renourishment cycle time in cells with and without structures

Purpose: Relate engineering performance to economic costs

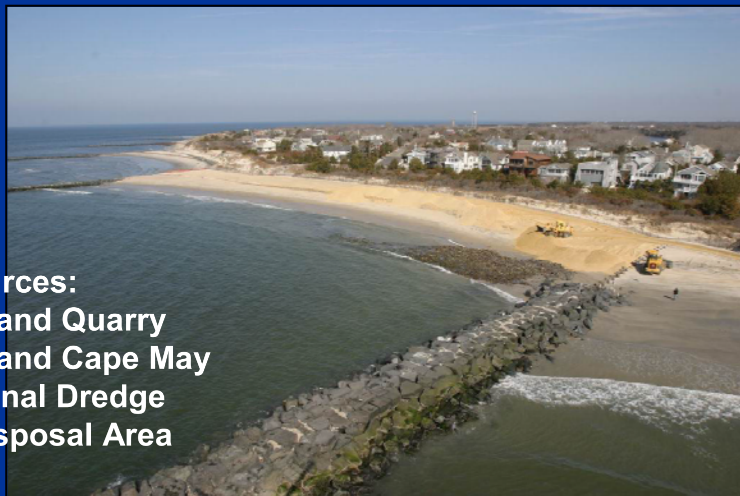
Goal: Evaluate improved performance (benefits) in relation to investment (costs)

Based on present monitoring
Anticipated savings in:

- Initial fill retention
- Longer renourishment intervals in cells with Beachsaver Reefs

