Egmont Key, FL and Galveston, TX Entrance Channel Beneficial Use of High Silt Maintenance Dredging Material

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ERDC
Engineer Research and Development Center

CIRP Research & Development

Outline

- Introduction
- Research Objectives
- Project Monitoring
- Operations - Dredging and Placement
- Results
- Summary and Conclusions

Egmont Key

- Virtually uninhabited island located at the mouth of Tampa Bay, Florida
- Cultural and environmental resources
  - Historical significance – Spanish-American & Civil War & Seminole Indian
  - Bird rookery
  - Turtle nesting
- Highly dynamic island due to its location
- Periodic beach placement on north tip of the island

St. Petersburg

North Traditional Placement

Cross Shore Swash Zone Placement

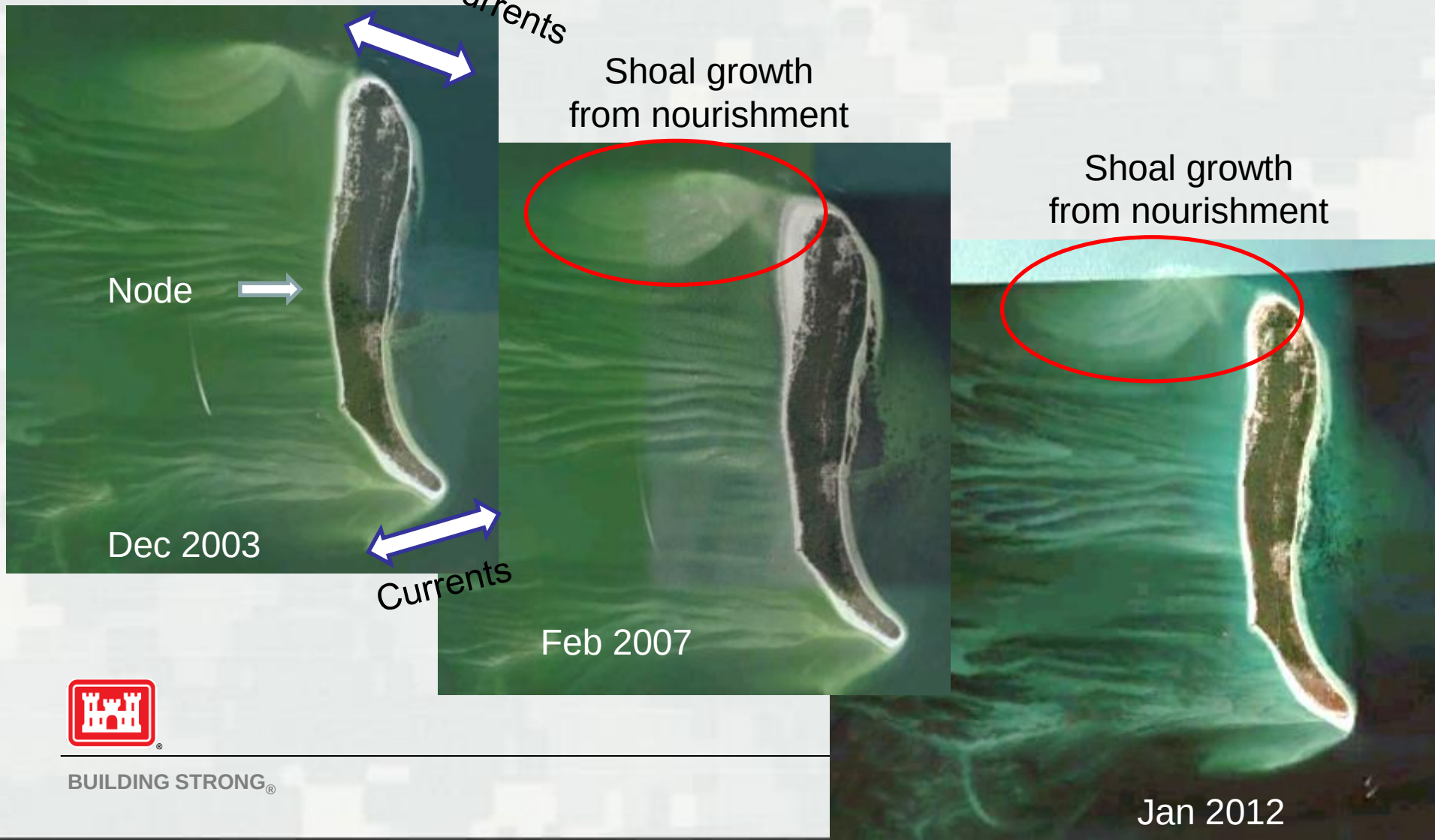
Tampa Bay Entrance Channel

Egmont Key

Anna Maria Island

Previous BU – Egmont Key 2001, 2006 & 2011

- Ebb dominated system



Egmont Key

- Dredging commenced 19 November 2014
- Material dredged from Tampa Entrance Channel
- Placement in a traditional beach nourishment and a cross-shore swash zone placement
- In situ fine content approximately 20% passing the #230 sieve
  - Exception to Florida Sand Rule was made for Egmont due to its environmental and cultural resources
- Ideal opportunity to study R&D to address environmental concerns and regulations

Definitions

- **Traditional Placement** – placement of material to “build a beach” using longitudinal dikes to increase settlement. This projects 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.

