Nearshore Berms R&D

Coastal Inlets Research Program (CIRP)
Dredging Operations and Environmental Research (DOER) Program
Regional Sediment Management Program (RSM)

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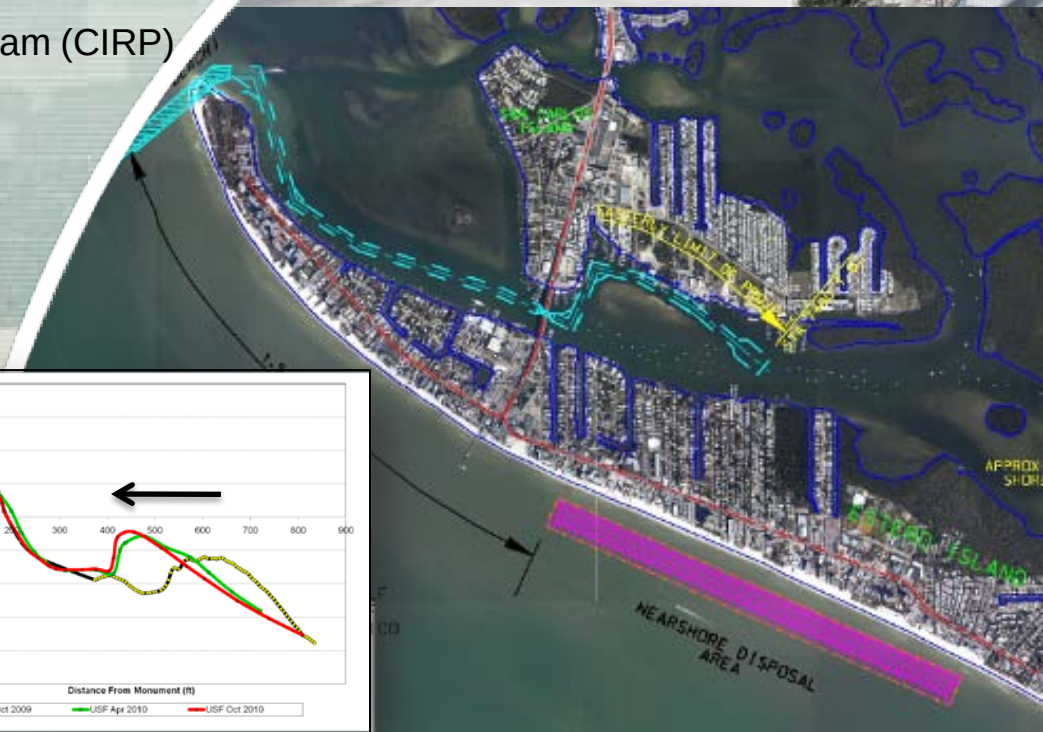
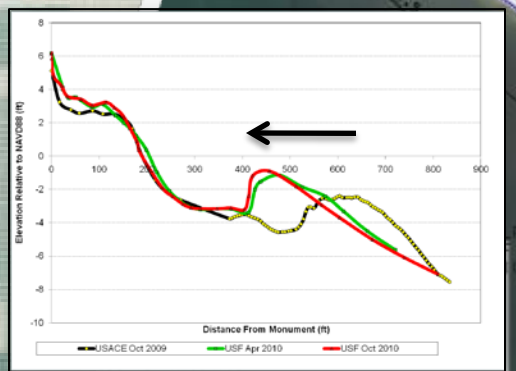