BEACH FILLS – 1

Placed Cell 4 only - March 2004
To Protect Dune Base



2 Sources:
- Upland Quarry
- Upland Cape May
  Canal Dredge
  Disposal Area

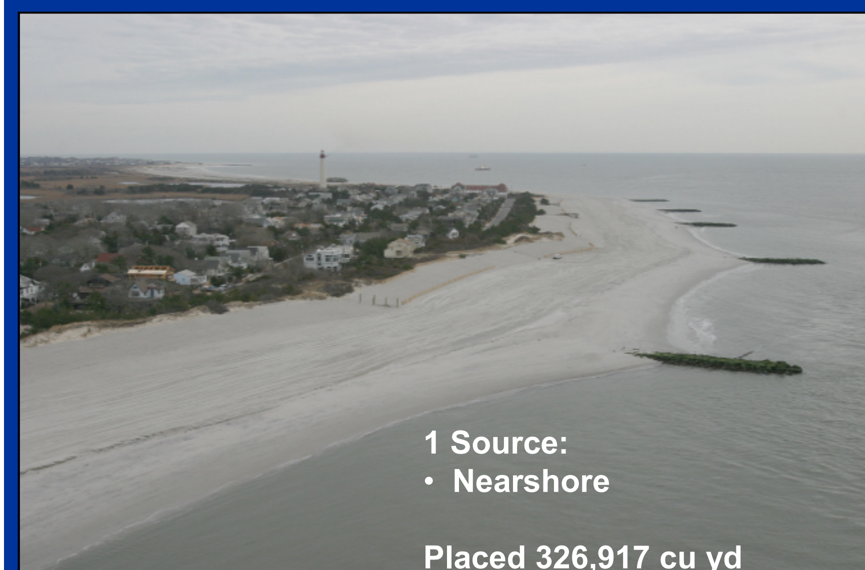
Placed 9,600 cu yd

4 months later

Post-fill: -16 ft shoreline retreat
48% volume remaining

2

Placed Cell 1-6 - December 2004
To Protect Coastal Wetland



1 Source:
- Nearshore

Placed 326,917 cu yd

4 months later

Post-fill: +7 ft to –42 ft shoreline gain/retreat
100% to 79% volume remaining

STRUCTURAL PERFORMANCE – Structural Stability

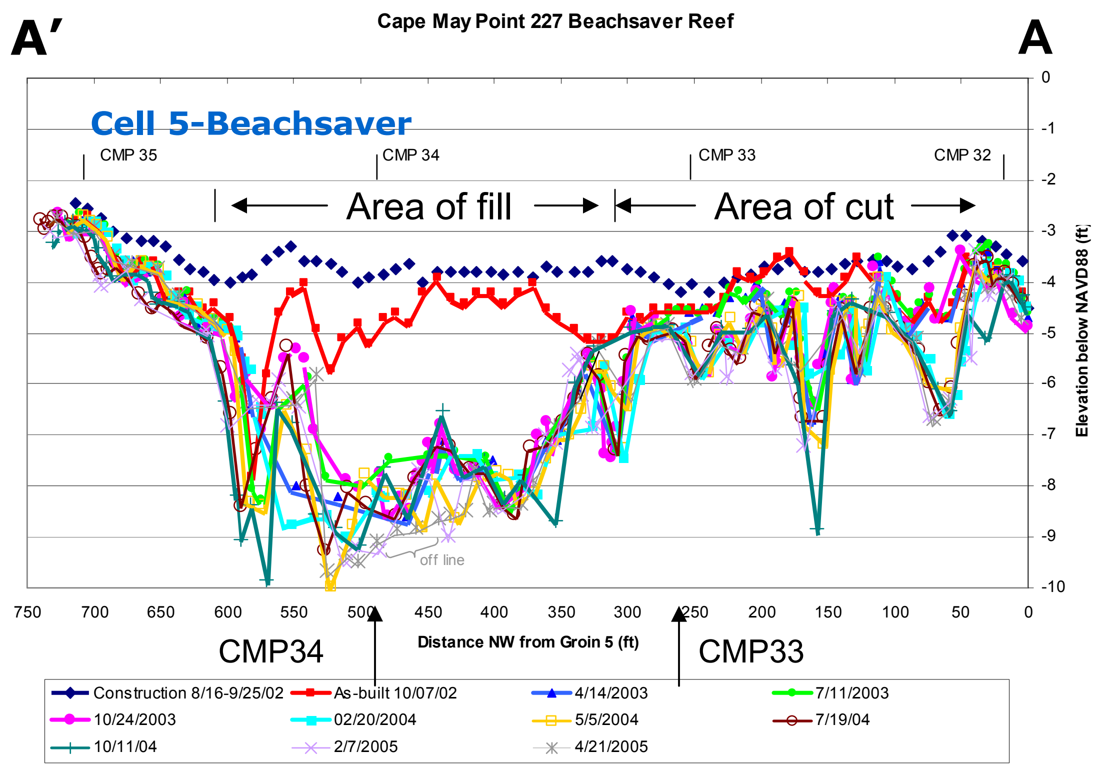
Measure Crest Elevations of Both Structures w/ Total Station to determine:

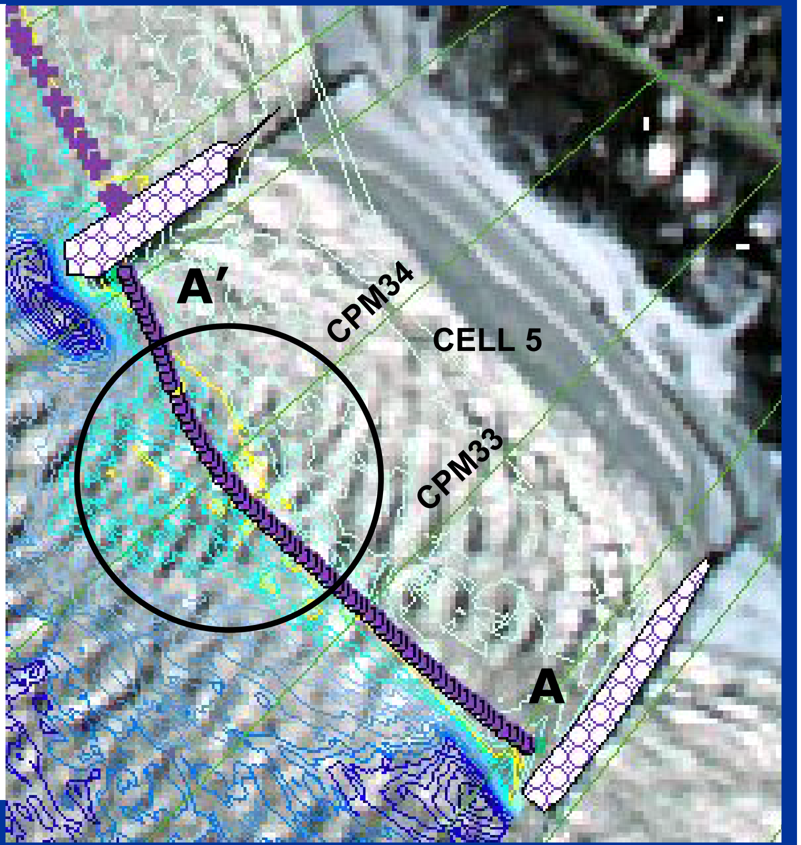
- Change in Structure Crest Elevation
- Alongshore Integrity
- Depth of Scour

