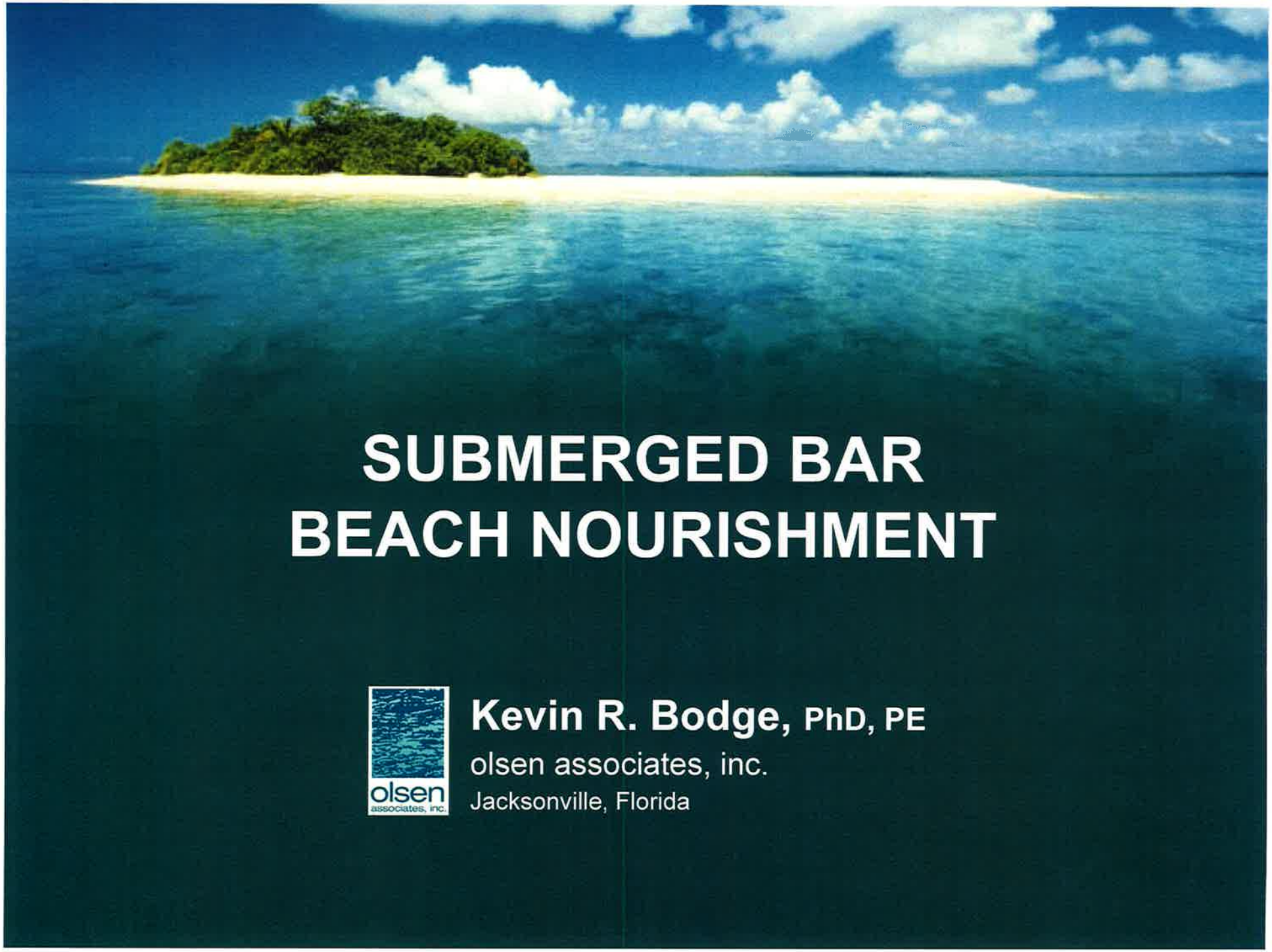
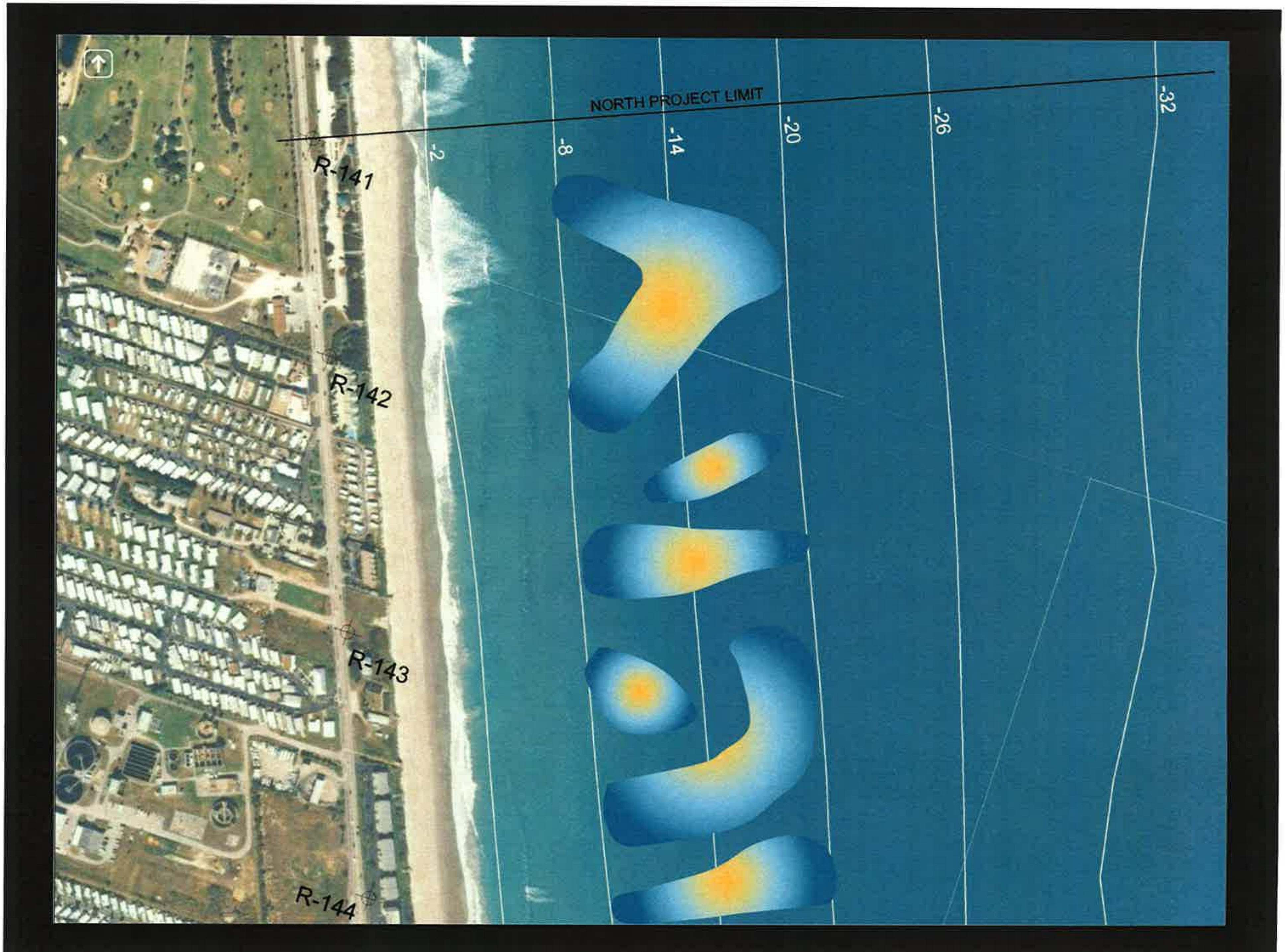
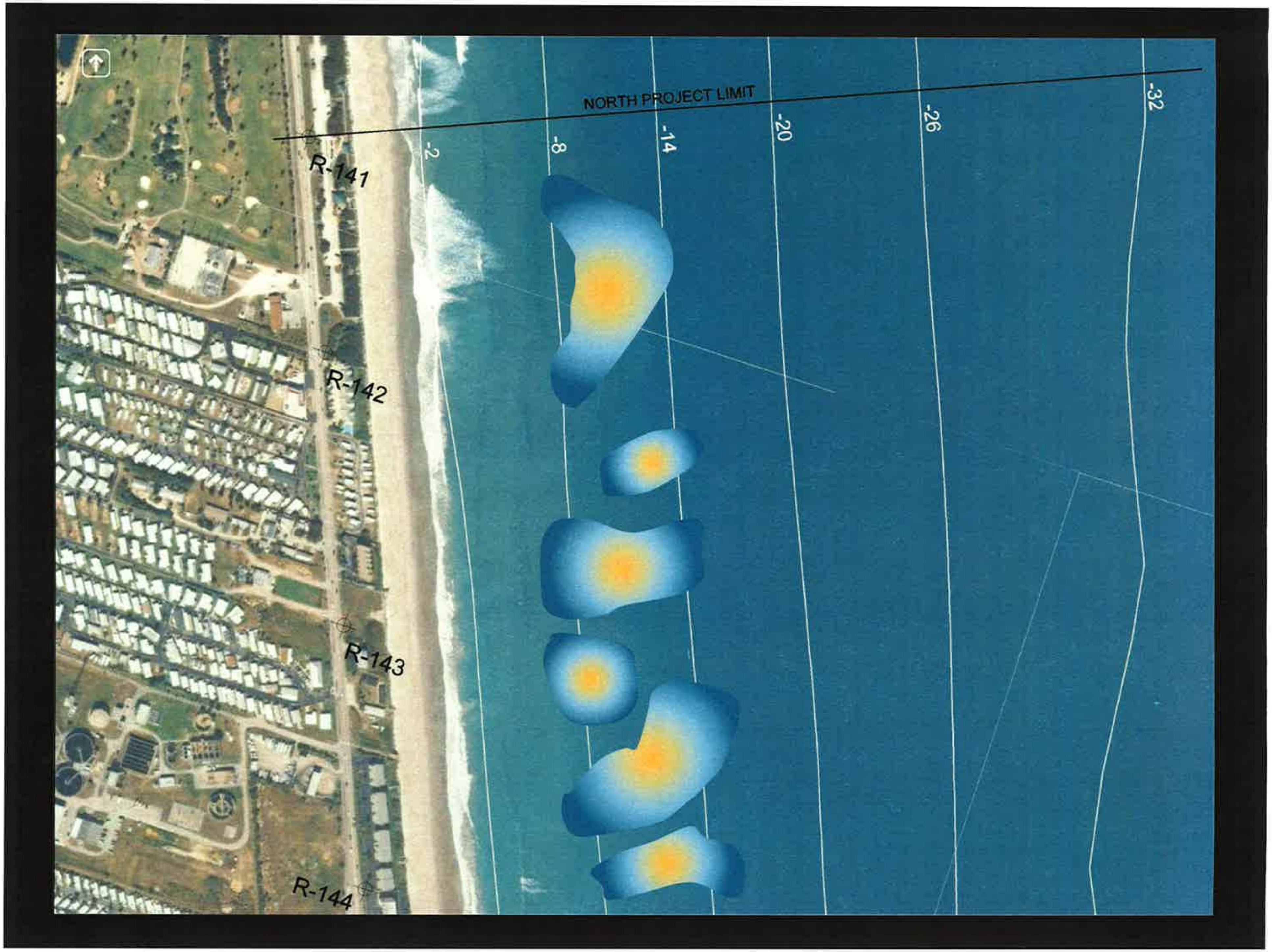