Regional Sediment Management Conference
10-12 August 2011



US Army Corps of Engineers
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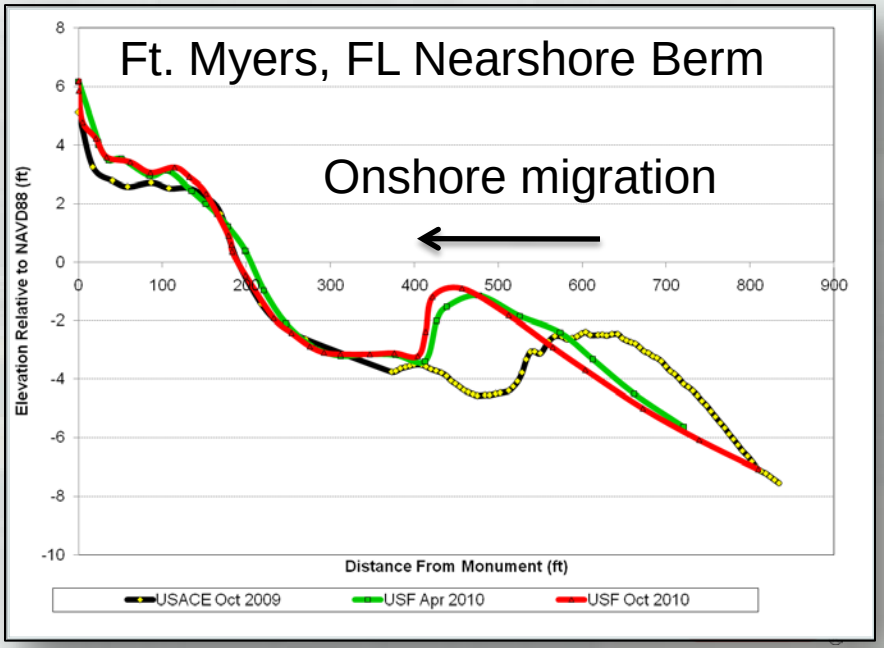
Outline

- Overview and Motivation
- State of Understanding for Berm Design & Evolution
- Questions Being Addressed
  - Operations
  - Design
  - Processes
  - Long-term Evolution & Benefits
- R&D: Needs & Approach
- Summary