STRUCTURAL PERFORMANCE

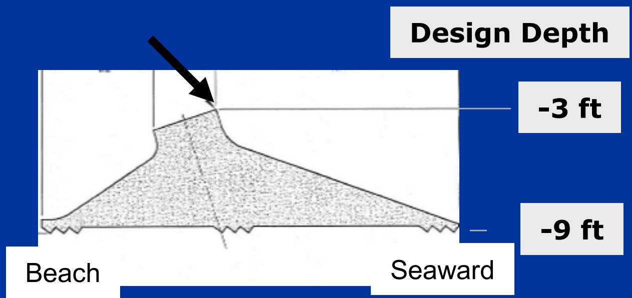
10/2002 to
4/2005

BEACHSAVER REEF - SETTLEMENT





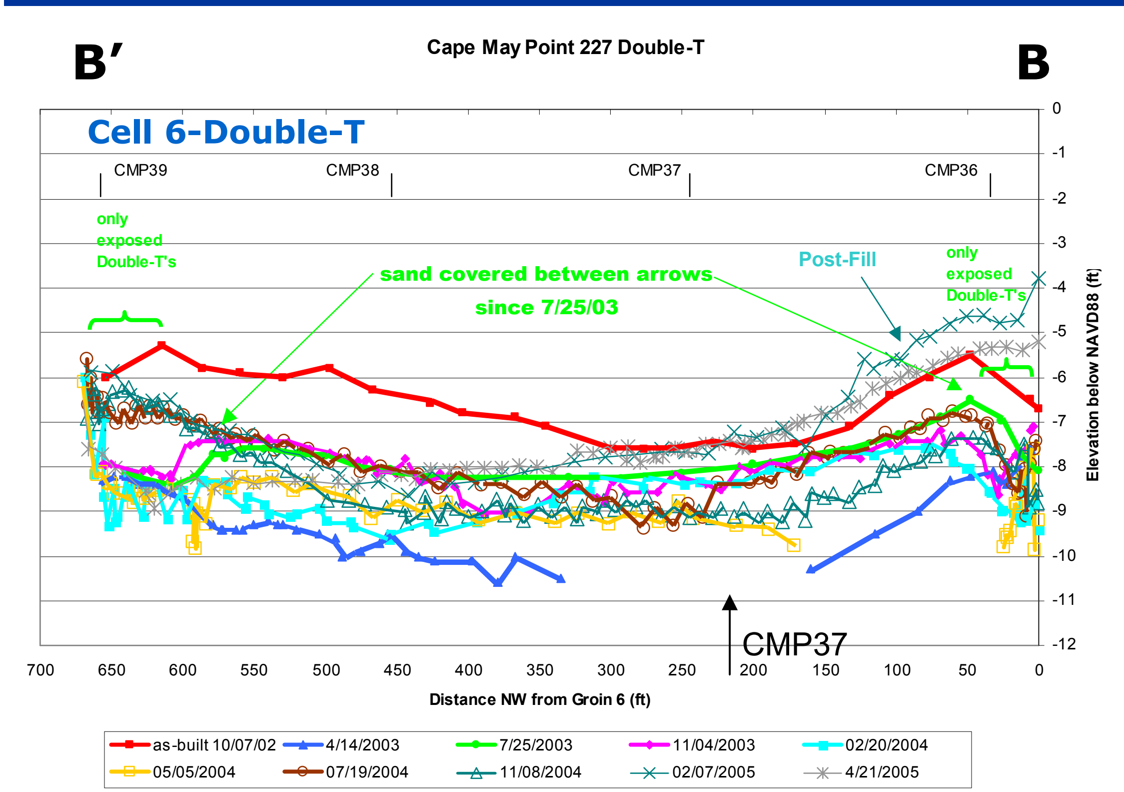
Area of most Settlement
up to 4 ft (1.2 m) within 6 months