SUBMERGED BAR BEACH NOURISHMENT

Kevin R. Bodge, PhD, PE
olsen associates, inc.
Jacksonville, Florida


NORTH PROJECT LIMIT
-2
-8
-14
-20
-26
-32
R-141
R-142
R-143
R-144



NORTH PROJECT LIMIT
R-141
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R-143
R-144
-2
-8
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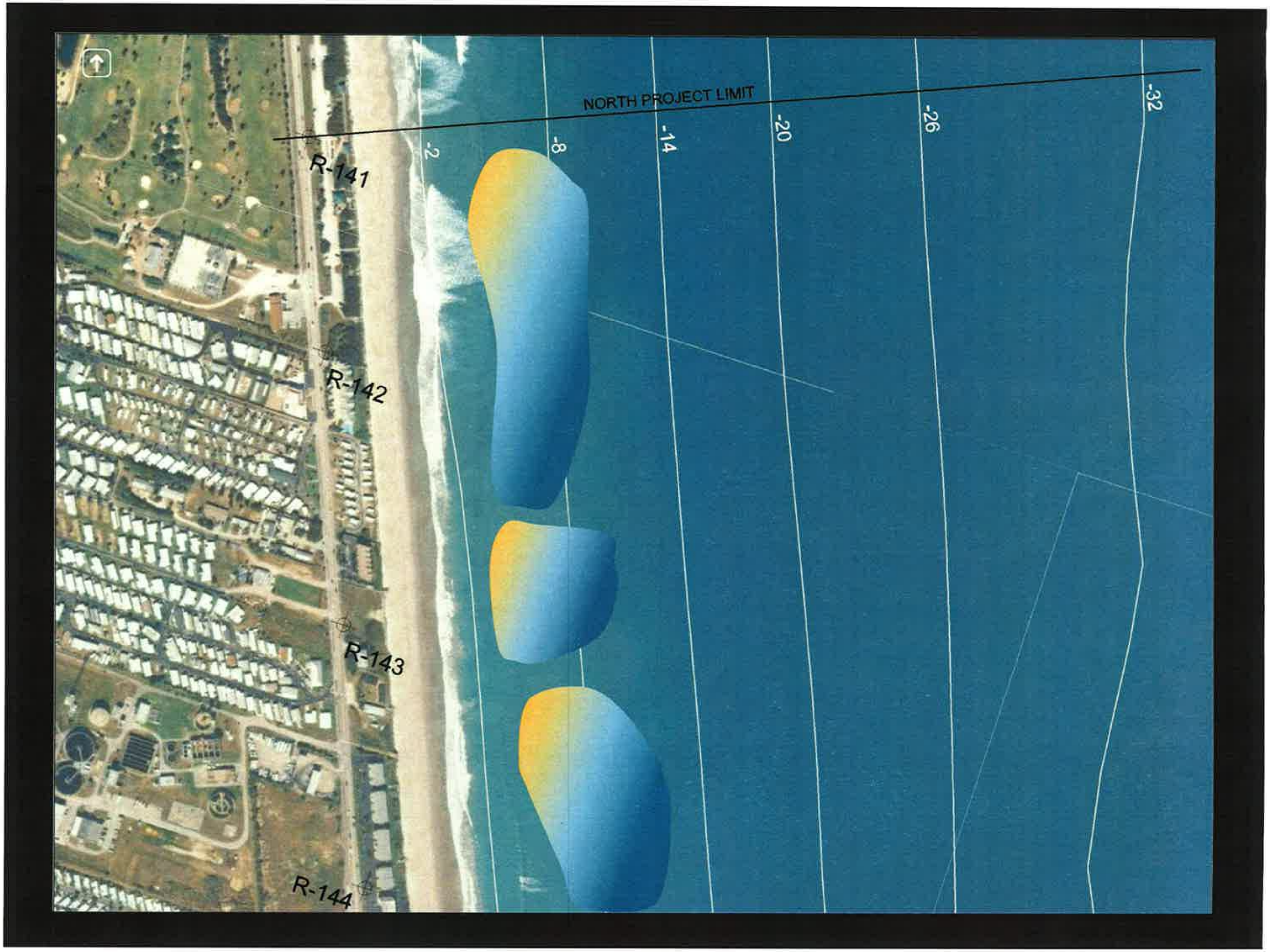

NORTH PROJECT LIMIT
-2
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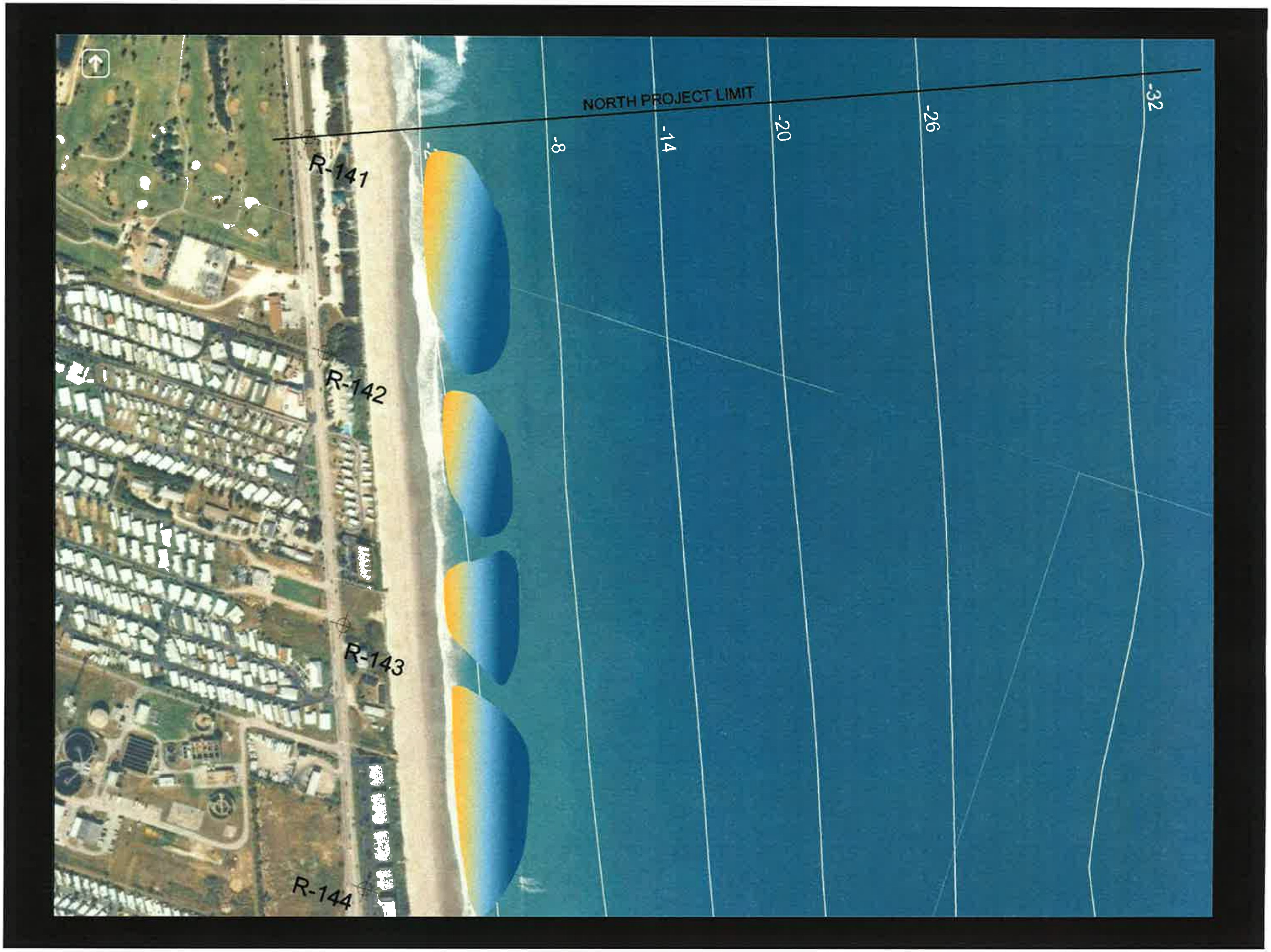

NORTH PROJECT LIMIT
R-141
R-142
R-143
R-144
-8
-14
-20
-26
-32


BREVARD COUNTY
SOUTH BEACHES

olsen associates, inc.
Coastal Engineering

Brevard County South Beaches

olsen associates, inc.
Coastal Engineering

Storm Erosion along South Beaches

olsen associates, inc.
Coastal Engineering

Post-Storm Dune Restoration

olsen associates, inc.
Coastal Engineering

Post-Storm Dune Restoration

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Coastal Engineering

Post-Storm Dune Restoration

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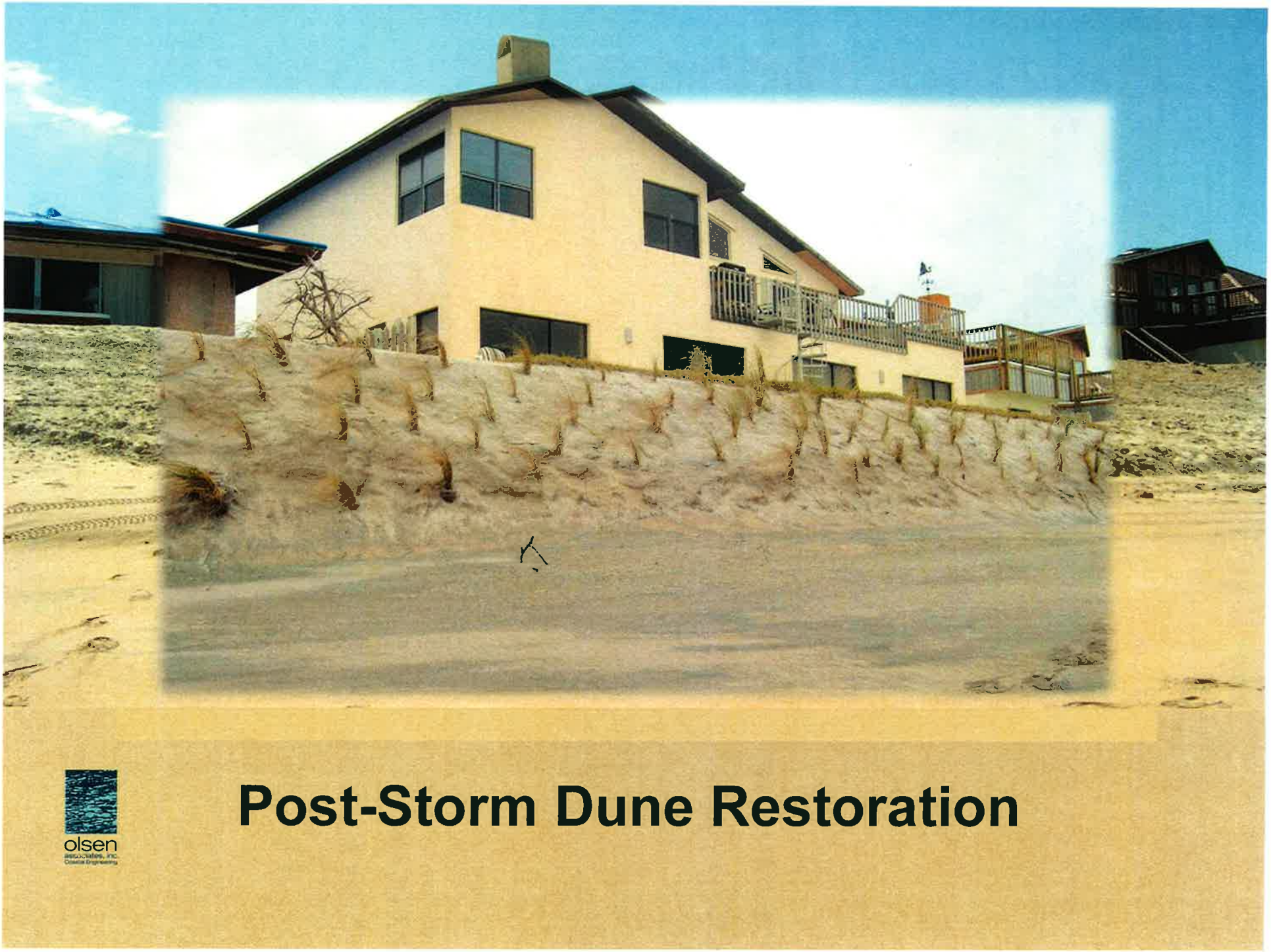
olsen
associates, Inc.
Coastal Engineering



Post-Storm Dune Restoration

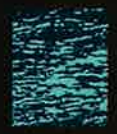
olsen associates, inc.
Coastal Engineering

South Beaches Project Area

- Mostly low-density, non-commercial development
- Archie Carr National Wildlife Refuge
- Very high marine turtle nesting density (>600 nests/km)
- No nearshore hardbottom

<u>Beach Management Options:</u>

- No Action (leads to armoring)
- Beach Nourishment
- Dune Restoration (truck-haul)
- Strategic Acquisition (Managed Retreat)
- Submerged Bar / Beachface Renourishment