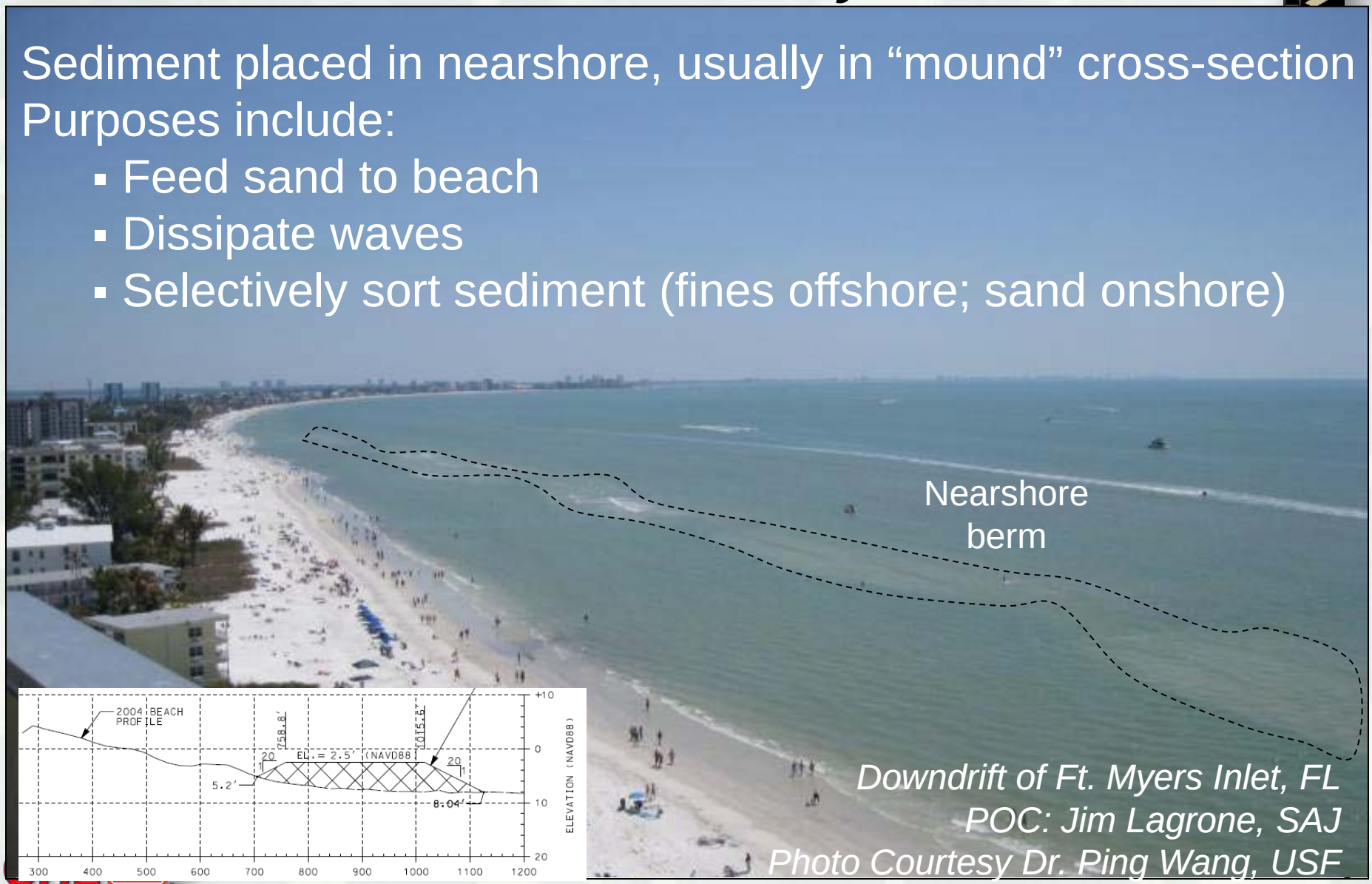
Nearshore Berms

What are they?

Sediment placed in nearshore, usually in “mound” cross-section

Purposes include:

- Feed sand to beach
- Dissipate waves
- Selectively sort sediment (fines offshore; sand onshore)



Downdrift of Ft. Myers Inlet, FL
POC: Jim Lagrone, SAJ
Photo Courtesy Dr. Ping Wang, USF

Nearshore Berms
Why?

Alternative for placement of O&M sediment in nearshore

Ideally sited near a navigation project (typically downdrift)

Less Sediment Restrictions (FL: sand with >10% fines cannot be placed on beach)

Goals:

- **Reduce O&M cost**
- **Nourish adjacent beaches**
- **Selectively transport fines offshore and sand onshore**

Downdrift of Ft. Myers Inlet, FL
POC: Jim Lagrone, SAJ
Photo Courtesy Dr. Ping Wang, USF

Berms

Motivation

Needs

- Mixed sediment (silt, sand) unsuitable for beach placement
- Offshore disposal and Confined Disposal Facilities (CDFs) remove sediment from regional littoral system
  - Lifetimes are finite
  - Sediments are not ideal for reuse
  - CDFs are 4x cost of nearshore placement
  - Great Lakes CDFs at 80% capacity
- Beaches down drift of navigation channels eroding

Concerns and Unknowns

- How to design berms in cross-shore and alongshore position
  - Are gaps desirable? If so, how large, what spacing?
- Where to place dredged sediment?
  - Minimize rehandling (infilling navigation channel) and cost?
- Will fine sediments transport during the placement & evolution process to cover Submerged Aquatic Vegetation (SAV; seagrasses) or other habitat (reefs)?