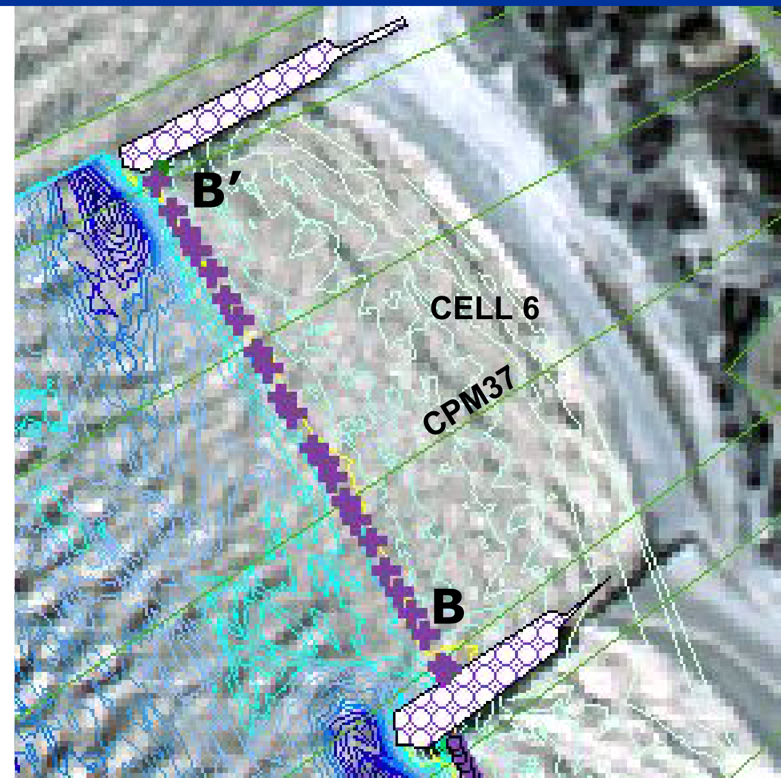


STRUCTURAL PERFORMANCE

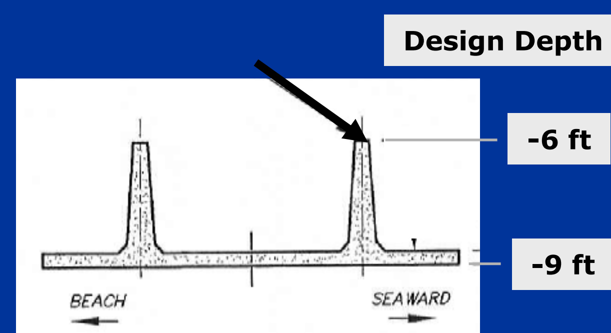
10/2002 to
4/2005

DOUBLE T SILL - SETTLEMENT



