TRADITIONAL BEACH TEMPLATE VS CROSS SHORE SWASH ZONE (CSSZ) PLACEMENT METHODS AT EGMONT KEY, FL

High Silt Content Beneficial Use Placement

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Engineer Research and Development Center
Coastal and Hydraulics Laboratory
&
USACE Jacksonville District
&
Great Lakes Dredge & Dock (GLDD)

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Outline

• Background
  • Ideal opportunity for R&D to address environmental concerns and regulations
  • Egmont Key National Wildlife Refuge – “Sand Rule”
  • Material is approx. 20% “fines” (passing 230 sieve)
  • Definitions and Example Projects
  • Time series aerials

• Dredging and Placement
  • Volumes
  • Compaction - Cone Penetrometer
  • Mass Balance of “fines”
  • Fines Content, Density, Munsell Color
  • Light Attenuation and Turbidity
  • Sea turtle nesting

• Conclusions
  • Traditional vs. Cross Shore Swash Zone Placement
  • Acknowledgments
Definitions

- **Traditional Placement** – placement of material to “build a beach” using longitudinal dikes to increase settlement. This project’s purpose is to create a wide flat dry beach berm.
Definitions

- **Cross Shore Swash Zone Placement (CSSZ)** – placement of dredged material by discharging material directly into the swash zone until a delta builds and then extending outfall shore perpendicular thus building a “point” (salient) feature.

Images Courtesy of GLDD
Case Examples – Mayport 1972

• Cross Shore Swash Zone Placement (CSSZ)

Clean Water Act (CWA)
Case Examples – Sand groynes Delfland 2009

- 3 concentrated nourishments 200k m³ each
- Uniformly redistributed over a stretch of coast of about 2.5km by the impact of waves and currents

https://publicwiki.deltares.nl/display/BWN/Building+Block+-+Feeder+beaches+-+Practical+Applications
Case Examples – Delfland Sand Engine 2011

- Concentrated nourishments 28M m³
- Intertidal ponds were intentional for added habitat
Time-series aerial photos

1942

2011

Slides Courtesy of USF
Previous BU — Egmont Key 2001, 2006 & 2011

- Ebb dominated system

Node

Dec 2003

Shoal growth from nourishment

Feb 2007

Shoal growth from nourishment

Jan 2012
Project Monitoring
## Cone Penetrometer

### Pre-Placement

<table>
<thead>
<tr>
<th>Depth (in)</th>
<th>0&quot;-6&quot;</th>
<th>6&quot;-12&quot;</th>
<th>12&quot;-18&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min (psi)</td>
<td>100</td>
<td>100</td>
<td>198</td>
</tr>
<tr>
<td>Max (psi)</td>
<td>580</td>
<td>700</td>
<td>617</td>
</tr>
<tr>
<td>Avg (psi)</td>
<td>293</td>
<td>406</td>
<td>457</td>
</tr>
<tr>
<td>Median (psi)</td>
<td>295</td>
<td>431</td>
<td>515</td>
</tr>
<tr>
<td># samples</td>
<td>19</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Refusals</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>% Refusal</td>
<td>5%</td>
<td>21%</td>
<td>26%</td>
</tr>
</tbody>
</table>

### Post-Placement

<table>
<thead>
<tr>
<th>Depth (in)</th>
<th>0&quot;-6&quot;</th>
<th>6&quot;-12&quot;</th>
<th>12&quot;-18&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min (psi)</td>
<td>50</td>
<td>125</td>
<td>200</td>
</tr>
<tr>
<td>Max (psi)</td>
<td>600</td>
<td>700</td>
<td>600</td>
</tr>
<tr>
<td>Avg (psi)</td>
<td>328</td>
<td>482</td>
<td>436</td>
</tr>
<tr>
<td>Median (psi)</td>
<td>300</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td># samples</td>
<td>21</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>Refusals</td>
<td>3</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>% Refusal</td>
<td>14%</td>
<td>29%</td>
<td>48%</td>
</tr>
</tbody>
</table>

- Increase in refusals due to shell hash areas
Mass Balance – Egmont Key 2014

<table>
<thead>
<tr>
<th>Tampa Harbor MD - Egmont Key 2014</th>
<th># of Samples</th>
<th>Sample by weight Fines (passing 230 sieve)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-situ Channel</td>
<td>80</td>
<td>20.7%</td>
</tr>
<tr>
<td>Discharge Slurry</td>
<td>27</td>
<td>18.4% *</td>
</tr>
<tr>
<td>Swash zone</td>
<td>27</td>
<td>17.5%</td>
</tr>
<tr>
<td>Beach samples</td>
<td>22</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

**Assumptions**
- 100% slurry water conveyed to the wash zone
- Slurry and swash zone sampling a closed system

**Relationships**
- Swash Zone samples carried 13.2% of the Discharge Slurry fines out of the beach template, thus leaving 5.2% on the beach.