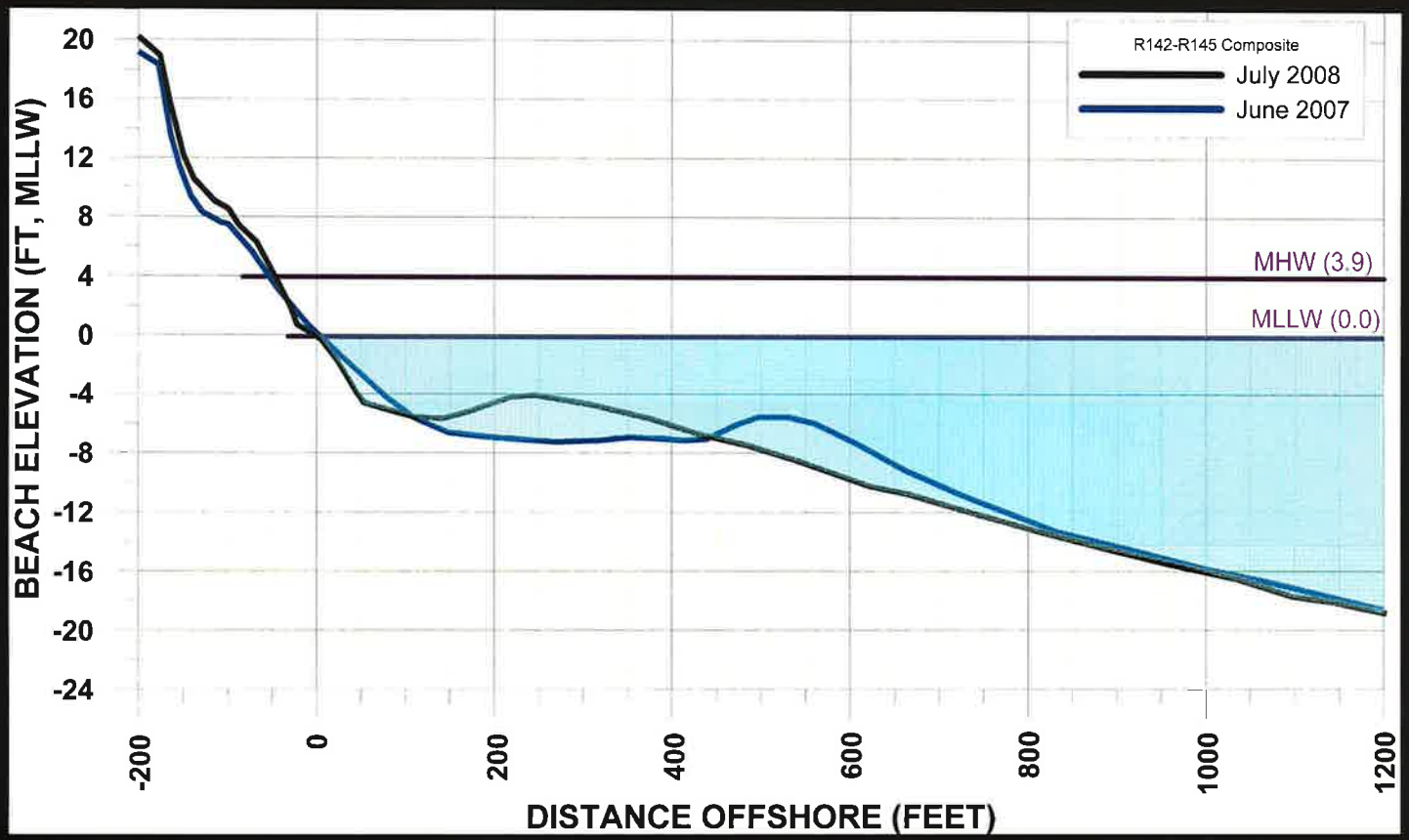
Project Objectives

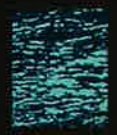
- Minimize Cost
- Minimize Impact to Nesting Beach
- High Quality Sand

Approach:

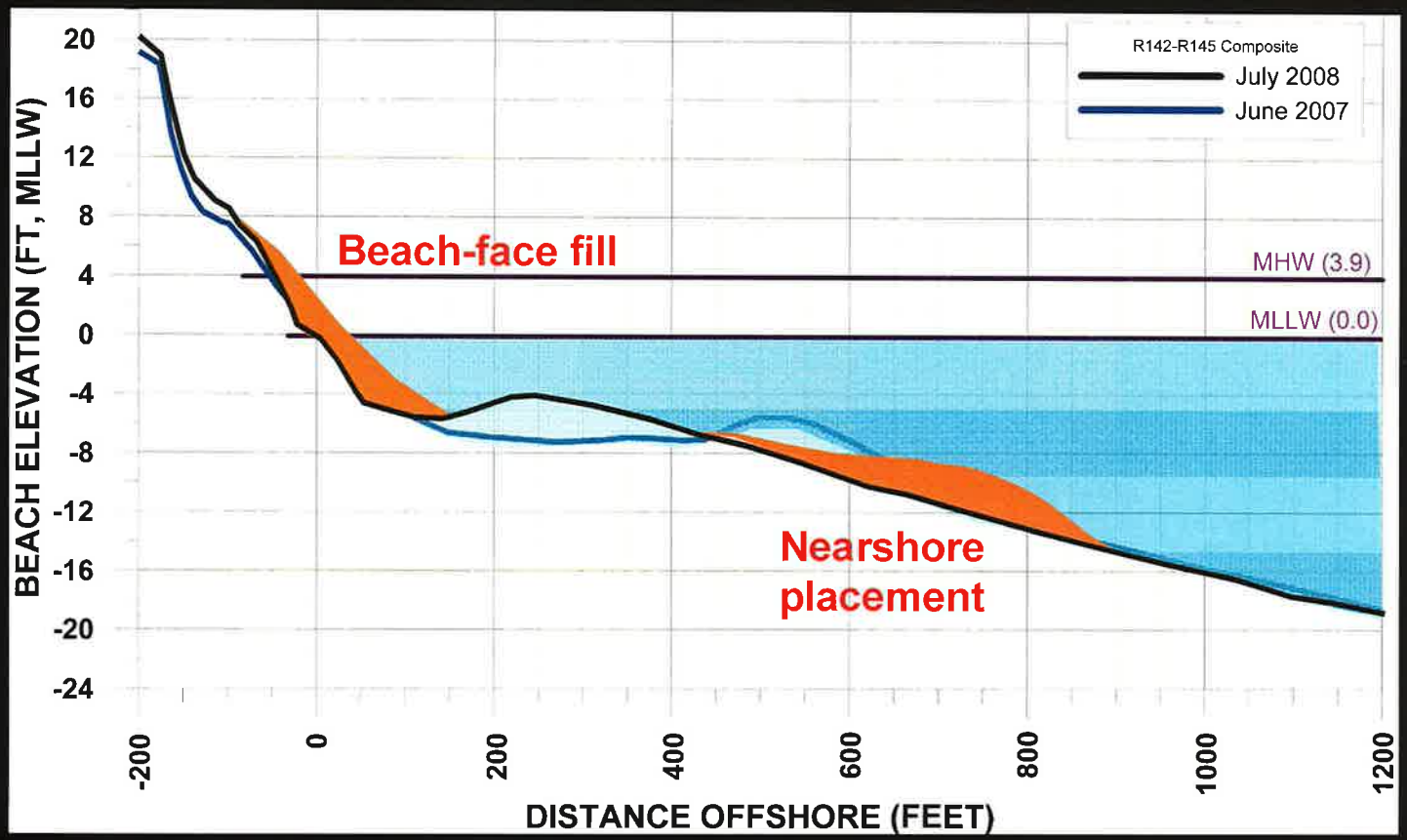
- Modest-scale sand renourishment (<20 cy/ft)
- Existing high-quality offshore sand sources
- Place sand to beach face or nearshore