21 Feb 15

29 Apr 15

Images Courtesy of GLDD

Research Objectives

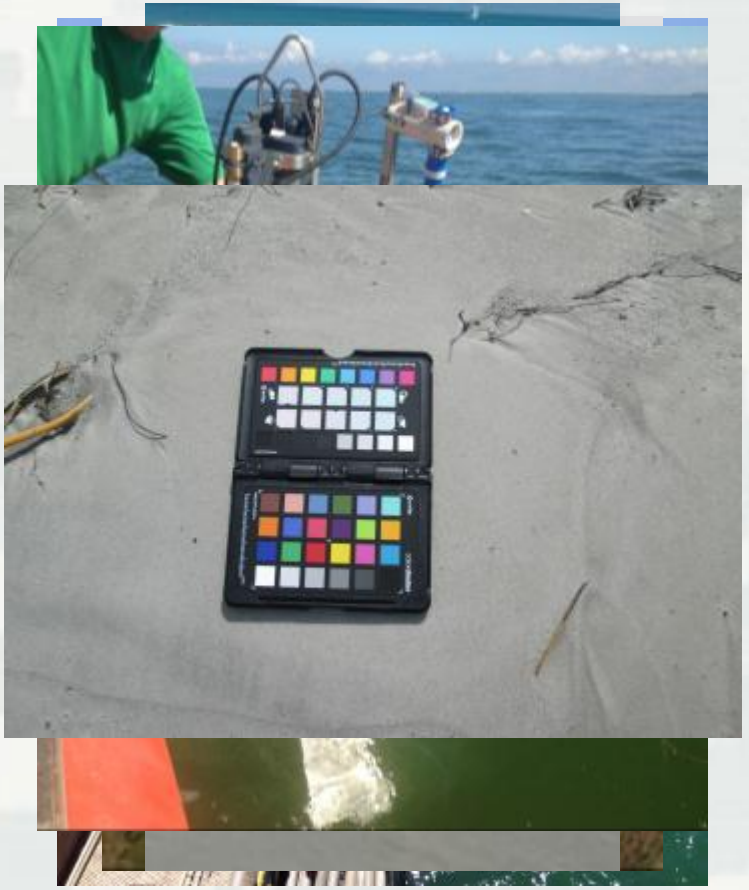
- To track the fine sediment loss through the dredging process and quantify their effects on the placement area.
  - If fine sediments can be more broadly utilized, regulatory standards could be changed which would ultimately save the USACE's limited dredging funds.
- To test several types of relatively inexpensive light and photosynthetically active radiation (PAR) sensors.
  - If lower-cost PARs can be correlated with turbidity measurements, they could be more broadly utilized as an alternative measurement method.
- To compare dredging conditions with ambient conditions.
  - Natural turbidity may be similar to that associated with dredging of fine sediments, lending additional justification to modification of regulatory standards.
- To compare CSSZ and traditional placements

Why worry about fines?

- Compaction and density issues
  - Thought to be an issue for sea turtle nesting
- Light attenuation
  - Dredge plume associated with fine sediments and impacts to biological resources
- Sediment color
  - Impacts to sea turtle male to female ratio, incubation period and reduces hatching success
  - Aesthetic issues
- Overall grain size
  - May not match existing beach

Project Monitoring

- Pre-dredging
  - Vibracores taken in channel
  - Sediment analysis
- During/Post-dredging
  - Cameras
  - Surveying
  - Sediment sampling and analysis
    - Dredge and Placement
  - Compaction testing
  - Light/PAR sensors
  - Munsell color
  - Sea turtle nesting surveys