*Sampling methods at discharge slurry not ideal

*Only Traditional Placement
## Fines Content and Density

### Tampa Harbor MD - Egmont Key 2014

<table>
<thead>
<tr>
<th></th>
<th># of Samples</th>
<th>Avg. % by wt. passing 230 sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-situ</td>
<td>80</td>
<td>20.7</td>
</tr>
<tr>
<td>pre-Beach</td>
<td>6</td>
<td>0.03</td>
</tr>
<tr>
<td>post-Dredged</td>
<td>21</td>
<td>0.51</td>
</tr>
<tr>
<td>Traditional</td>
<td>14</td>
<td>0.52*</td>
</tr>
<tr>
<td>CSSZ</td>
<td>7</td>
<td>0.49*</td>
</tr>
</tbody>
</table>

*Sampling occurred within 72 hours of placement completion*

### Tampa Harbor MD - Egmont Key 2014

<table>
<thead>
<tr>
<th></th>
<th># of Samples</th>
<th>Value avg. (kg/m³)</th>
<th>% Greater</th>
</tr>
</thead>
<tbody>
<tr>
<td>pre-Beach</td>
<td>7</td>
<td>1405.1</td>
<td>0.0%</td>
</tr>
<tr>
<td>post-Dredged</td>
<td>17</td>
<td>1471.6</td>
<td>4.7%</td>
</tr>
<tr>
<td>Traditional</td>
<td>11</td>
<td>1476.0</td>
<td>5.0%</td>
</tr>
<tr>
<td>CSSZ</td>
<td>6</td>
<td>1463.5</td>
<td>4.2%</td>
</tr>
</tbody>
</table>

Images Courtesy of GLDD
### Munsell Color

<table>
<thead>
<tr>
<th>Tampa Harbor MD - Egmont Key 2014</th>
<th># of Samples</th>
<th>Value avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-situ</td>
<td>80</td>
<td>4.36*</td>
</tr>
<tr>
<td>pre-Beach</td>
<td>13</td>
<td>5.9</td>
</tr>
<tr>
<td>post-Dredged</td>
<td>24</td>
<td>5.3</td>
</tr>
<tr>
<td>Traditional</td>
<td>16</td>
<td>5.0</td>
</tr>
<tr>
<td>CSSZ</td>
<td>8</td>
<td>5.9</td>
</tr>
</tbody>
</table>

*Munsell color value<5 unacceptable for beach placement in Florida*

NOTES: Triplicate measurements of hue, value, and chroma were collected from three areas on each moist sand sample using a digital colorimeter (CR-400, Konica Minolta, Osaka, Japan).
Light Attenuation Long-term Monitoring

Egmont Key, FL
Long-term Deployment Map
14 Nov – 15 Dec

Image Courtesy of GLDD
Light Attenuation Monitoring
Light Attenuation Long-term Monitoring

Turbidity versus PAR values

Dredging 19 Nov. – 28 Dec.
Dredging 21 Jan. – 6 Mar.
Sea Turtle Nesting 2015

Nesting as of 16 August 2015

Image Courtesy of USACE Jacksonville District
CSSZ Drawbacks vs. Traditional Placement

• Issues
  • Material is not immediately visible to public
  • Remediation for unacceptable material far more difficult
  • Egmont Key not identical to other projects, low energy, with inlets
  • Each contractor’s crew has their preferred operational techniques: longitudinal dike length, equipment, and methodology

• Risks
  • If parameters imposed on nearshore placement are more restrictive this placement method could become more expensive than traditional beach placement
  • Project shutdowns for turbidity
    • Instantaneous vs. chronic
CSSZ Benefits vs. Traditional Placement

• Less linear feet of beach impacted for equivalent volume
• Reduced environmental Impacts
  • Turtle nest relocations
  • Ponding
  • Cementation
  • Munsell Color
  • Shorebird impacts
• Lower cost
  • Construction – less beach equipment
  • Reduced pipeline extensions
  • Maintenance – less escarpment, tiling
• Reduced beach traditional use impacts
  • Sunbathing and Water sports
• Another tool in the BU toolbox
• Purely performance based regulations
  • More beneficial reuse
  • Lower costs - better bids due to more equipment able to perform work
Conclusions

• CSSZ placement operations within intent of “Sand Rule” – reasonable assurance
• CSSZ material spread longshore very quickly
• Grain Size sampling indicates significant “fines” losses
  • 2.4% of original (in-situ) “fines” remaining on beach = 0.5% total
  • 98% of “fines” lost
• Munsell Color and Compaction similar to pre-conditions
• Better RSM practice, better environmental practice, and better economic practice
• Engineering with Nature (EwN)
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Thank You!

Questions?

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