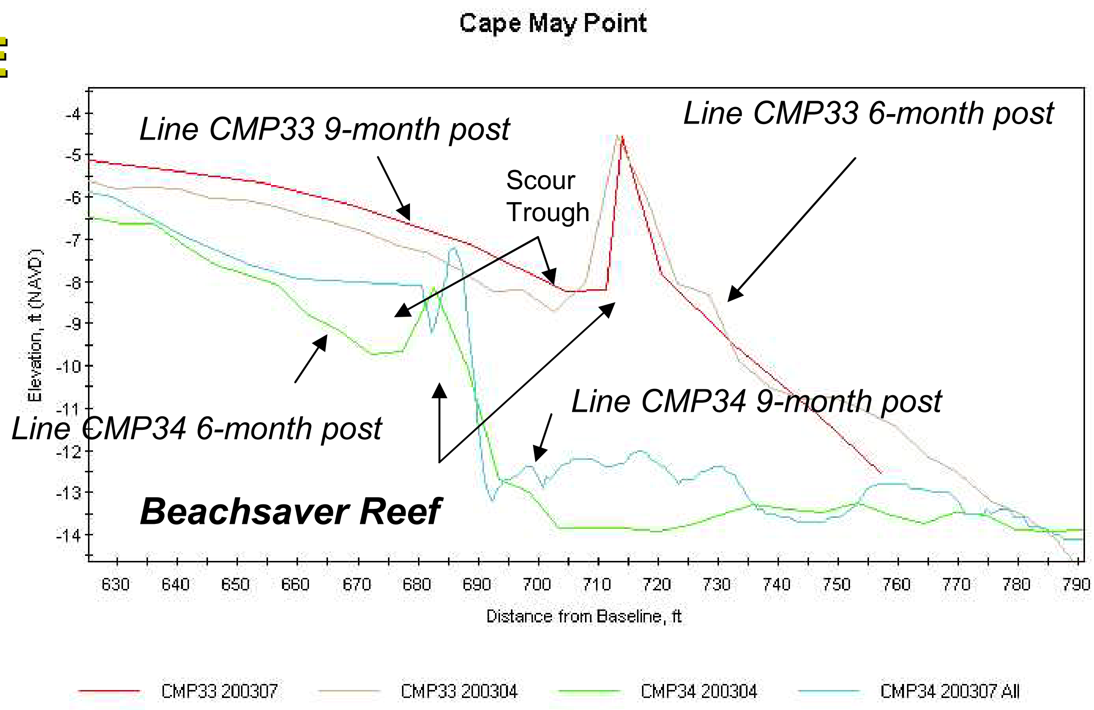


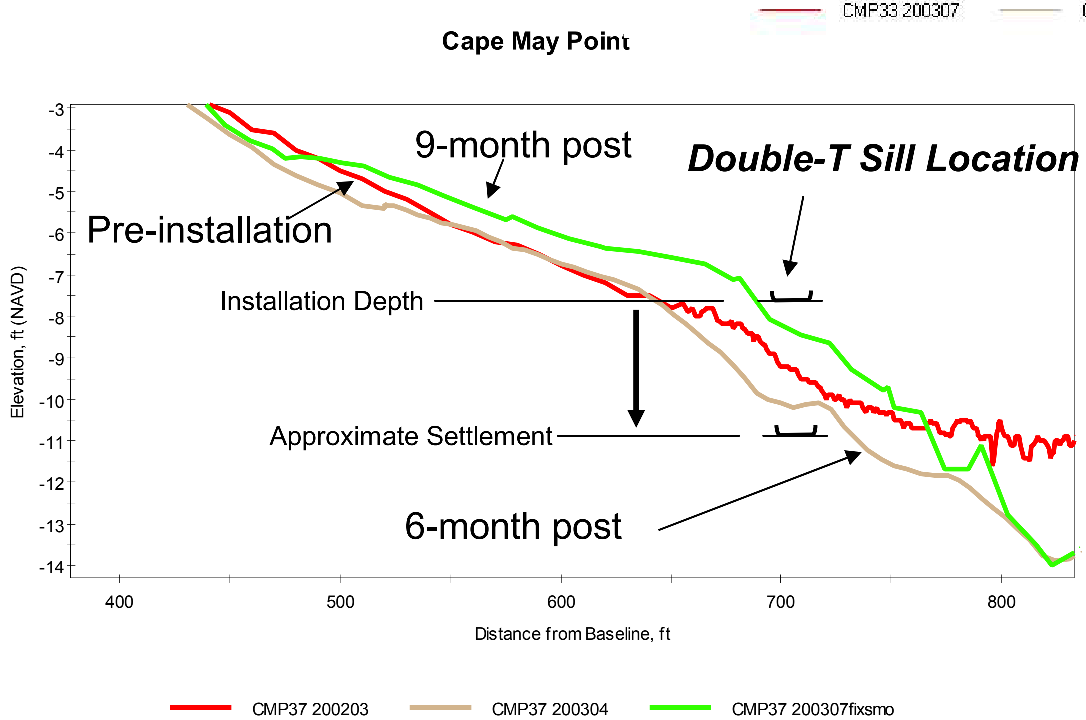
2 to 3 ft (0.5 to 1 m) Settlement &
Complete Burial under 1 to 2 ft (0.3 to 0.6 m)
of sand within 6 months