2014 Dredging and Placement

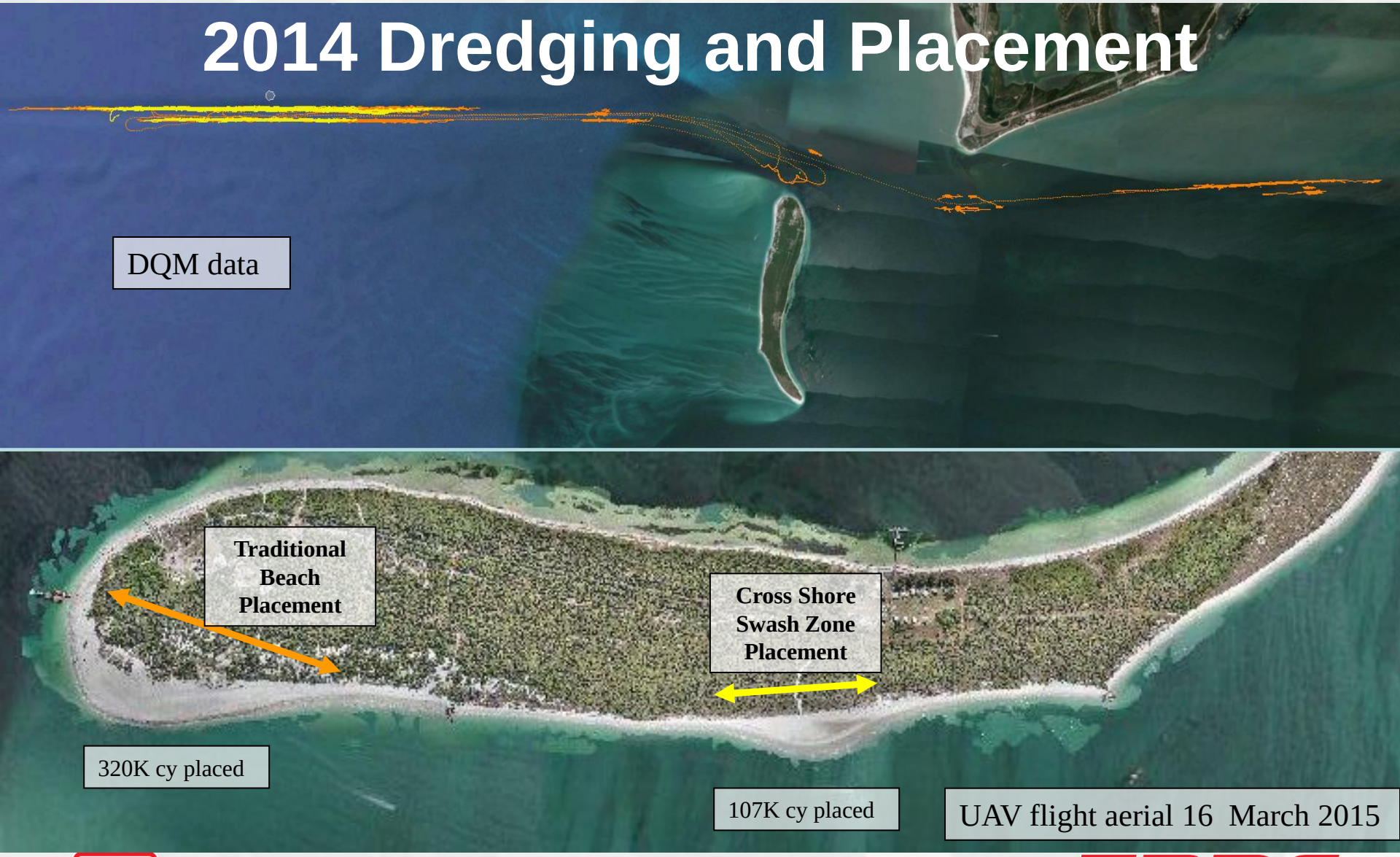


Image Courtesy of USACE Jacksonville District

Fines Content and Density

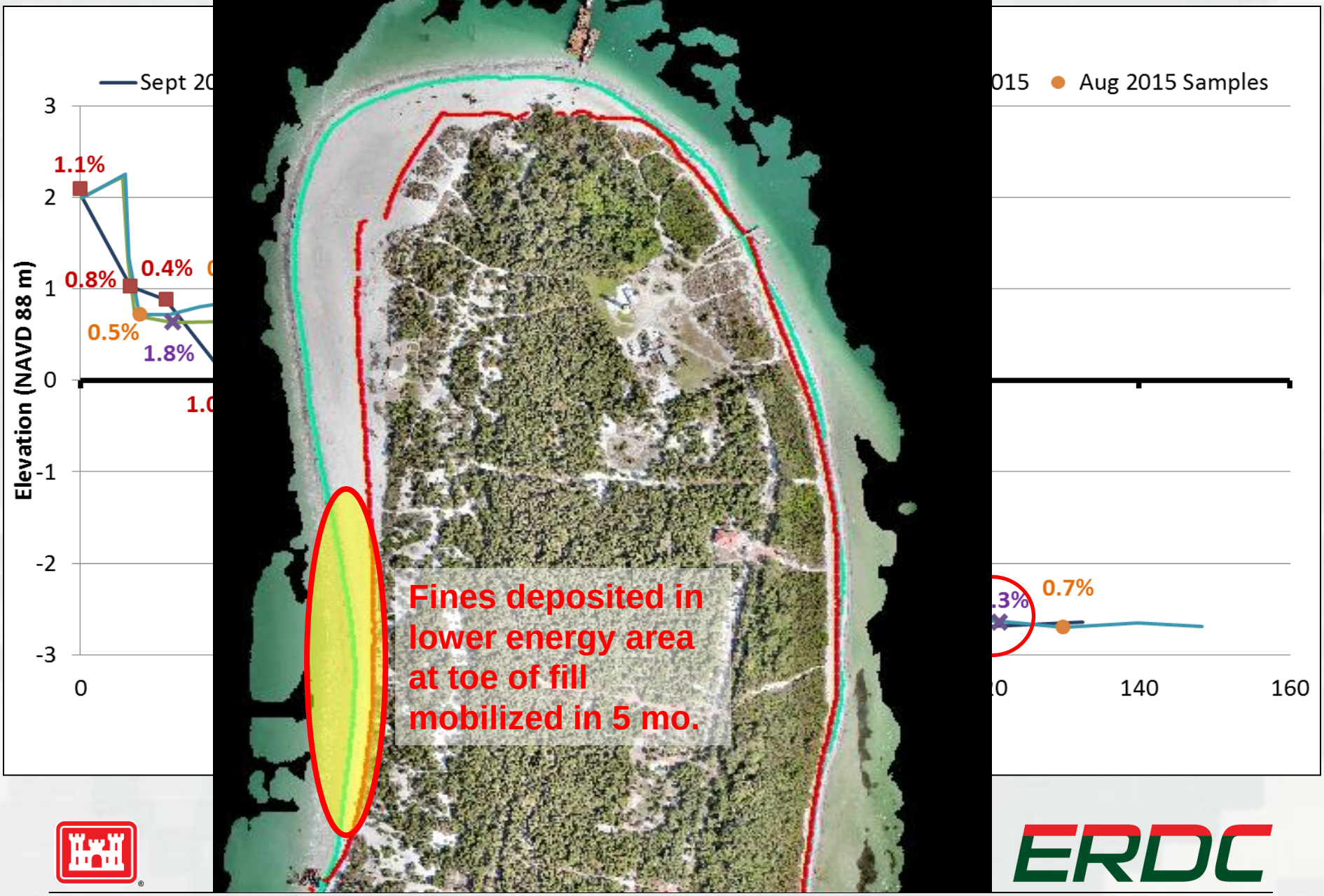
Tampa Harbor MD - Egmont Key 2014		
	# of Samples	Avg. % by wt. passing 230 sieve
In-situ avg.	80	20.7
In-situ Traditional	45	20*
In-situ CSSZ	35	24*
Pre-Beach	**6**	**0.03**
Post-Dredged avg.	21	0.51**
Post Traditional	14	0.52**
Post CSSZ	7	0.49**

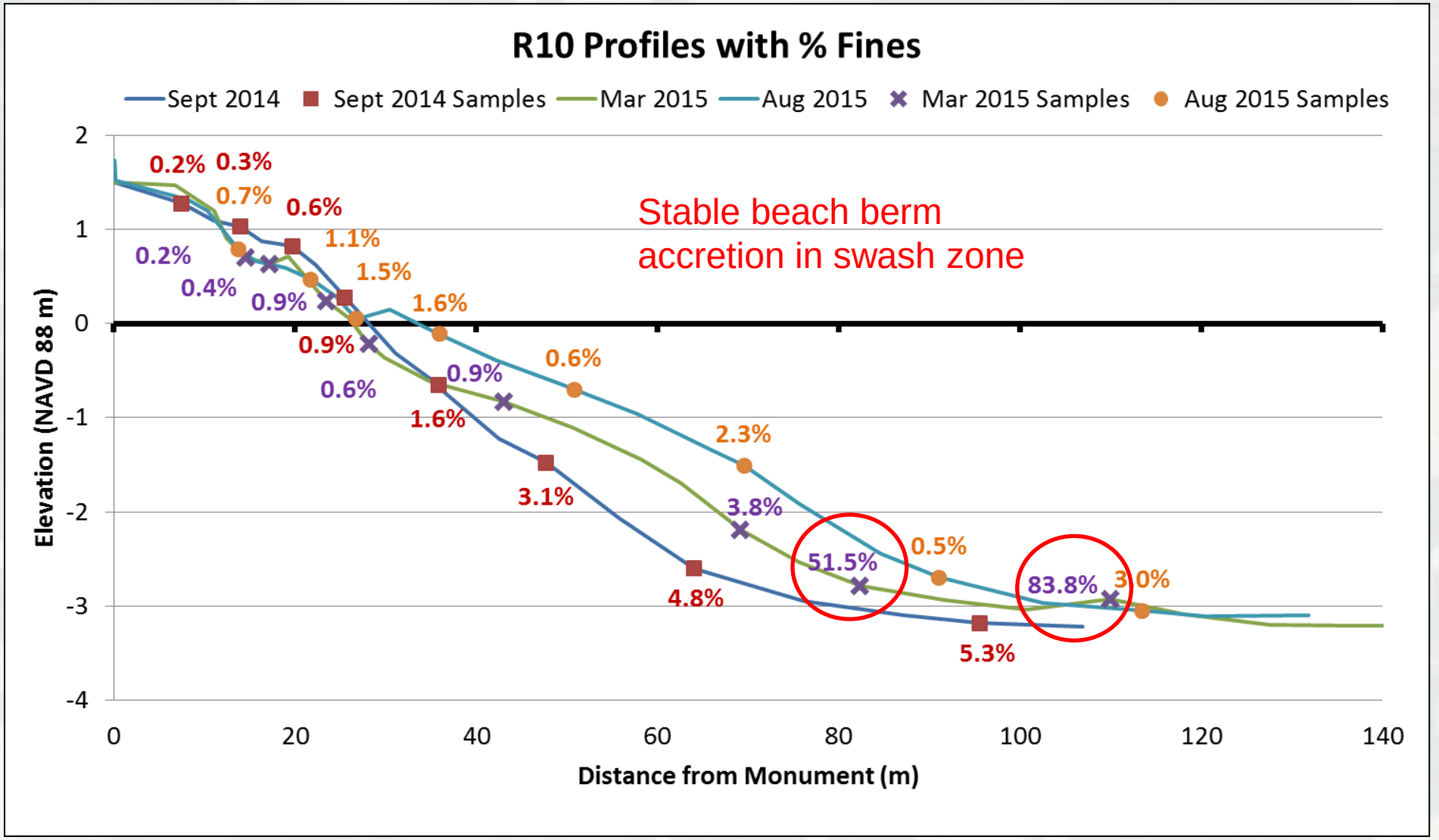
Tampa Harbor MD - Egmont Key 2014			
Density	# of Samples	Value avg. (kg/m3)	% Greater
pre-Beach	7	1405.1	0.0%
post-Dredged	17	1471.6	4.7%
Traditional	11	1476.0	5.0%
CSSZ	6	1463.5	4.2%