Composite (Average) Beach Profile

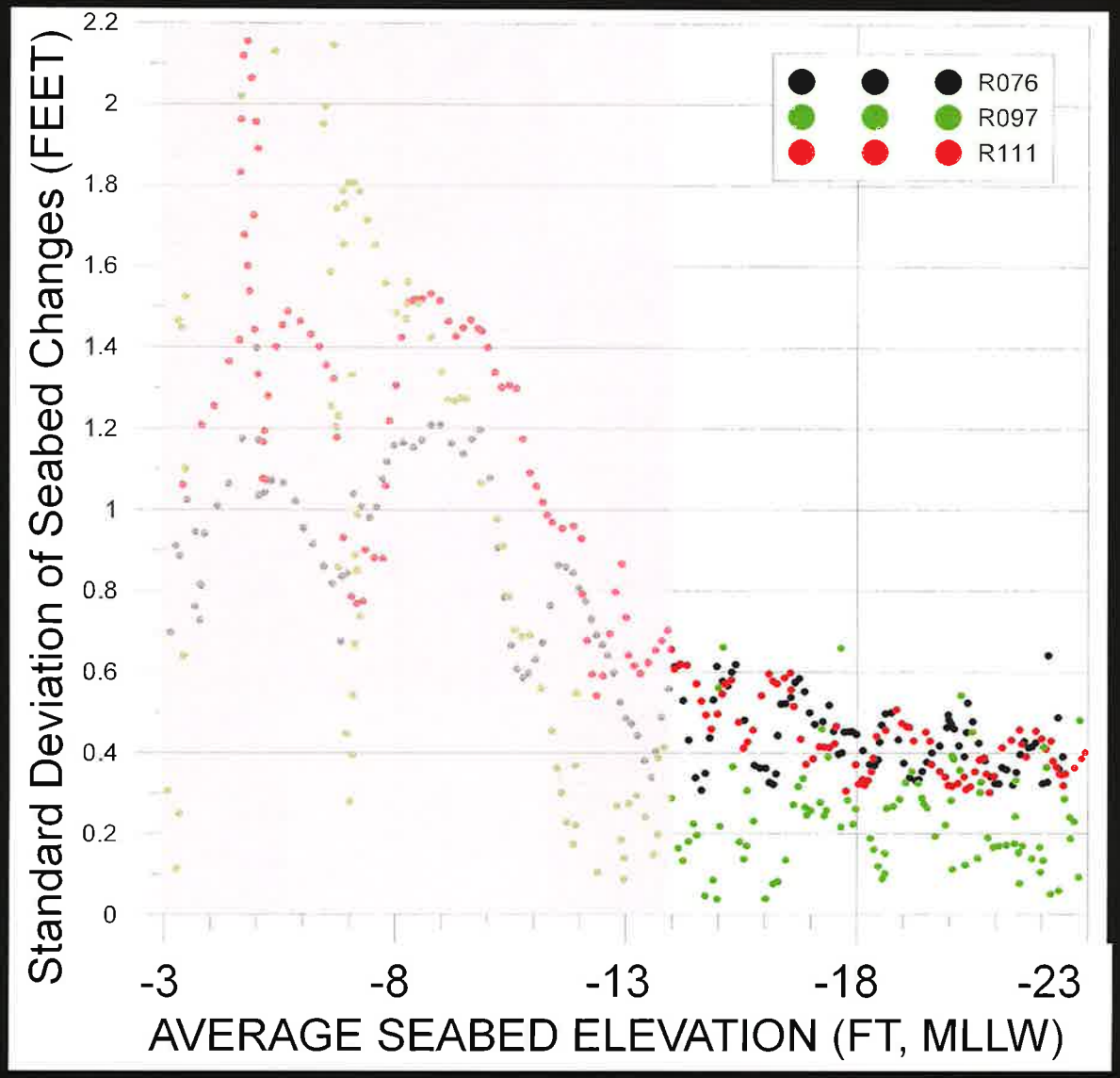




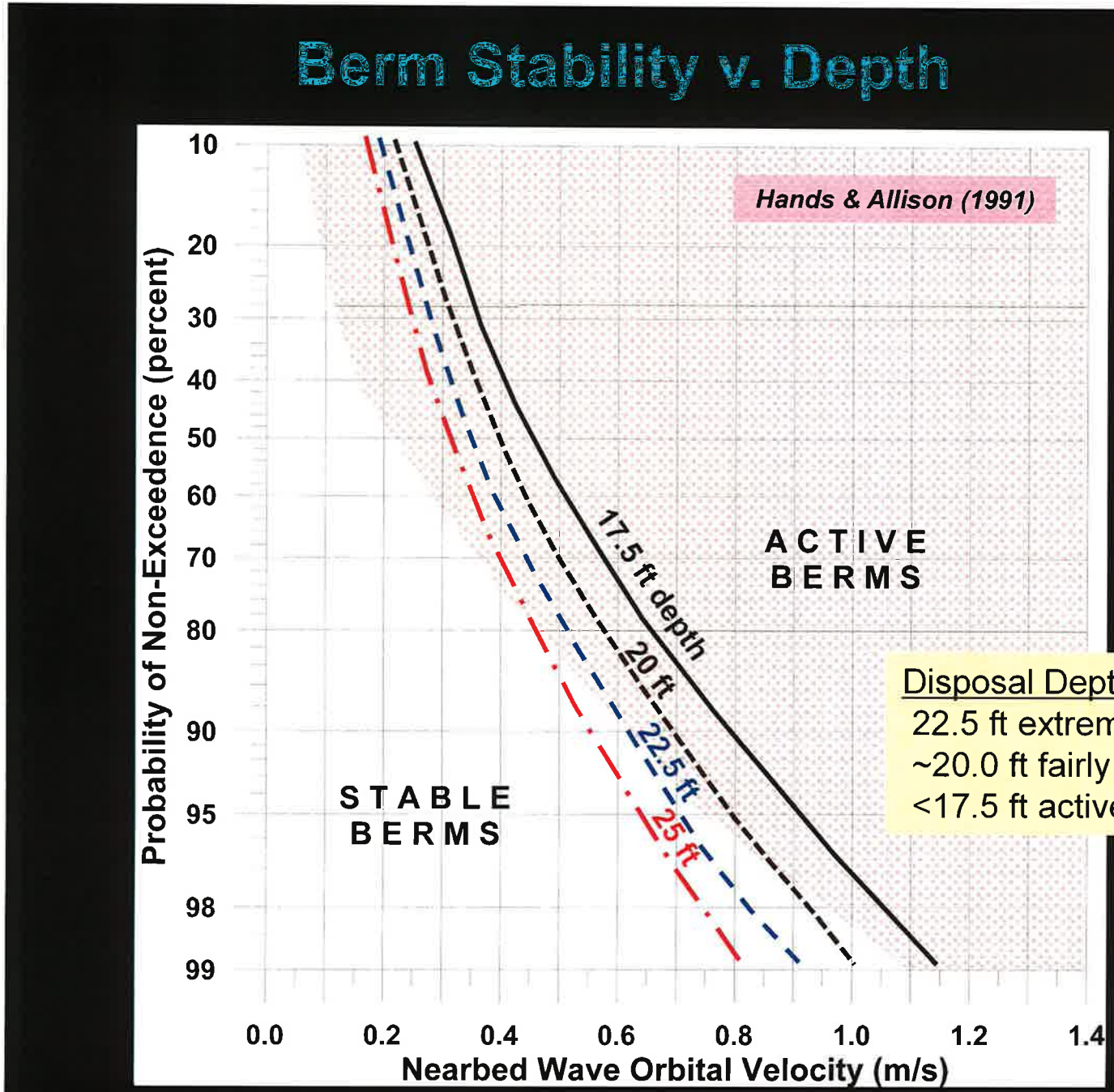
Composite (Average) Beach Profile

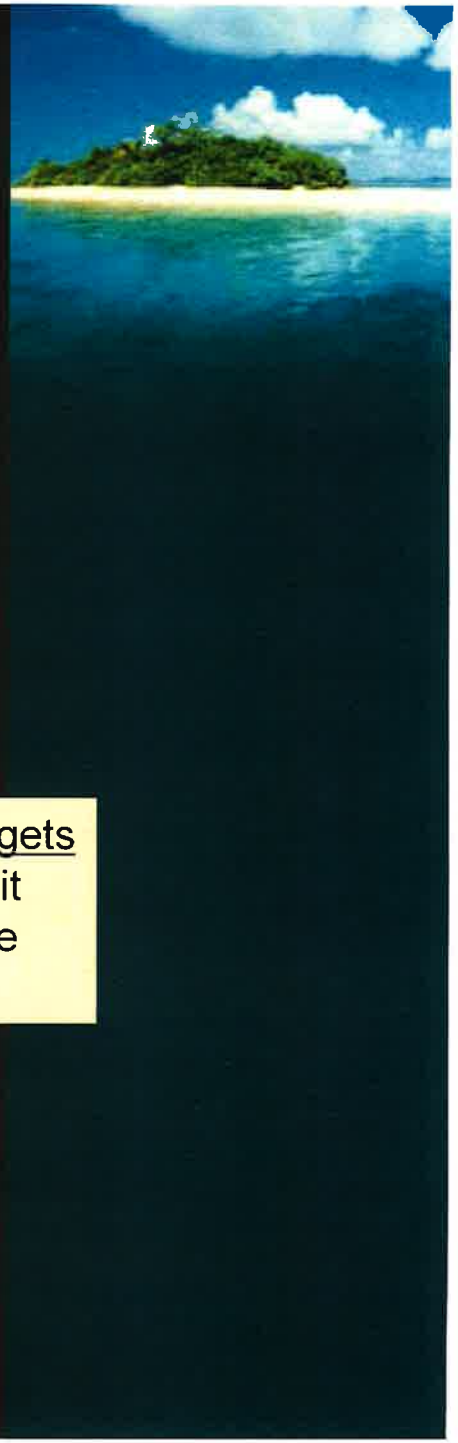


Beach Profile Variations by Depth



Berm Stability v. Depth



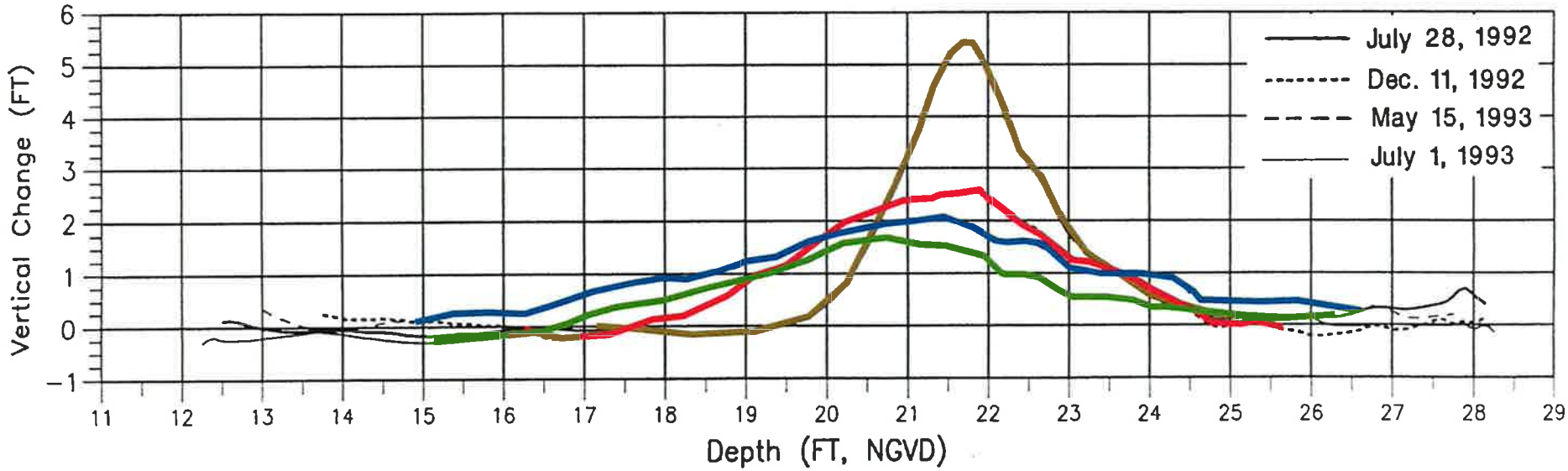


Disposal Depth Targets
22.5 ft extreme limit
~20.0 ft fairly active
<17.5 ft active

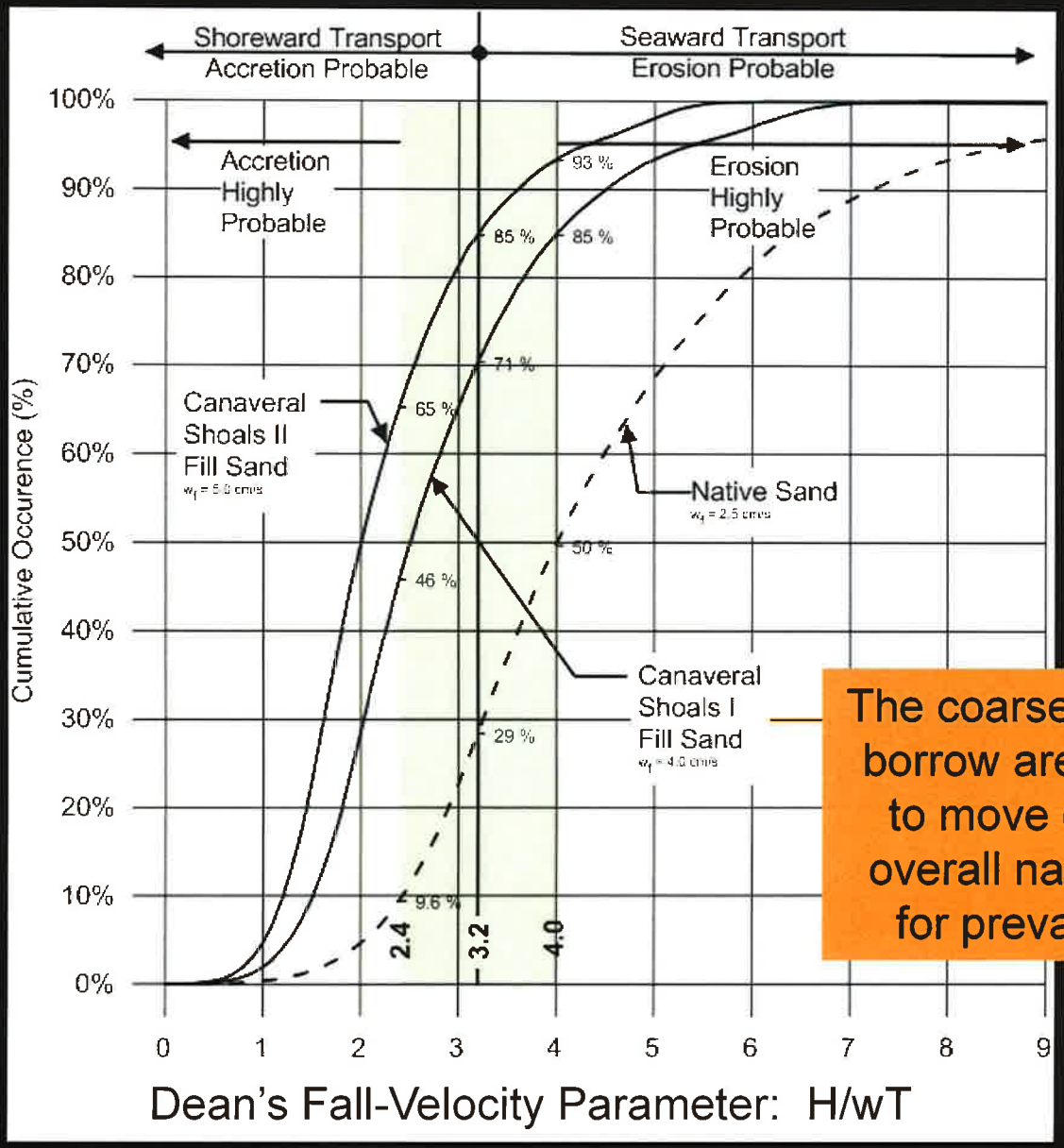
Prototype Experience

Nearshore Disposal from Canaveral Harbor Maintenance Dredging

(Cocoa Beach, c. 1992-93)



Prediction of Onshore/Offshore Transport



The coarser sand from the offshore borrow area is 3 times more likely to move onshore relative to the overall native beach profile sand, for prevailing wave conditions.