Berms

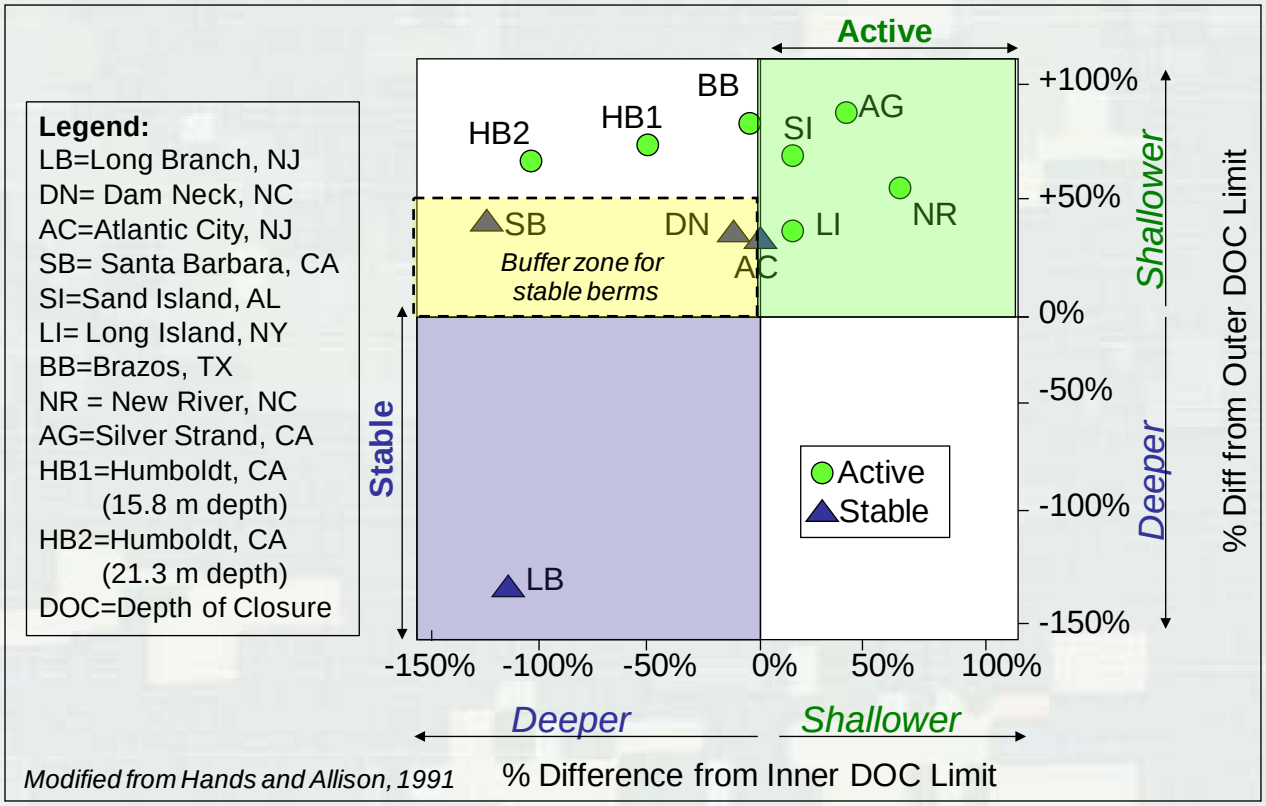
State of Understanding

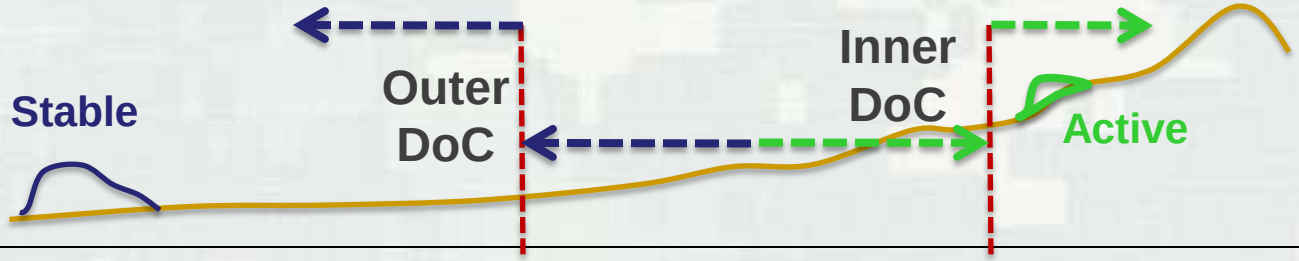
Present design guidance is based on design goals:

- Stable: stationary
- Active, Feeder, or Dispersive: feeding the beach or dispersing with time

Berms

State of Understanding *(Hands and Allison 1991)*





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Berms

Questions and R&D

- Operations
- Design
- Processes
- Long-term Evolution & Benefits

Berms

Questions and R&D

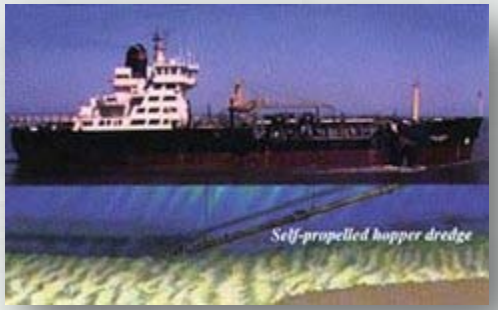
Operations

Relative cost & dredge capability
(placement depths & distances)
Zone of deposition for fines