CHANGE IN STRUCTURE
Crest Elevation, Alongshore Integrity & Depth of Scour

Beachsaver Reef

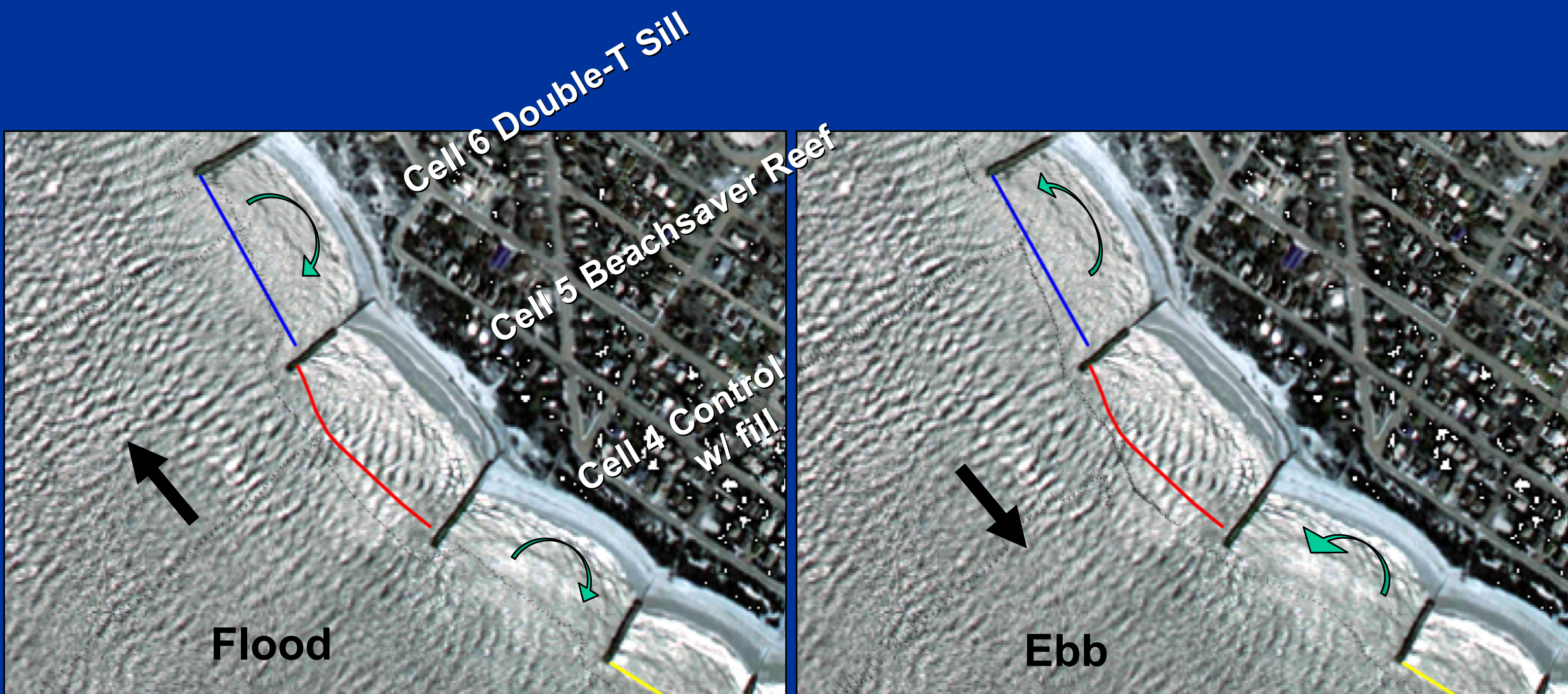




Double-T Sill

GROIN COMPARTMENT CIRCULATION

opposite tidal Flow based on ADCP current studies



Beachsaver Reef traps sand in compartment
Double-T Sill submerged w/ no trapping

SUMMARY

S E C T I O N 227

227 Project constructed August - October 2002
2.5 Year Quarterly Monitoring Results Reported Here
Eco Restoration Project constructed December 2004

Preliminary Findings:

- Retention of sand greatest in groin compartments w/ Beachsaver Reefs even w/ settlement
- Double-T Sill vs. Beachsaver Reef
  a) Could not be evaluated due to settlement of Double-T Sill
  b) Settlement w/ Beachsaver Reef due to construction excavation
- Anticipated savings in retention of beach fill w/ Beachsaver Reefs

PRODUCTS

S E C T I O N 227

Accomplishments

2003 *Journal of Coastal Research* - Paper
National Conference on Beach Preservation Technology – Paper
Coastal Structures'03 – 2 papers

2005 TR – Performance of Beachsaver Reef with Filter Blanket, and Double-T Sill at Cape May Point, New Jersey, Section 227 Demonstration site – First Year Monitoring Report

Future

Summary Report - Economic Performance/Life Cycle Cost Analysis for the Section 227 Cape May Demo Project

Conference Papers – Waves/Current/Structure Interaction
- Beach Fill Retention

TR – Performance of Beachsaver Reef with Filter Blanket, and Double-T Sill at Cape May Point, New Jersey, Section 227 Demonstration site – 2 Year Monitoring Report