Predicting Fill Placement Depths

Mathematical Model

19.5	Dredge Depth (loaded)
9.5	Dredge Depth (light)
4	Min. keel clearance allowed (loaded)
4	Min. keel clearance allowed (light)
180	Median rainbow distance
70	bottom slope
-2.6	Depth difference at rainbow
20.9	Water depth at rainbow (dredge loaded)
10.9	Water depth at rainbow (dredge light)

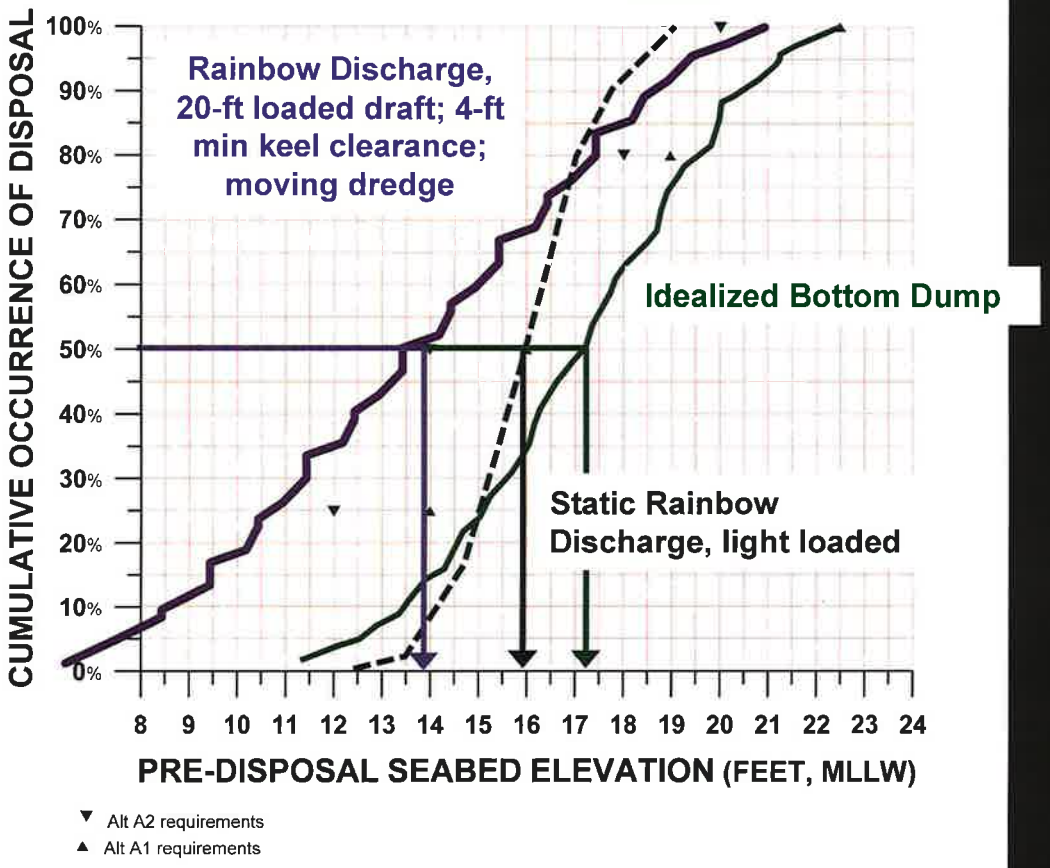
Example
A2

Nearshore Placement
-20 to -10 ft MLLW

Assumes rainbow discharge with dredge ideally advancing to shallow water as load lightens.

Tide levels	Range	Occurrence	
0	< 0.5'	0.15	*100%*
0.75	+0.5' to +1	0.12	
1.5	+1' to +2'	0.23	
2.5	+2' to +3'	0.22	
3.5	+3' to +4'	0.21	
4.5	+4' to +5	0.07	

Result
Weighted Avg Disposal Depth (MLLW)
13.9 ft



Specifying Fill Placement Depths

19.5	Dredge Depth (loaded)
9.5	Dredge Depth (light)
4	Min. keel clearance allowed (loaded)
4	Min. keel clearance allowed (light)
180	Median rainbow distance
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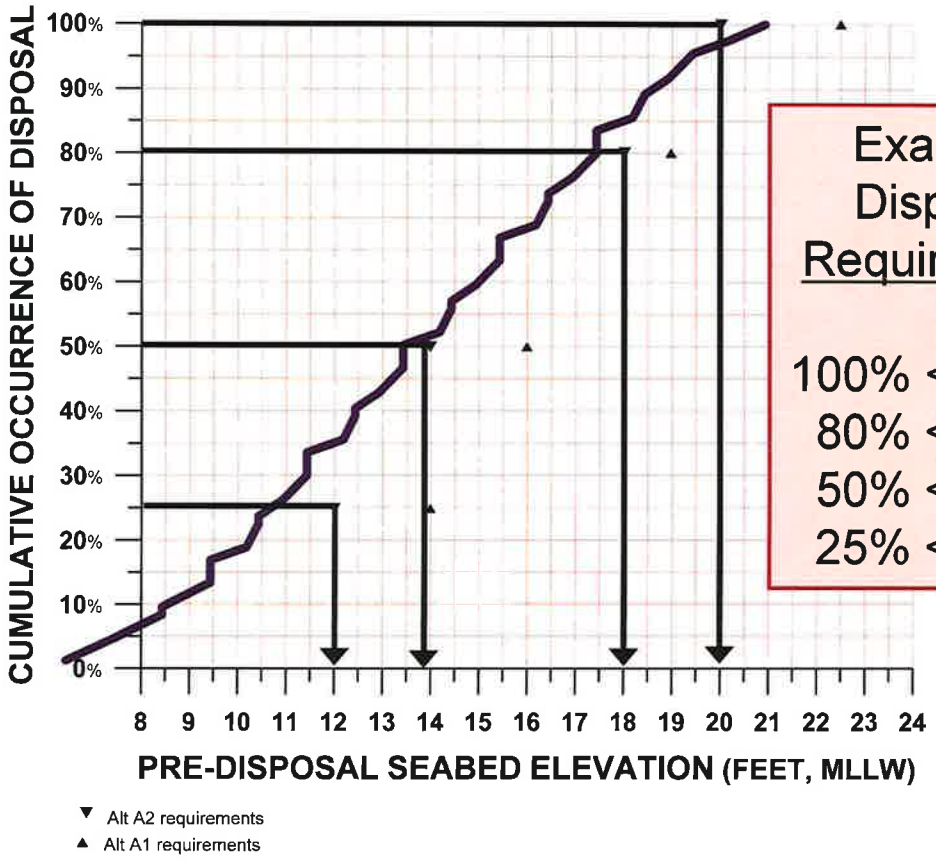
Result:
Weighted Avg Disposal Depth (MLLW)
13.9 ft



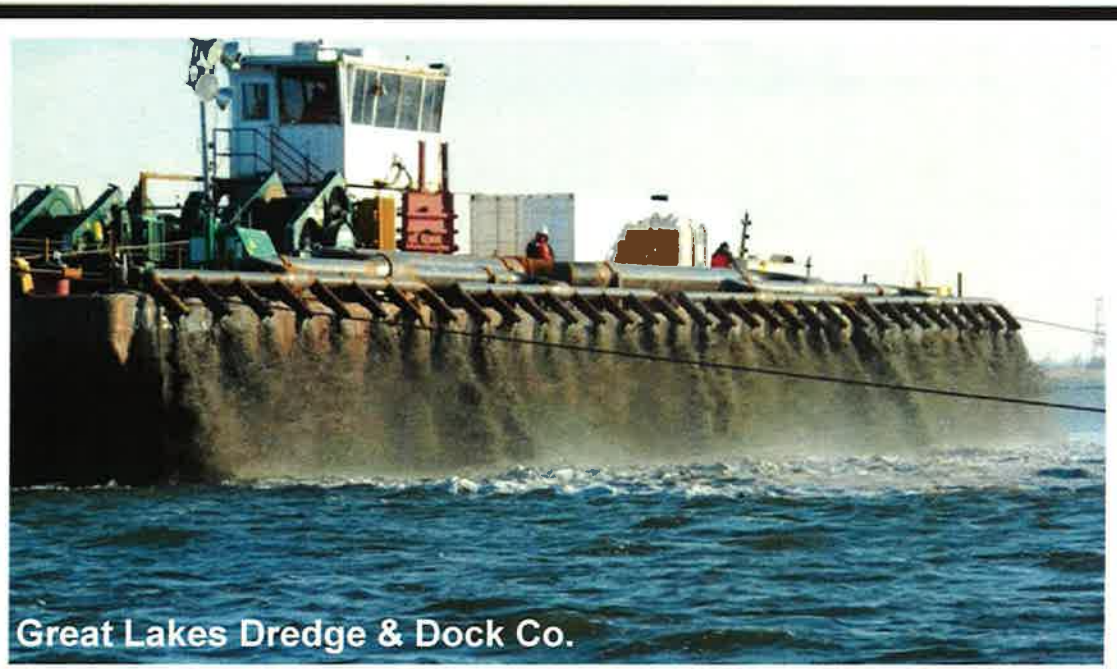
Example Disposal Requirement:

100% < 20 ft
80% < 18 ft
50% < 14 ft
25% < 12 ft

Potential Construction Methods

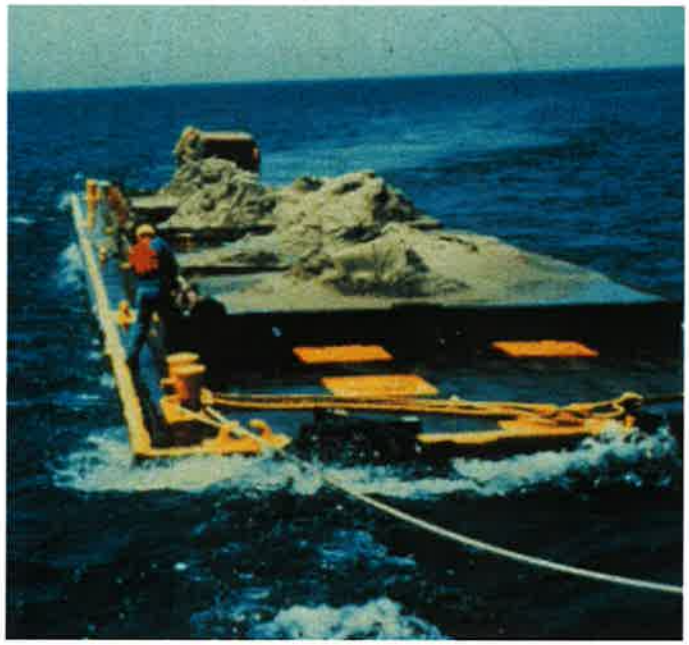
Spill Barge


Weeks Marine

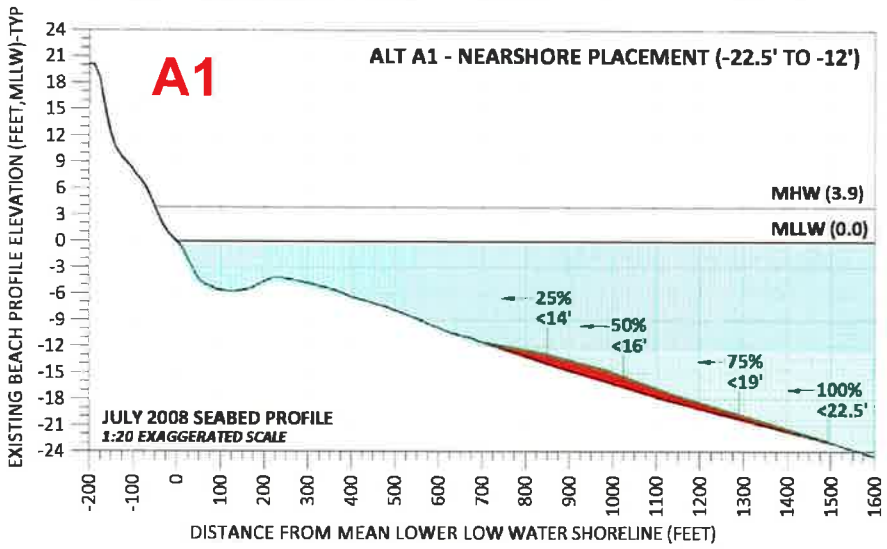

Great Lakes Dredge & Dock Co.