Design

Processes

Long-term Evolution & Benefits



Berms

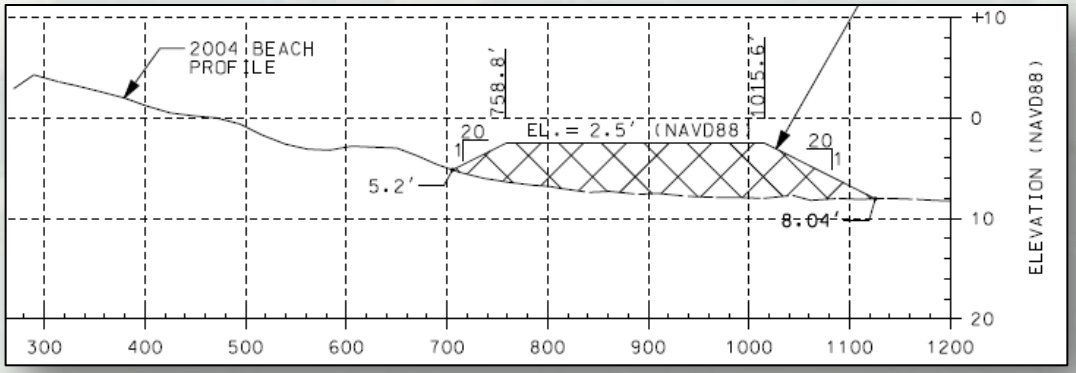
Questions and R&D

Operations

Design → Cross-shore
Longshore
Best gap width and spacing

Processes

Long-term Evolution & Benefits



Berms

Questions and R&D

Operations

Design

Processes

Long-term Evolution

- Proximity to inlets and navigation channels
- Spatial and temporal scales of migration
- Accretion volume relative to the original placement
- Sorting of fines vs. sand

Berms

Questions and R&D

Operations

Design

Processes

Long-term Evolution & Benefits

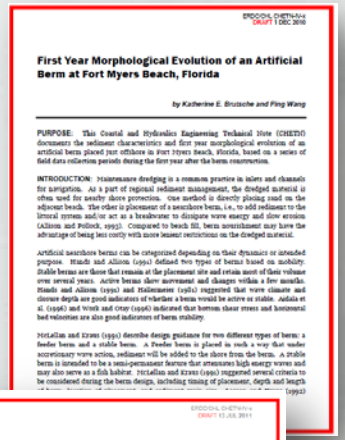
Decision-Support:
Alongshore zone of accretion
Time value of berm operations vs. other methods

Berms

R&D: Need and Approach

Requirements

- Tools and guidance to design & optimize location of nearshore placement
  - Mixed sediment sizes
  - Alongshore location to minimize cost and feed down-drift beach
  - Avoid rehandling in navigation channel
  - Avoid deposition of fines on habitat
- Demonstrate reliability of berm performance prediction



ERDC/CHL CHETN-xx
DRAFT 1 DEC 2010

First Year Morphological Evolution of an Artificial Berm at Fort Myers Beach, Florida

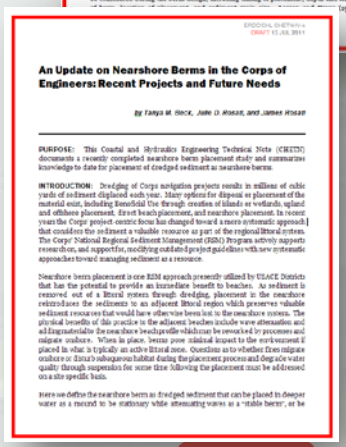
by Katherine E. Brutsche and Ping Wang

PURPOSE: This Coastal and Hydraulics Engineering Technical Note (CHETN) documents the sediment characteristics and first year morphological evolution of an artificial berm placed just offshore in Fort Myers Beach, Florida, based on a series of field data collection periods during the first year after the berm construction.

INTRODUCTION: Maintenance dredging is a common practice in inlets and channels for navigation. As a part of regional sediment management, the dredged material is often used for nearby shore protection. One method is directly placing sand on the adjacent beach. The other is placement of a nearshore berm, i.e., to add sediment to the littoral system and/or act as a breakwater to dissipate wave energy and slow erosion (Allison and Pollock, 1993). Compared to beach fill, berm nourishment may have the advantage of being less costly with more limited restrictions on the dredged material.

Artificial nearshore berms can be categorized depending on their dynamics or intended purpose. Hands and Allison (1991) defined two types of berms based on mobility. Stable berms are those that remain at the placement site and retain most of their volume over several years. Active berms show movement and changes within a few months. Hands and Allison (1991) and Stalmasters (1981) suggested that wave climate and closure depth are good indicators of whether a berm would be active or stable. Aadala et al. (1996) and Work and Gray (1996) indicated that bottom shear stress and horizontal bed velocities are also good indicators of berm stability.

Nicollas and Kraus (1991) describe design guidance for two different types of berm: a feeder berm and a stable berm. A Feeder berm is placed in such a way that under accretionary wave action, sediment will be added to the shore from the berm. A stable berm is intended to be a semi-permanent feature that attenuates high energy waves and may also serve as a fish habitat. Nicollas and Kraus (1991) suggested several criteria to be considered during the berm design, including timing of placement, depth and length



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DRAFT 15 JUL 2011

An Update on Nearshore Berms in the Corps of Engineers: Recent Projects and Future Needs

by Tanya M. Beck, John D. Rosati, and James Rosati

PURPOSE: This Coastal and Hydraulics Engineering Technical Note (CHETN) documents a recently completed nearshore berm placement study and summarizes knowledge to date for placement of dredged sediment as nearshore berms.