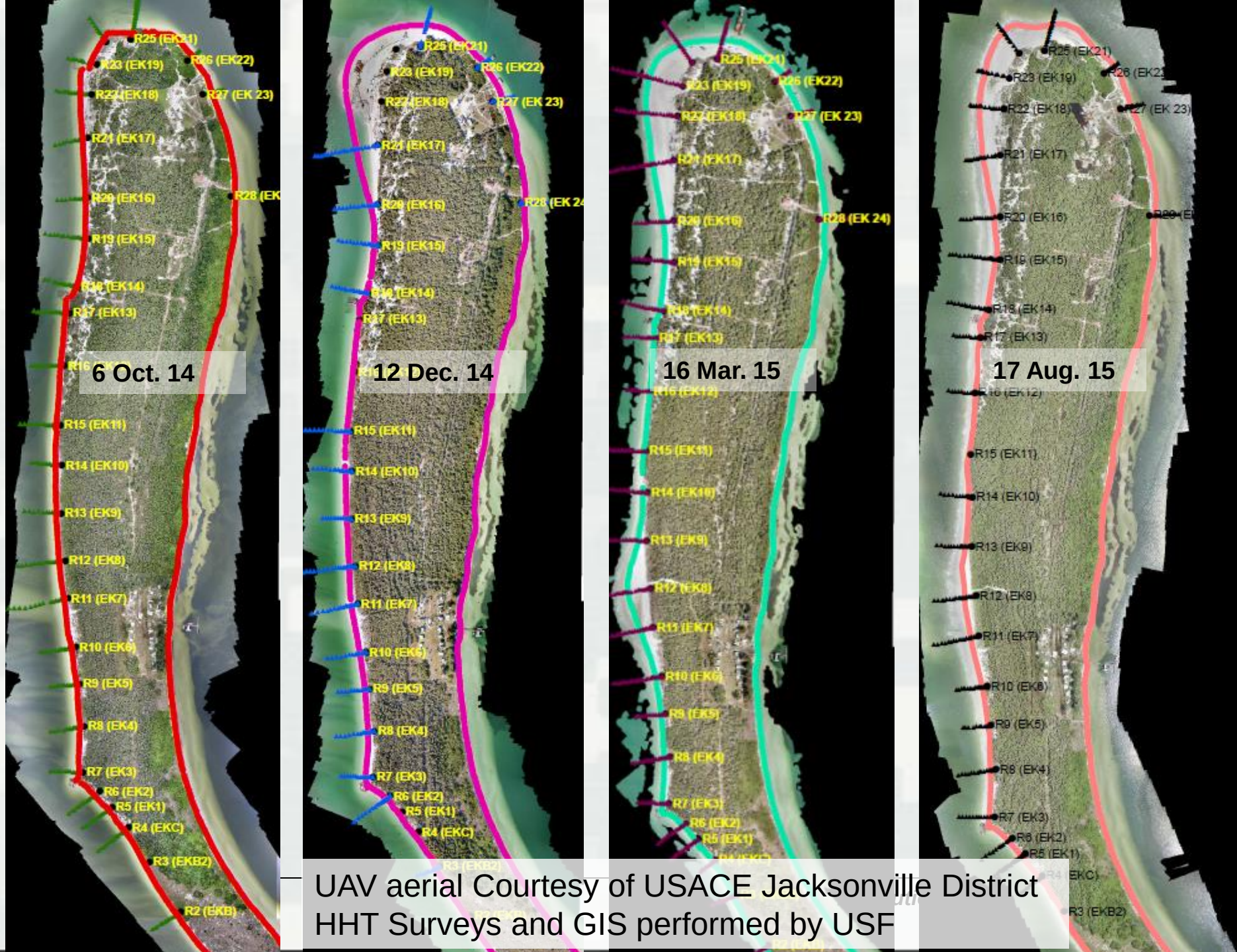
* Based on DQM and core boring data

**Sampling occurred within 72 hours of placement completion

ERDC


Sept 20
015
Aug 2015 Samples
Elevation (NAVD 88 m)
3
2
1
0
-1
-2
-3
1.1%
0.8%
0.4%
0.5%
1.8%
0.7%
.3%
0
140
160
Fines deposited in lower energy area at toe of fill mobilized in 5 mo.


R10 Profiles with % Fines
Sept 2014
Sept 2014 Samples
Mar 2015
Aug 2015
Mar 2015 Samples
Aug 2015 Samples
Stable beach berm
accretion in swash zone
Elevation (NAVD 88 m)
Distance from Monument (m)
0.2%
0.3%
0.7%
0.6%
1.1%
0.2%
0.4%
1.5%
0.9%
1.6%
0.9%
0.6%
0.9%
0.6%
1.6%
2.3%
3.1%
3.8%
51.5%
0.5%
83.8%
3.0%
4.8%
5.3%



UAV aerial Courtesy of USACE Jacksonville District
HHT Surveys and GIS performed by USF

Cone Penetrometer

Pre-Placement

Depth (in)	0"-6"	6"-12"	12"-18"
Min (psi)	100	100	198
Max (psi)	580	700	617
Avg (psi)	293	406	457
Median (psi)	295	431	515
# samples	19	19	19
Refusals	1	4	5
% Refusal	5%	21%	26%