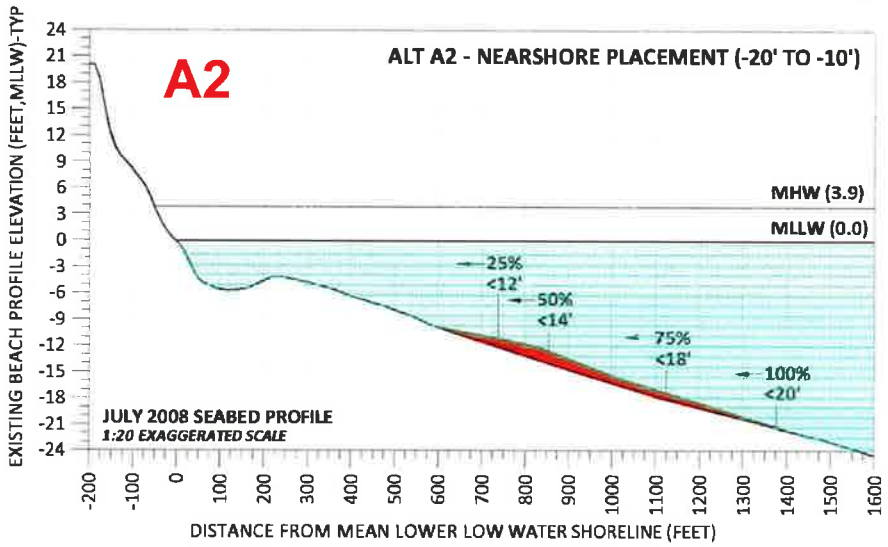
Bottom Dump


Norfolk Dredging Co. (Cocoa Beach 1992)

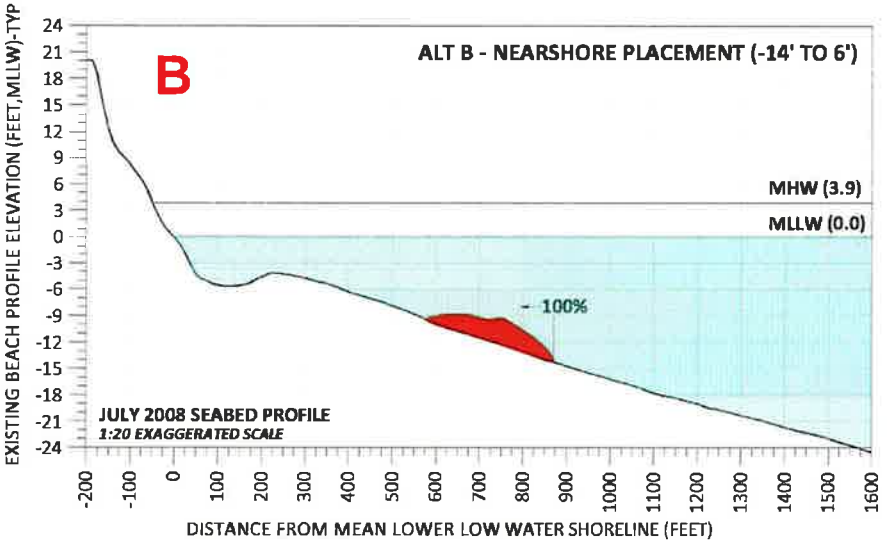


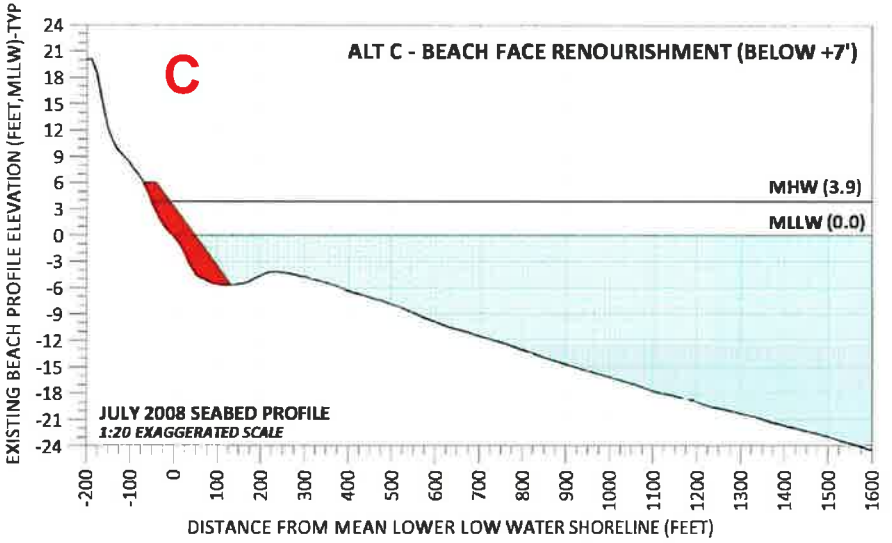
Rainbow Discharge



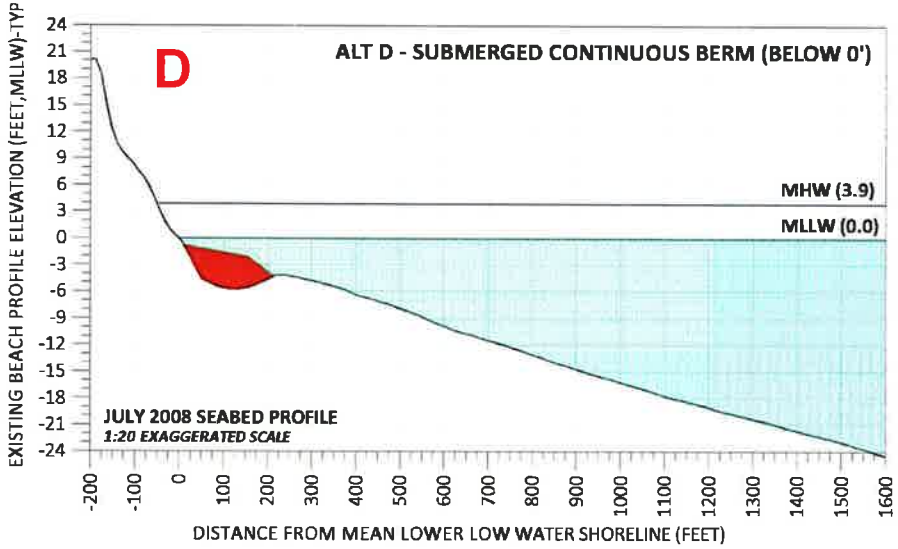


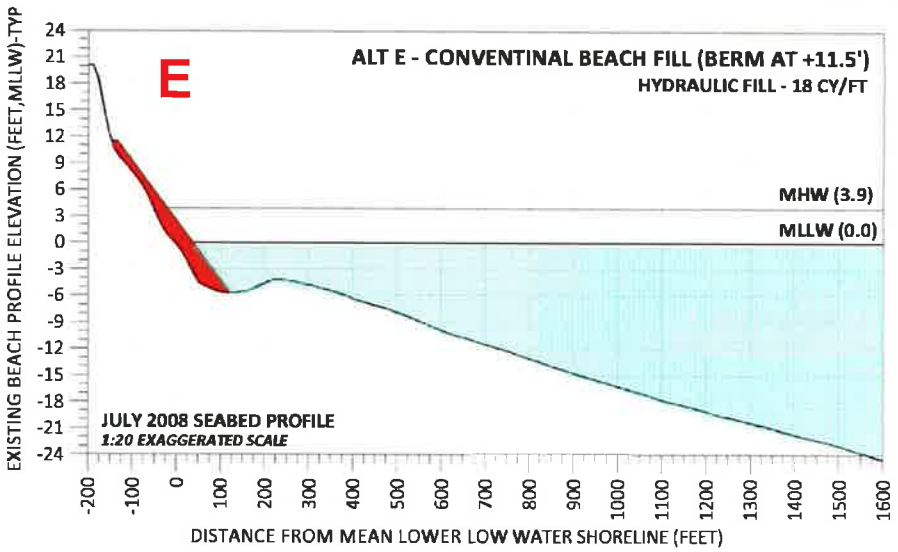
Beach Fill Placement Alternatives

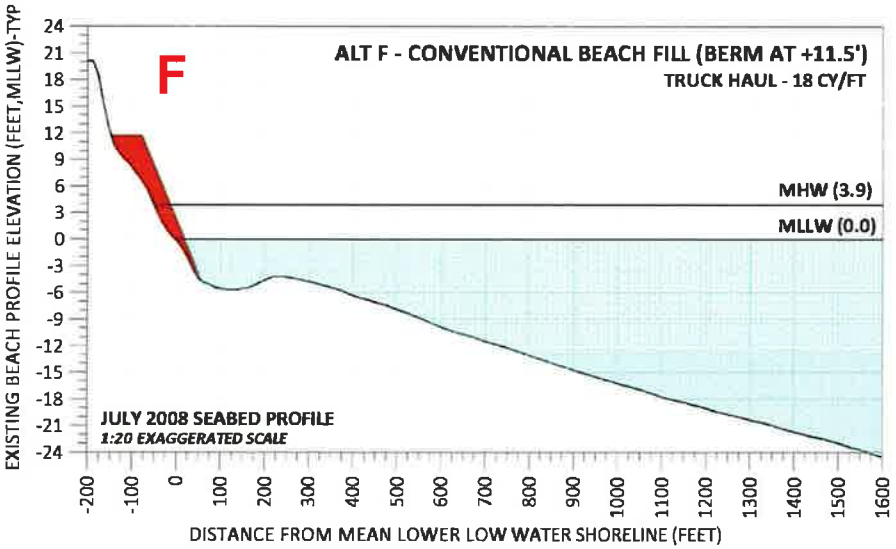


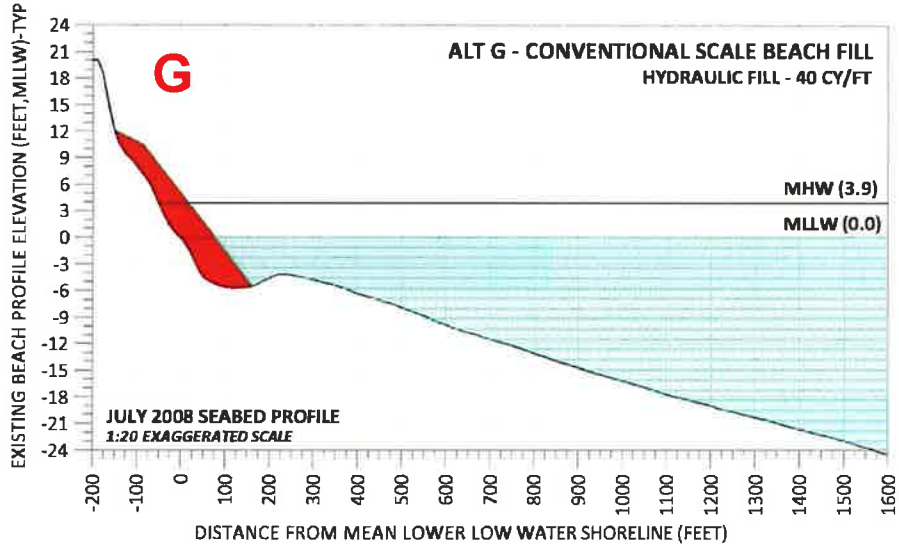


Beach Fill Placement Alternatives









Estimated Probable Costs of Construction

162,000 cubic yards along 1.7-miles shoreline (18 cy/ft)

Alternative		Construction Cost	Unit Sand Cost (per cubic yard)	Presumed Littoral / Shore Protection Benefit (est'd)
A1	Nearshore Disposal (Deeper: -22.5' to -12' MLLW)	$ 2,083,100	$ 12.86	55% to 70%
A2	Nearshore Disposal (Less Deep: -20' to -10' MLLW)	$ 2,771,600	$ 17.11	70% to 80%
F	Truck-Haul Beach Fill Upland Source - 18 cy/ft ϕ	$ 4,236,750	$ 26.15	100%
C	Beach Face Nourishment (Below +7' MLLW)	$ 4,241,300	$ 26.18	100%
D	Submerged Continuous Berm (Below 0' MLLW)	$ 4,472,900	$ 27.61	95%
E	Conventional Beach Fill - 18 cy/ft (Berm at/below +11.5' MLLW)	$ 4,698,125	$ 29.00	100%
B**	Nearshore Disposal ** (Shallow: -14' to -6' MLLW)**	$ 5,656,400	$ 34.92	90%
G	Conventional Beach Fill *40 cubic yards per ft alongshore*	$ 7,488,880	$ 20.80	100%

ϕ Includes 15% bulking allowance (20.7 cy/ft truck-haul measure = 18 cy/ft hydraulic-dredge bin measure).

