Nearshore Placement as a Regional Sediment Management Practice

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Outline

- Regional Sediment Management
- Nearshore Placement
- Nearshore Berms
- Tools and Technologies
  - SMT
  - CMS
  - RIOS
- Case Study at Vilano Beach, Florida
- Summary and Conclusions
Regional Sediment Management (RSM)

A systems approach to deliberately manage sediments in a manner that maximizes natural and economic efficiencies to contribute to sustainable water resource projects, environments, and communities = Healthy Systems

- O&M, FRM, Ecosystem, Emergency Mgmt:
  - Short and long-term sustainable, resilient solutions
  - Coastal and Inland
- Recognizes sediment as a valuable regional resource
- Work across multiple projects, authorities, business lines
- Tools and technologies for regional approaches
- Relationship building, decision making, implementation
RSM Strategies

- Reduce Offshore Placement
- Nearshore/Beach Placement Optimization
- Bypass Optimize Placement
- Reduce Sediments at the Source
- Reduce CDF Placement and Improve System
- Ecosystem Restoration with partners

- Keep sediment in the littoral system
- Mimic natural sediment processes
- Reduce sedimentation
Nearshore Placement

- Dredged material placement in the nearshore in a manner and at locations that permits natural forces to disperse the dredged material toward other locations where it can deliver benefits
  - Maximize benefits
  - Minimize rehandling
  - Minimize negative environmental impacts
  - Reduced cost (vs. direct placement)
  - Increase beneficial use applications

- Typically consist of dredged sediment from navigation projects that is incompatible with natural beach sediment

- Nearshore berms are a specific example of nearshore placement
Terminology

Nearshore Placement vs. Nearshore Berm

- Discrete mounds placed within a project design template
- Intentional placement of material in an elongate bar or mound feature
Nearshore Berms

- Sediment placed in the nearshore in either an elongate (bar-like) feature or a mound
  - Stable berms- remain stationary for years
  - Active/Feeder berms- sediment dispersed by waves and currents

Modified from Hands and Allison, 1991
% Difference from Inner DOC Limit

BUILDING STRONG®
Nearshore Placement

- Nearshore placement is becoming an increasingly utilized method for beneficial use of dredged material
  - Less costly than beach nourishment, fewer restrictions, fewer environmental concerns
- Important to have a better understanding of what happens once the sediment is placed
- Update to current design guidance to answer key regulatory questions
Important Questions

- Will sediment move once it is placed in the nearshore?
- Will sediment move onshore?
- What direction will it move alongshore?
- How much sediment will move?
- How long will it take for the sediment to move?
Sediment Mobility Tool

- Estimates
  - Frequency of sediment mobility
  - On/Offshore migration direction
  - Dominant axis of wave direction to estimate alongshore migration

- Preliminary tool to make educated decisions with little data

<table>
<thead>
<tr>
<th>$d_{50}$ (mm)</th>
<th>Frequency of Mobilization</th>
<th>Predicted Sediment Migration</th>
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</thead>
<tbody>
<tr>
<td>0.1</td>
<td>16 – 38%</td>
<td>83% Offshore</td>
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<tr>
<td>0.2</td>
<td>14 – 30%</td>
<td>60% Onshore</td>
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<tr>
<td>0.3</td>
<td>12 – 26%</td>
<td>84% Onshore</td>
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Coastal Modeling System

- The Coastal Modeling System is an integrated 2D numerical modeling system for simulating waves, current, water level, sediment transport, and morphology change at coastal inlets and entrances.
- User input: waves, tides, bathymetry, grain size.
- CMS output: currents, waves, water levels, morphology, sediment transport.
Radar Inlet Observing System: RIOS

- Measures position of inlet channels and shoals continuously to make results available in real time
- Uses X-band radar to measure wave conditions including breaking, speed, period, and angle – from which depths can be determined
- Combination of wave breaking intensity and measured depths from prior surveys and not fully intended to replace traditional bathy survey
- Calculates depth based on linear wave dispersion relationship

RIOS information from J. Waters and J. McNinch
Case Study: Vilano Beach, Florida

- 150,000 cy
- St. Augustine Inlet ebb shoal, flood shoal and part of the IWW
- *Murden* 500cy hopper, light loaded for NS access ~350-400cy
- Between T-114 and R-115 and R-116 and R-117
- In front of the two property clusters
- Two berm methods to see if there is a differing outcome
Project and Objectives

Can we observe, document and make conclusions about beneficial placement of dredged materials in the nearshore?

- Concentrate the placement area
  - Two berms
- Understand the sediments
- Predict sediment mobility using SMT
- Visually document changes to the shoreline and nearshore (photogrammetry/RIOS)
- CMS model
Data Collection

- Set up two camera arrays, T-114.5 and R-116.5
- 180 view of the coastline
- Cross shore topo and multi-beam bathy
- Collected cross shore profile sediment samples
- RIOS

Morgan & Eklund survey the nearshore for the county prior to placement
Pre-Construction

Vilano Beach

R113
T114
R115
R116
R117
R118

SHEET NO. 003
Sediment Mobility Tool

- $d_{50} = 0.33$ mm
- $h = 10$ ft
- WIS Station 63416

<table>
<thead>
<tr>
<th>Grain Size (mm)</th>
<th>Predicted Sediment Migration</th>
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<tbody>
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<td>0.1</td>
<td>88% Offshore</td>
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<tr>
<td>0.2</td>
<td>93% Onshore</td>
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<tr>
<td>0.3</td>
<td>100% Onshore</td>
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<tr>
<td>0.33</td>
<td>100% Onshore</td>
</tr>
<tr>
<td>0.4</td>
<td>100% Onshore</td>
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</table>
Camera Array
Radar Inlet Observing System

- continuous, hourly measurements of inlet channel and shoals
- autonomous power and internet data upload (xyz depth files and geo-images)
- minimal bi-monthly service

Present deployment: St. Augustine Inlet

Logistics and ground support provided by USACE-SAJ
Detecting Berm Evolution
Shoreline Changes

July to December Shoreline Change

![Graph showing Shoreline Changes from July to December with various data points and lines indicating changes at different distances from the northern line.](image-url)
Summary and Conclusions

- Nearshore placement is a common RSM strategy to beneficially use dredged material.
- Nearshore berms are a specific type of nearshore placement.
  - Sediment placed in an elongate bar or mound.
- Several tools available to determine whether sediment in the nearshore will mobilize and to visualize nearshore placement evolution:
  - SMT
  - CMS
  - RIOS
Summary and Conclusions

- Vilano Beach project is an example case study showcasing nearshore berm tools and technologies
  - Validation for SMT
    - Correctly predicted that material would mobilize
    - Gain of sediment in the nearshore may indicate onshore movement of the berms
    - Salients formed in the lee of the berms
  - RIOS captured continuous changes in berms
  - CMS is being used to help validate tool and help visualize berm evolution