INTRODUCTION: Dredging of Corps navigation projects results in millions of cubic yards of sediment displaced each year. Many options for disposal or placement of the material exist, including Beneficial Use through creation of islands or wetlands, upland and offshore placement, direct beach placement, and nearshore placement. In recent years the Corps' project-centric focus has changed toward a more systematic approach that considers the sediment a valuable resource as part of the regional littoral system. The Corps' National Regional Sediment Management (RSM) Program actively supports research on, and support for, modifying outdated project guidelines with new systematic approaches toward managing sediment as a resource.

Nearshore berm placement is one RSM approach presently utilized by USACE Districts that has the potential to provide an immediate benefit to beaches. As sediment is removed out of a littoral system through dredging, placement in the nearshore reintroduces the sediments to an adjacent littoral region which preserves valuable sediment resources that would have otherwise been lost to the nearshore system. The physical benefits of this practice to the adjacent beaches include wave attenuation and sediment delivery to the nearshore beach profile which may be revocked by processes and migrate onshore. When in place, berms pose minimal impact to the environment if placed in what is typically an active littoral zone. Questions as to whether fines migrate onshore or form subaqueous habitat during the placement process and degrade water quality through suspension for some time following the placement must be addressed on a site specific basis.

Here we define the nearshore berm as dredged sediment that can be placed in deeper water as a mound to be stationary while attenuating waves as a "stable berm", or be

Requirements

- Monitoring of two berm projects (Ft. Myers Beach; Egmont Key)
- Compilation & assessment of literature and data from previous projects
- Developing flexible tools (rapid desk-top to detailed models) to compare and optimize placement locations as function of…
  - Dredged sediment size(s) and volume
  - Placement locations
  - Site Processes
- Guidance documents and tools to District offices

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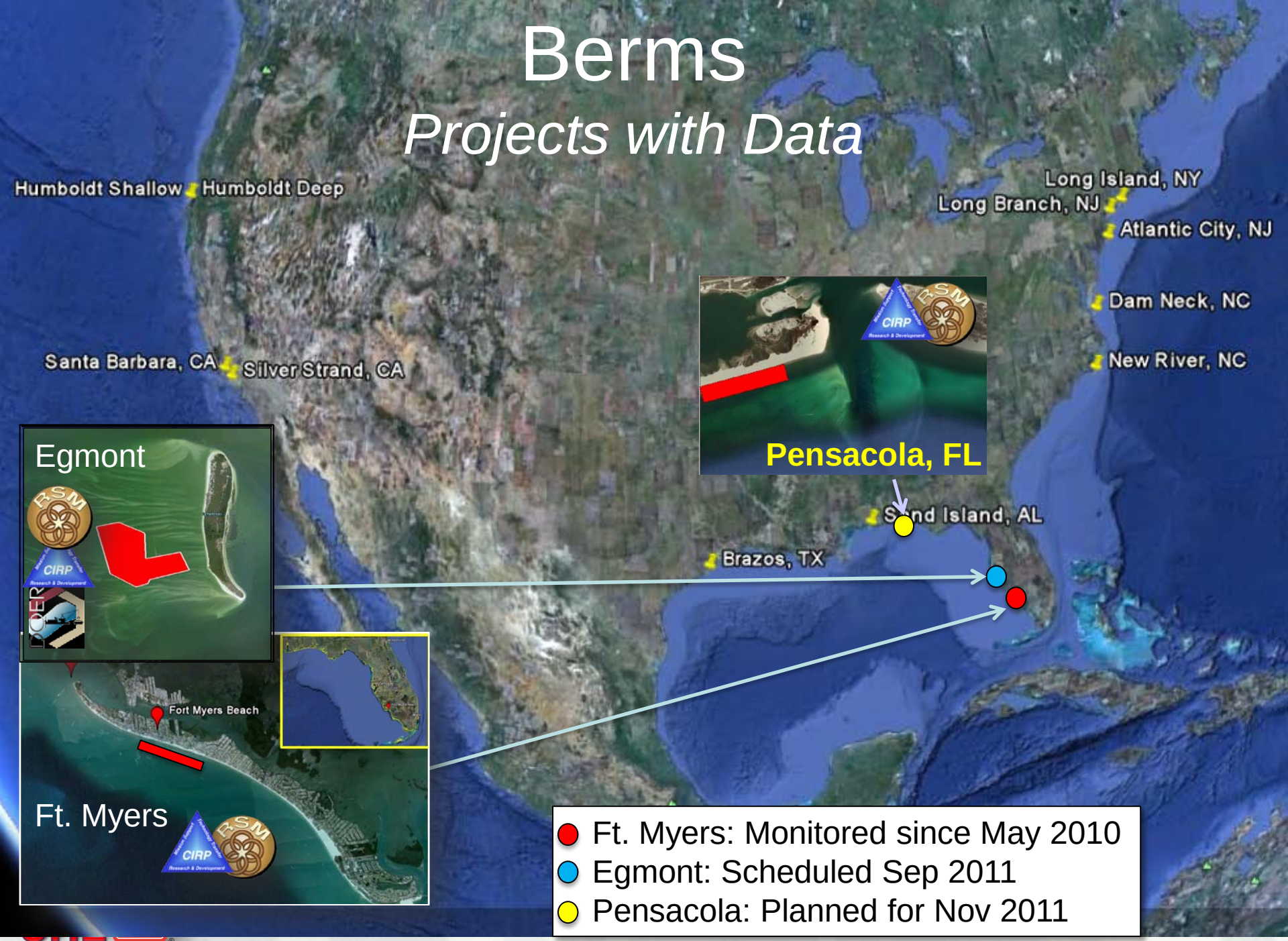
Berms