** This alternative is not considered feasible for November-April construction window.

Estimated Probable Costs of Construction

162,000 cubic yards along 1.7-miles shoreline (18 cy/ft)

Alternative		Construction Cost	Unit Sand Cost (per cubic yard)	Presumed Littoral / Shore Protection Benefit (est'd)	Effective Total Unit Cost for Sand ($ per cu.yd)	Nominal Storm Event Protection*
A1	Nearshore Disposal (Deeper: -22.5' to -12' MLLW)	$ 2,083,100	$ 12.86	55% to 70%	$18.37 to $23.38	3 yr
A2	Nearshore Disposal (Less Deep: -20' to -10' MLLW)	$ 2,771,600	$ 17.11	70% to 80%	$21.39 to $24.44	4 yr
F	Truck-Haul Beach Fill Upland Source - 18 cy/ft ϕ	$ 4,236,750	$ 26.15	100%	$ 26.15	7 yr
C	Beach Face Nourishment (Below +7' MLLW)	$ 4,241,300	$ 26.18	100%	$ 26.18	6 yr
D	Submerged Continuous Berm (Below 0' MLLW)	$ 4,472,900	$ 27.61	95%	$ 29.06	5 yr
E	Conventional Beach Fill - 18 cy/ft (Berm at/below +11.5' MLLW)	$ 4,698,125	$ 29.00	100%	$ 29.00	7 yr
~~D**~~	~~Nearshore Disposal ** (Shallow: -14' to -6' MLLW)**~~	~~$ 5,656,408~~	~~$ 34.92~~	~~90%~~	~~$ 38.80~~	~~5 yr~~
G	Conventional Beach Fill *40 cubic yards per ft alongshore*	$ 7,488,880	$ 20.80	100%	$ 20.80	20 yr

* Approx. level of storm return period for which alternative may provide protection from bluff-erosion. Relative values only.

ϕ Includes 15% bulking allowance (20.7 cy/ft truck-haul measure = 18 cy/ft hydraulic-dredge bin measure).

** This alternative is not considered feasible for November-April construction window.

Summary Cost Conclusion

162,000 cubic yards along 1.7-miles shoreline (18 cy/ft)

Nearshore Disposal ~ $2.0 to $2.8 M

~ $13 to $17 / cy (construction cost)

~ $18 to $24 / cy (net effective cost)

Truck Haul or Dredge Nourishment along Beachface

~ $4.2 to $4.5 M

~ $26 / cy (construction & net eff. cost)

Beach Fill along berm ~ $4.7 M

~ $29 / cy (construction & net eff. cost)

Conventional Beach Fill (40 cy/ft): ~ $7.5 M

~ $21 / cy

Very Shallow Nearshore Disposal: ~ 5.6 M

~ $35 / cy

Practical Contract Considerations

- November – April construction window.
- Any construction method is allowable (don't limit contractor).
- Payment:
  - Measurement by in-hopper volume (not by survey).
  - Payment by Cubic Yard.
  - Subject to conformance with placement requirements.

Practical Contract Considerations

- November – April construction window.
- Any construction method is allowable (don't limit contractor).
- Payment:
  - Measurement by in-hopper volume (not by survey).
  - Payment by Cubic Yard.
  - Subject to conformance with placement requirements.

- Specified Placement Requirements:
  - Cross-shore:
    > 100% shallower than 20' MLLW
    > 80% shallower than 18' MLLW
    Example
    > 50% shallower than 14' MLLW
    > 25% shallower than 12' MLLW

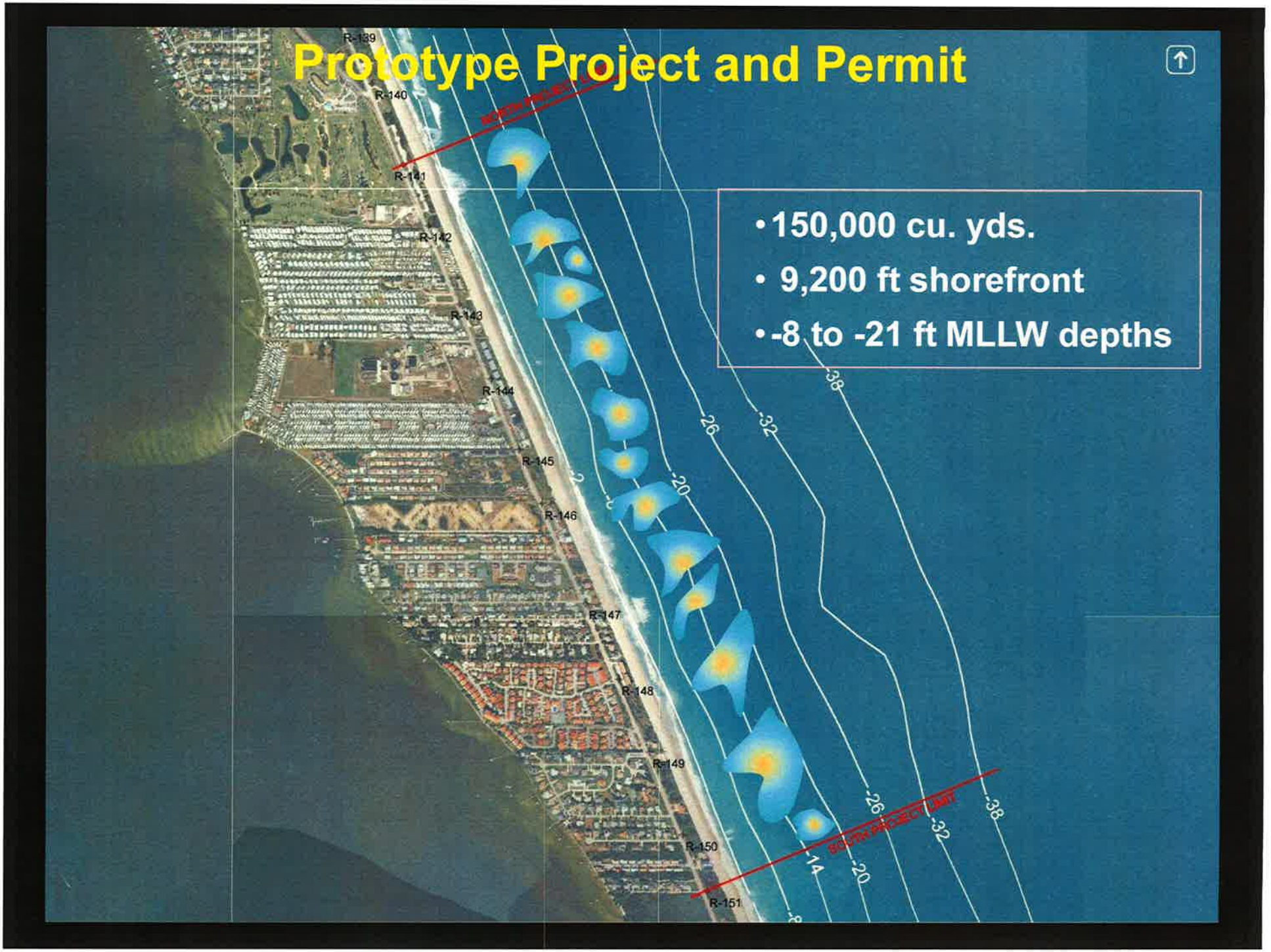
  - Along-shore:
    ~1000-ft acceptance sections
    Distribute total fill among each acceptance section uniformly ±15%
    Cross-shore depth requirement must be satisfied across total job, with tolerance within each accept. section.

Practical Contract Considerations

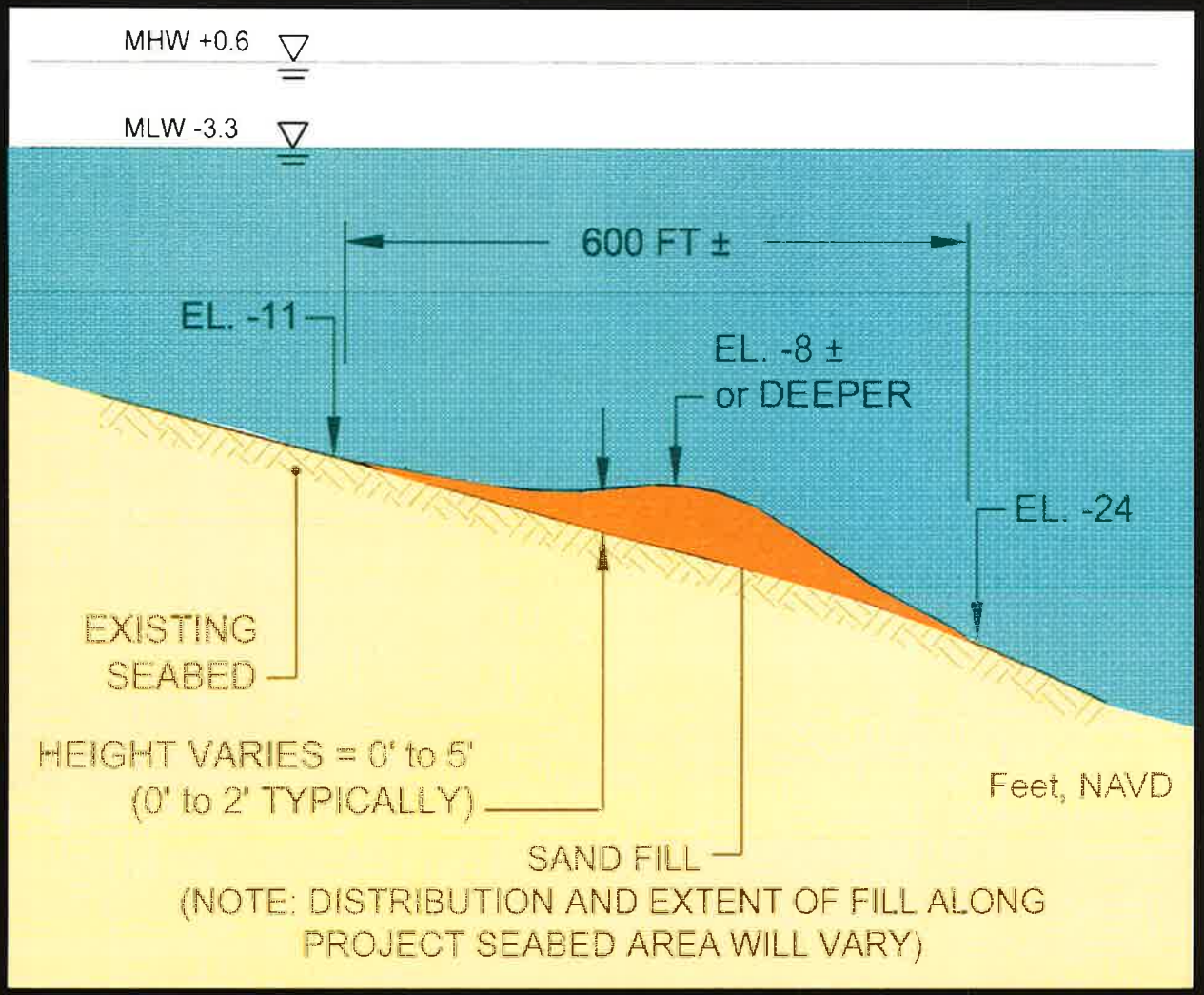
- Assessing conformance with Placement Requirements
  - Disposal requirements are by pre-project seabed elevation.
  - Method 1: Report times & locations of discharge
  - Method 2: Seabed surveys (Assess relative, not absolute, volume placement)
  - Employ both methods; agree upon approach prior to construction.