Post-Placement

Depth (in)	0"-6"	6"-12"	12"-18"
Min (psi)	50	125	200
Max (psi)	600	700	600
Avg (psi)	328	482	436
Median (psi)	300	500	500
# samples	21	21	21
Refusals	3	6	10
% Refusal	14%	29%	48%

- Increase in refusals due to shell hash areas

Munsell Color

Tampa Harbor MD - Egmont Key 2014		
	# of Samples	Value avg.
In-situ	80	4.36*
pre-Beach	13	5.9
post-Dredged	24	5.3
Traditional	16	5.0
CSSZ	8	5.9

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

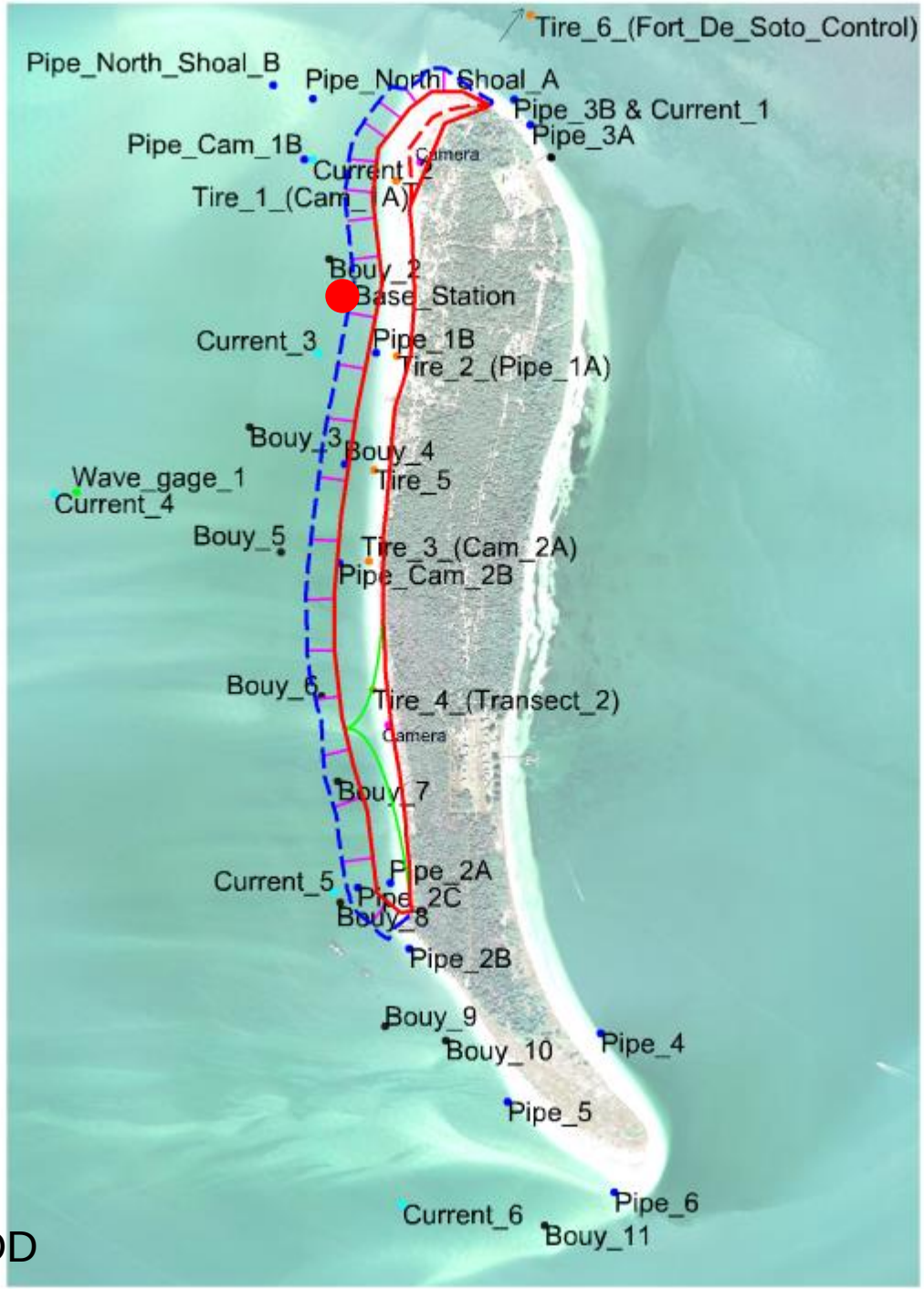
NOTES: Triplicate measurements of hue, value, and chroma were collected from three areas on each moist sand sample using a digital colorimeter (CR-400, Konica Minolta, Osaka, Japan).

Light Attenuation Long-term Monitoring

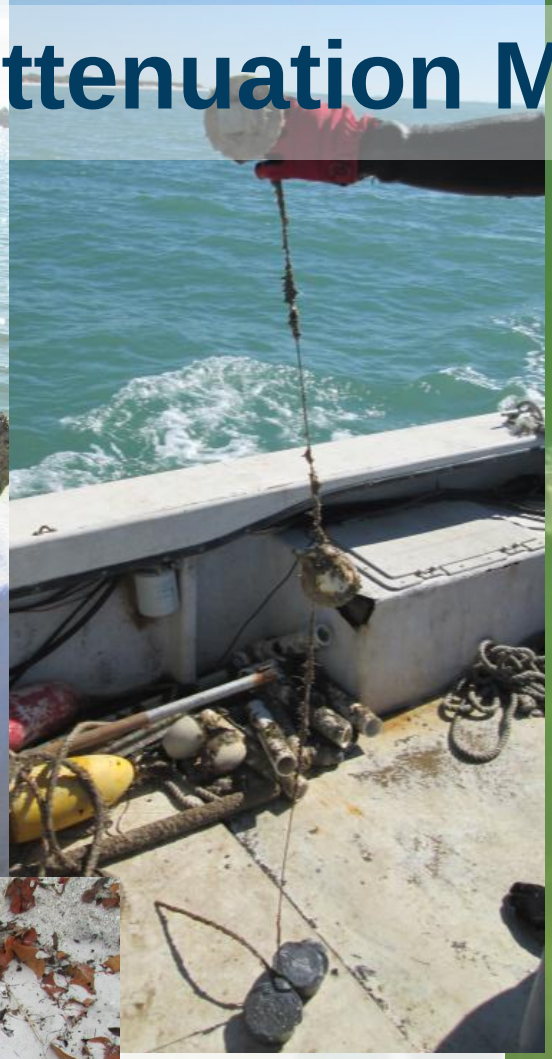
Egmont Key, FL
Long-term
Deployment Map
14 Nov – 15 Dec