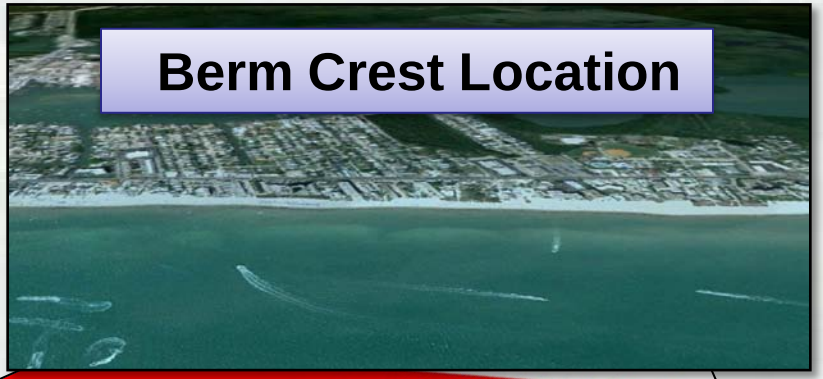
Projects with Data

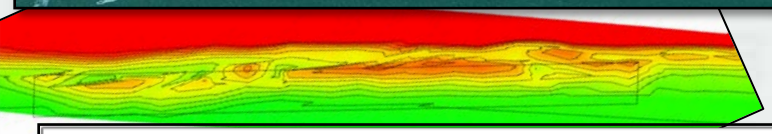


Ft. Myers Berm

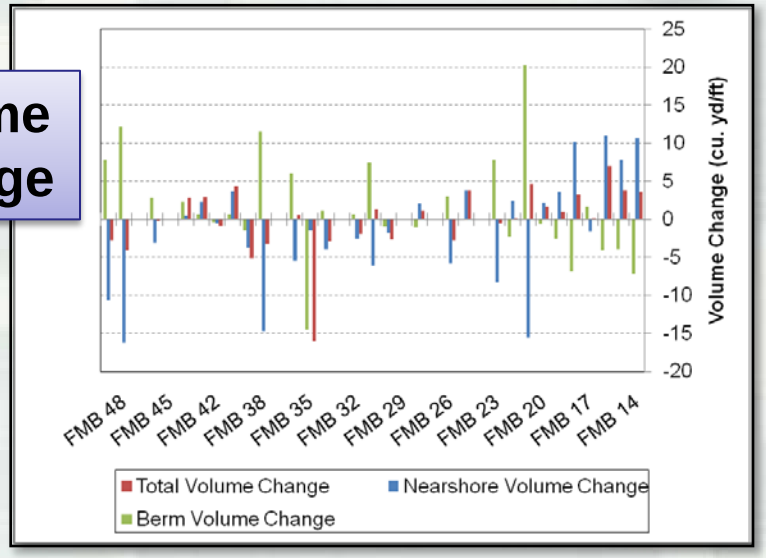
Alongshore Migration & Accretion

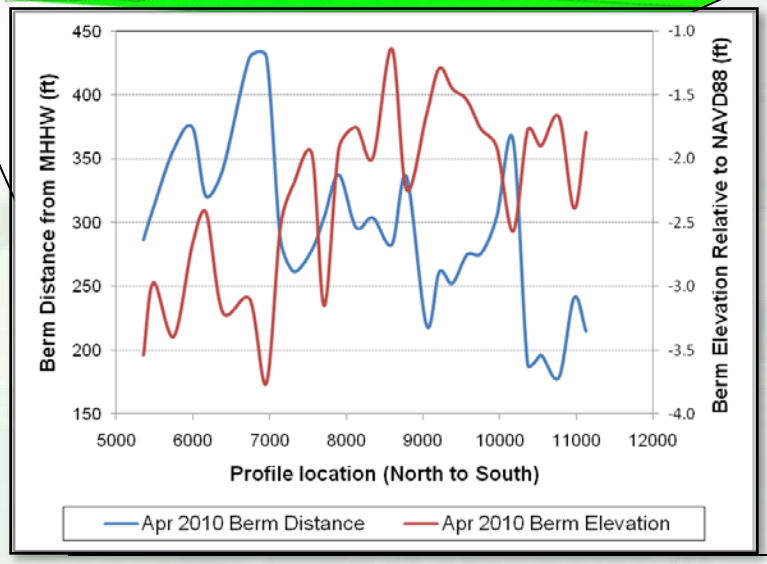
Berm Crest Location



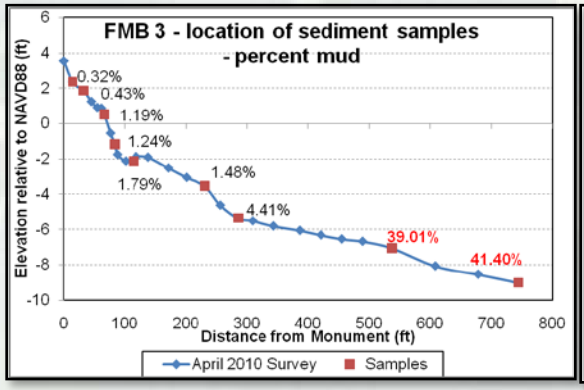


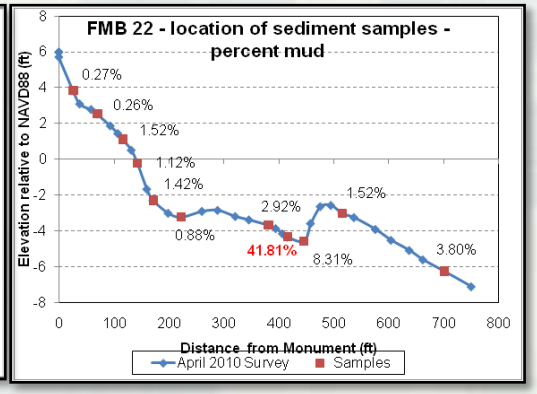
Volume Change





Migration of Fines



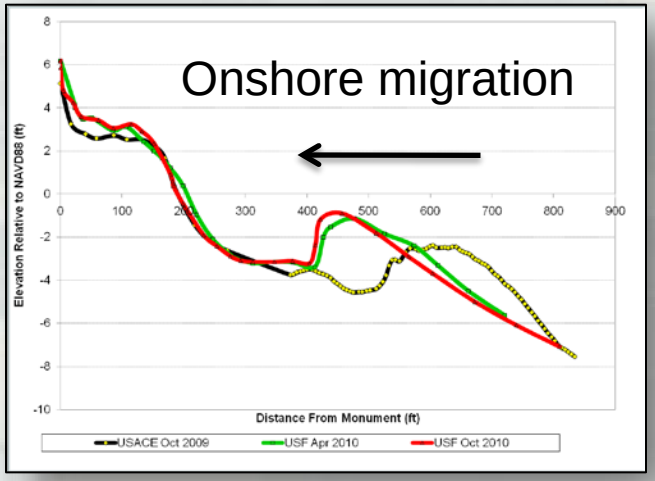


Berms

Summary

Much to be learned about nearshore berm evolution
- Stable vs. Feeder berms
- Sorting of fines and sand
- Temporal and spatial scales of migration
- Dispersion of fines during placement and evolution

Guidance required
- Design
- Operations
- Decision-support

R&D feeds simple and advanced tools
- Online calculators
- Numerical models

Collaborative approach with leveraged funding
- RSM, DOER, CIRP