Monitoring

- Physical surveys to include project area and adjacent control area. 1000-ft spacing plus 250-ft spacing along tighter study area.
  - Pre-construction (<30 days pre)
  - Post-construction (<10 days post)
  - 1 month post
  - 3 months post
  - 12 months post


Prototype Project and Permit
•150,000 cu. yds.
• 9,200 ft shorefront
•-8 to -21 ft MLLW depths
R-139
R-140
R-141
R-142
R-143
R-144
R-145
R-146
R-147
R-148
R-149
R-150
R-151
SOUTH PROJECT LIMIT
SOUTH PROJECT LIMIT
-38
-26
-32
-20
-14

Typical Section



Project Status

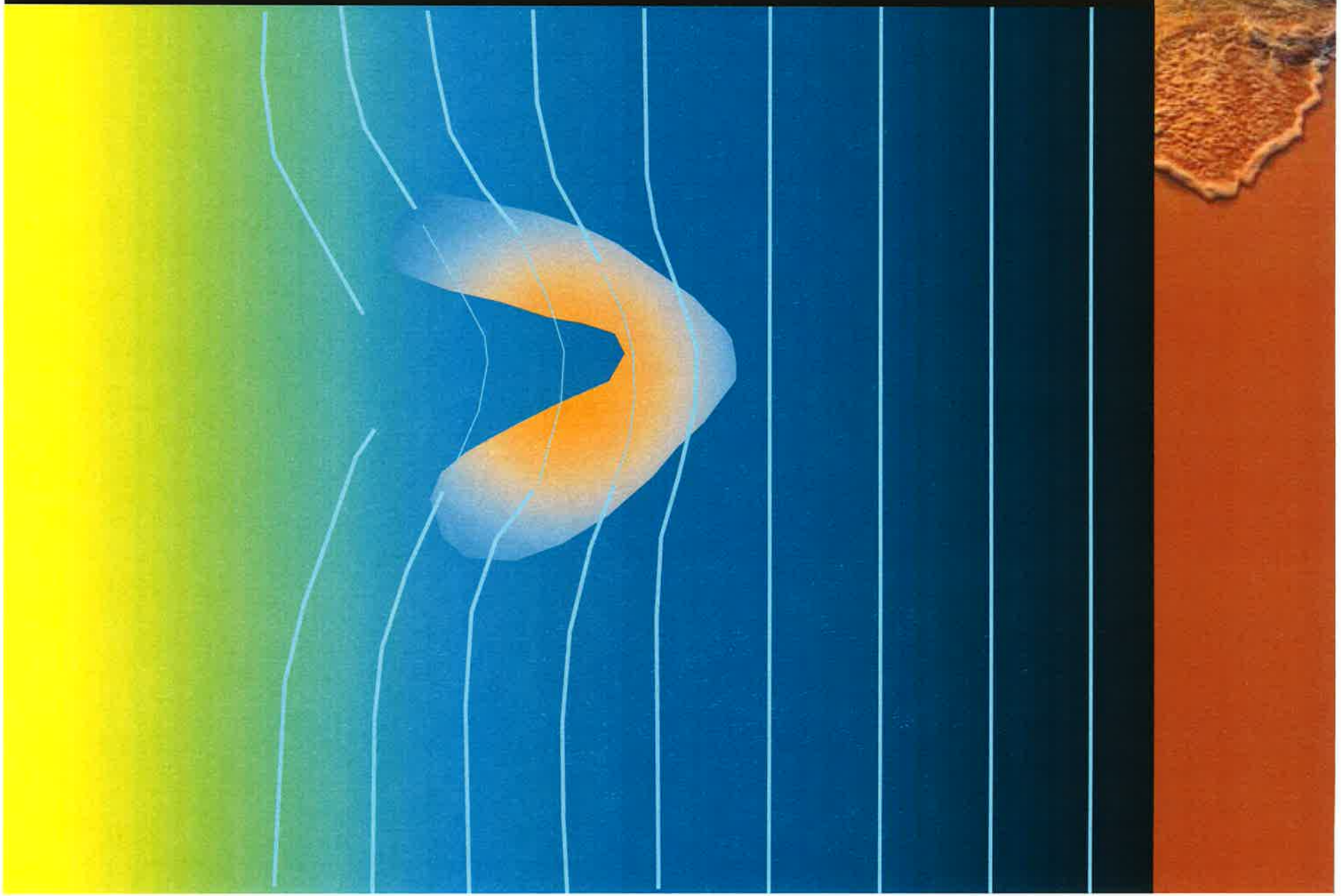
Permits mostly complete – pending resolution of cultural resource survey requirements

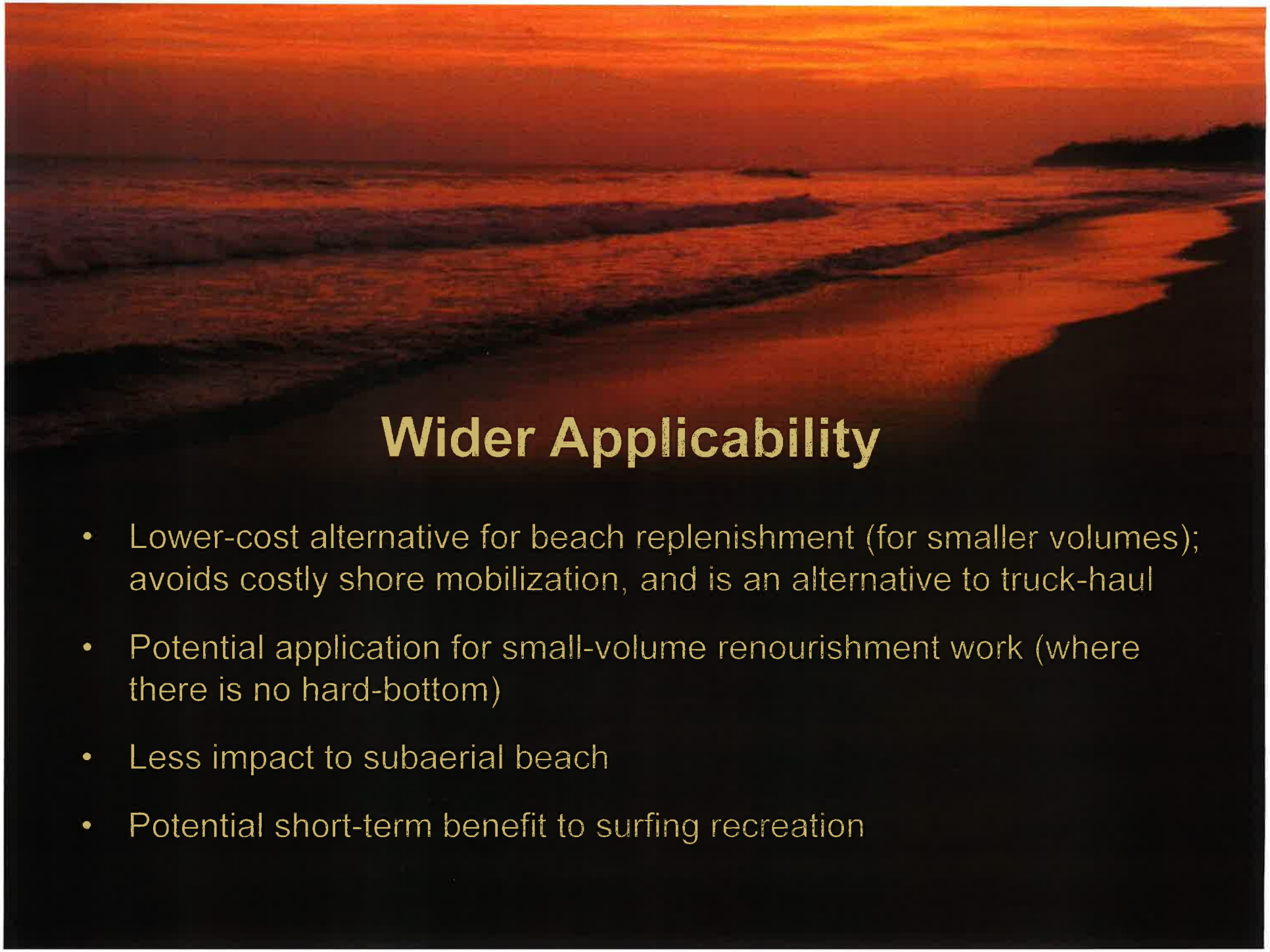
Funding not yet identified;
Construction schedule not established.

Alternative Nourishment Placement Concepts

Mayport Naval Station,
Jacksonville Beaches (1972)

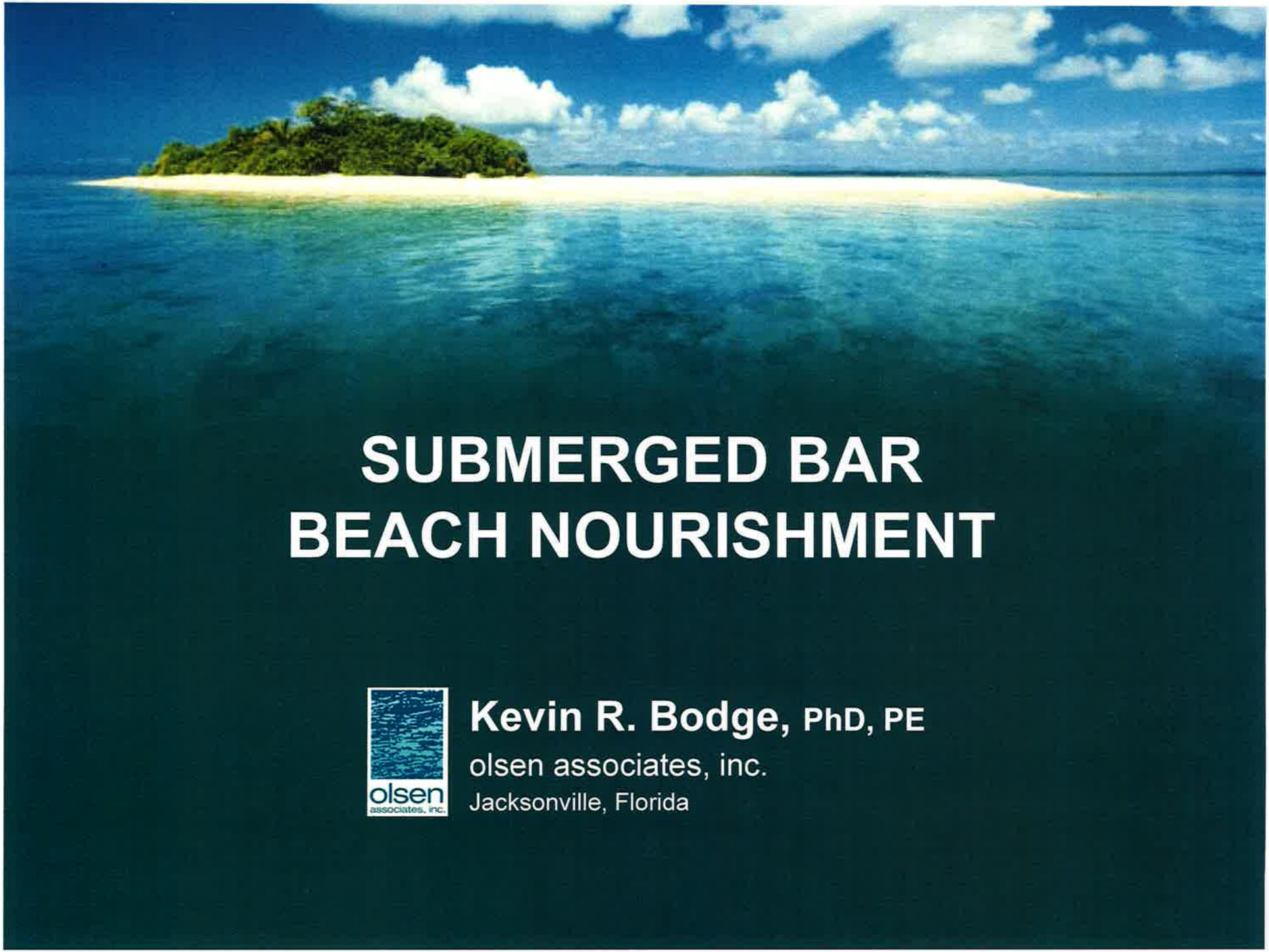
Alternative Nourishment Placement Concepts





Wider Applicability

- Lower-cost alternative for beach replenishment (for smaller volumes); avoids costly shore mobilization, and is an alternative to truck-haul
- Potential application for small-volume renourishment work (where there is no hard-bottom)
- Less impact to subaerial beach
- Potential short-term benefit to surfing recreation



SUBMERGED BAR BEACH NOURISHMENT

Kevin R. Bodge, PhD, PE
olsen associates, inc.
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