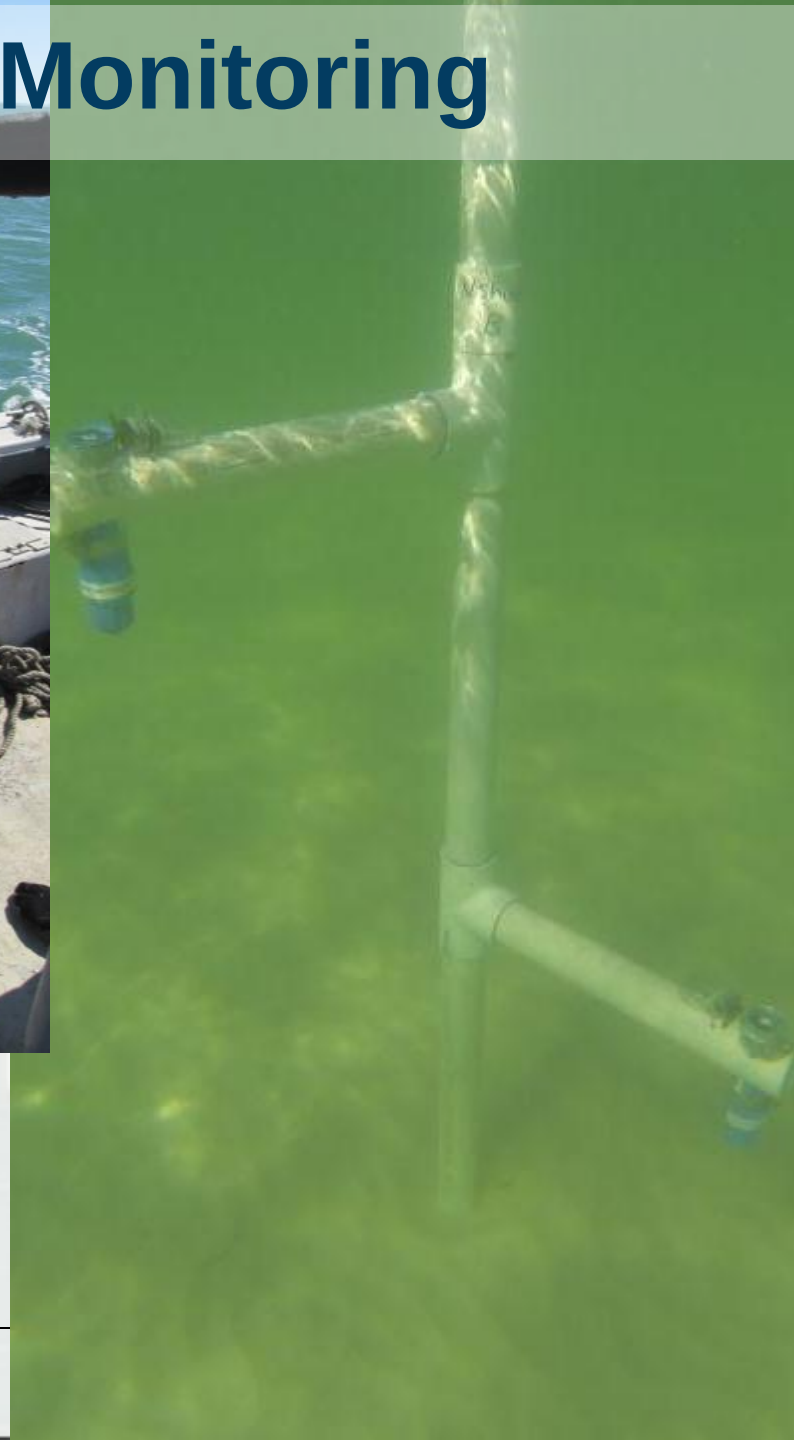
BUILDING STRONG®

Image Courtesy of GLDD

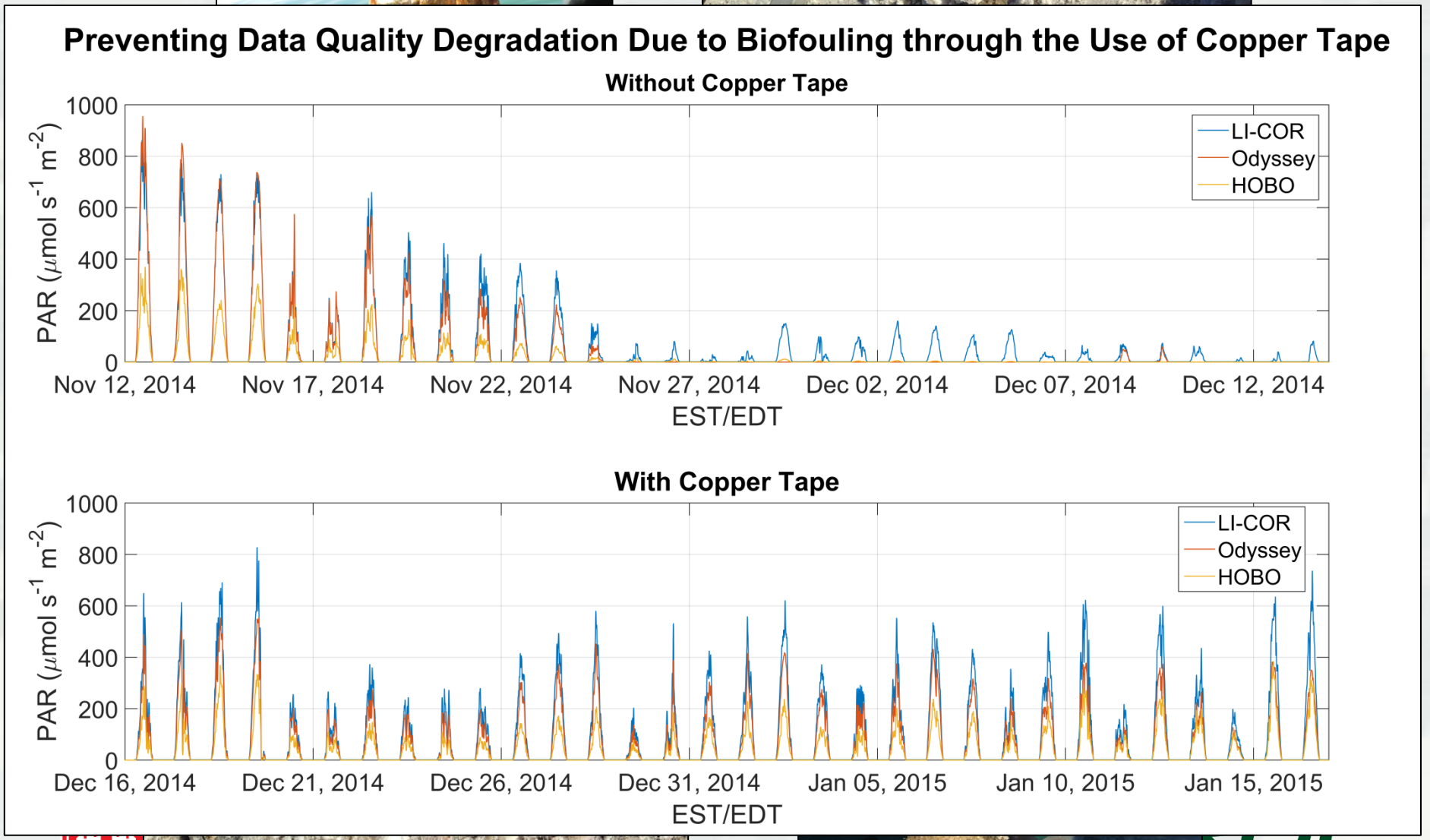


Light Attenuation Monitoring



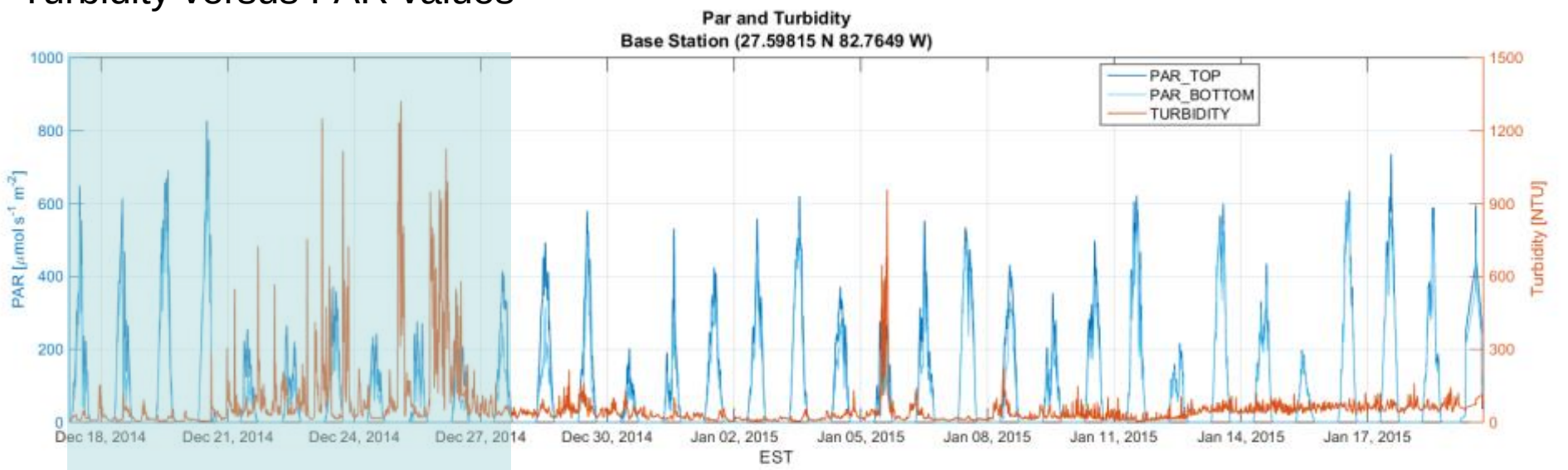


Instrument Biofouling



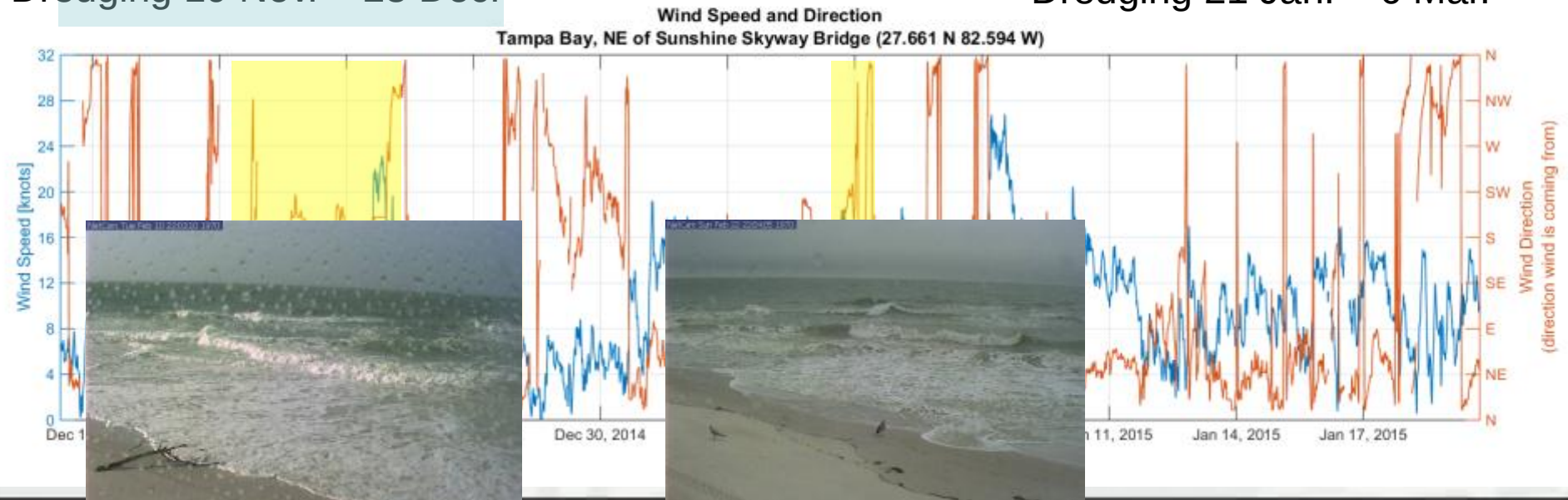
Light Attenuation Long-term Monitoring

Turbidity versus PAR values



Dredging 19 Nov. – 28 Dec.

Dredging 21 Jan. – 6 Mar.



CSSZ vs. Traditional Placement

- **Less linear feet of beach impacted for equivalent volume**
  - CSSZ
- **Reduced environmental Impacts**
  - Cementation
  - Munsell Color
  - Shorebird impacts
- **Material is not visible to public**
- **Lower cost**
  - Construction – less beach equipment
  - Reduced pipeline extensions
  - Maintenance – less escarpment, tilling
- **Purely performance based regulations**
  - More beneficial reuse
  - Lower costs - better bids due to more equipment able to perform work

Image Courtesy of GLDD

Project Performance - Galveston

Galveston - Data Set

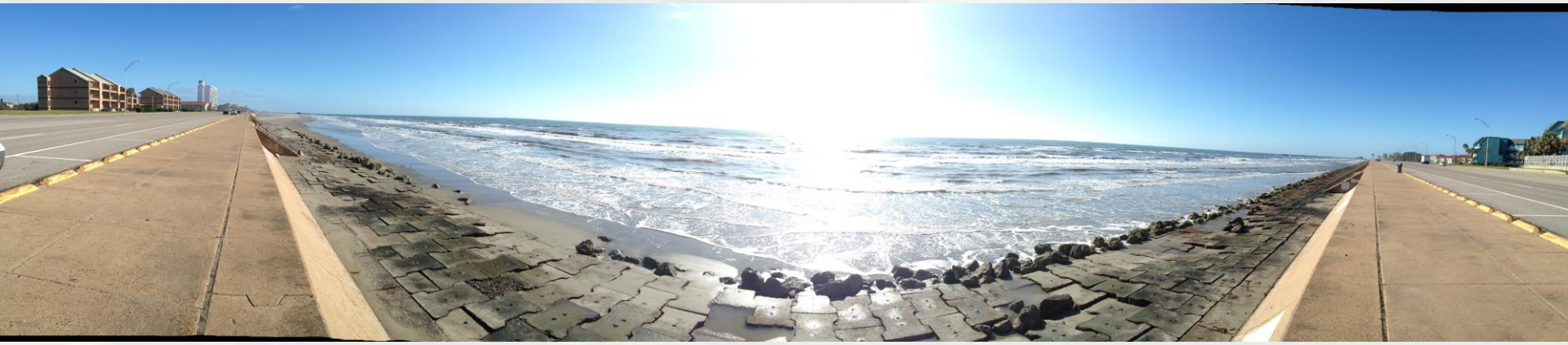
- 94 samples collected on the dredge Terrapin Island – over two loads
  - 35 Inflow
  - 59 overflow

- 330 samples collected at the beach over 3 months by GLDD
  - Discharge slurry
  - Carrier water
  - Beach berm

- Munsell Color
- Cone Penetrometer

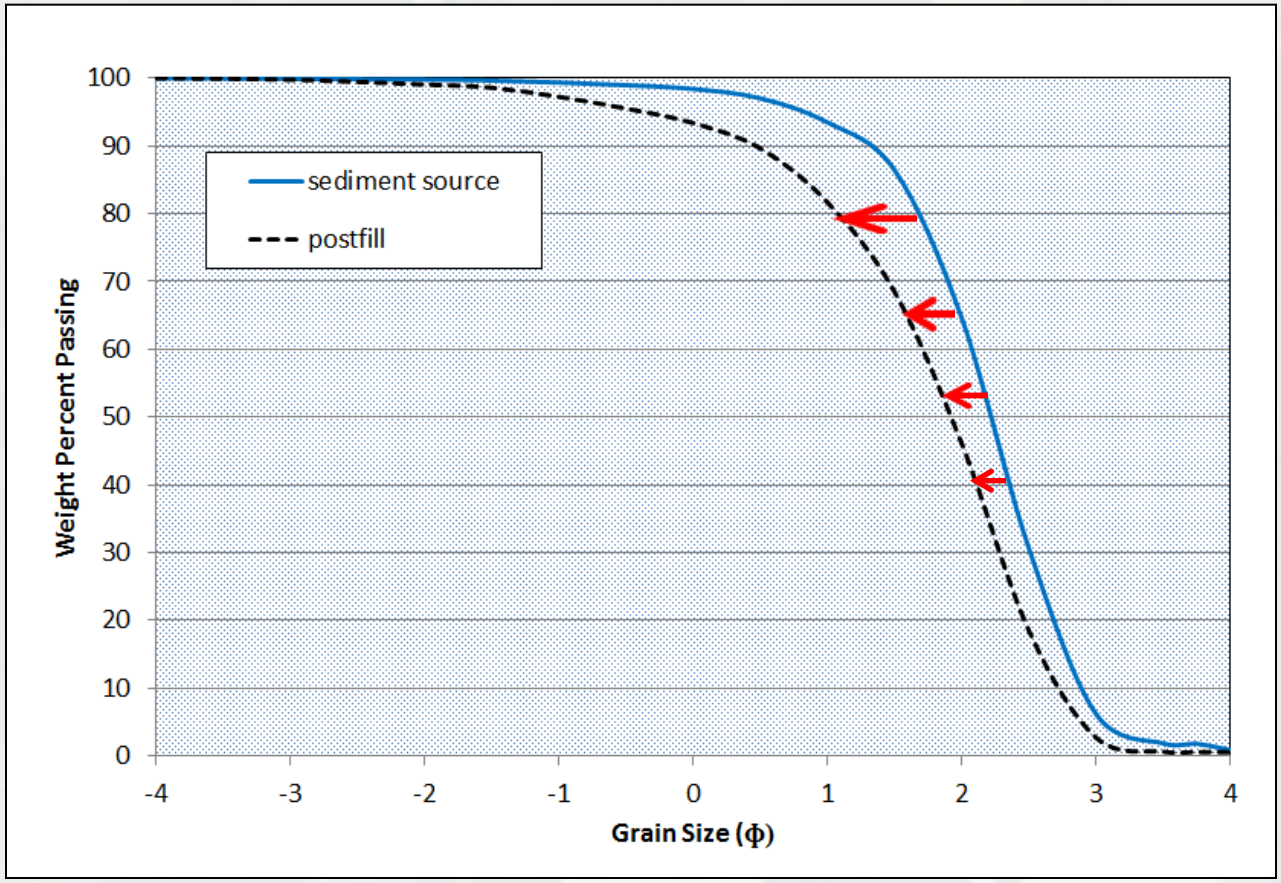
Project Performance - Galveston

Before



After 15 December 2015

Fine Sediment Loss Prediction



Δ Loss = Sediment Source fines content – Post fill fines content

Summary and Conclusions

- Grain Size sampling indicates significant “fines” losses through dredging process
- Longshore spreading of both nourishment types occurred
- Most of the sediment gained from longshore spreading appeared in the intertidal to subtidal zones
- Fine material initially located at the toe of the fill no longer appears along profile
- Munsell Color and Compaction similar to pre-conditions
- Turbidity decreases when not pumping
  - Copper tape reduced impacts of biofouling
- Turtle nesting appears lower in traditional nourishment than CSSZ, however overall number of nests may not have been impacted

Acknowledgements

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Questions?

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