Long Key State Park Design and Evaluation of Bahamian Sand

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Sponsor:

Florida Park Service

APPLIED TECHNOLOGY & MANAGEMENT

Coastal, Environmental, Marine, and Water Resources Engineering

Overview

- Project Setting
- Site Characteristics
- Beach Template Design
- Sand Sources
- Summary

APPLIED TECHNOLOGY & MANAGEMENT


Florida
Long Key State Park

Long Key State Park

- 60 Campsites with Waiting List

Long Key State Park

Long Key State Park

Sediment Transport

- Low Energy, Wave Dampened Area
- Alongshore
  - Estimated Potential – 14,600 cy/year West
- Cross-Shore
  - Storm-Driven, Depth-Limited

	Cat. 1	Cat. 2	Cat. 3	Cat. 4	Cat. 5
Surge (SLOSH Model) ft. NAVD	2.0 to 2.5	3.5 to 4.5	5.0 to 6.0	6.5 to 7.5	8.5 to 10.0

Beach Template Design

- Beach Width vs. Resource Impacts

	Alt. 1	Alt. 2	Alt. 3	Pref. Alt.
Added Beach Width	20 ft.	40 ft.	20/40 ft.	20/40 ft.
Volume	13,600	27,900	21,100	20,000
Halodule wrightii	0.18	0.80	0.72	0.56
Thalassia testudinum		0.16		<0.001
Hardbottom	1.44	2.32	1.89	1.51

Beach Design Template

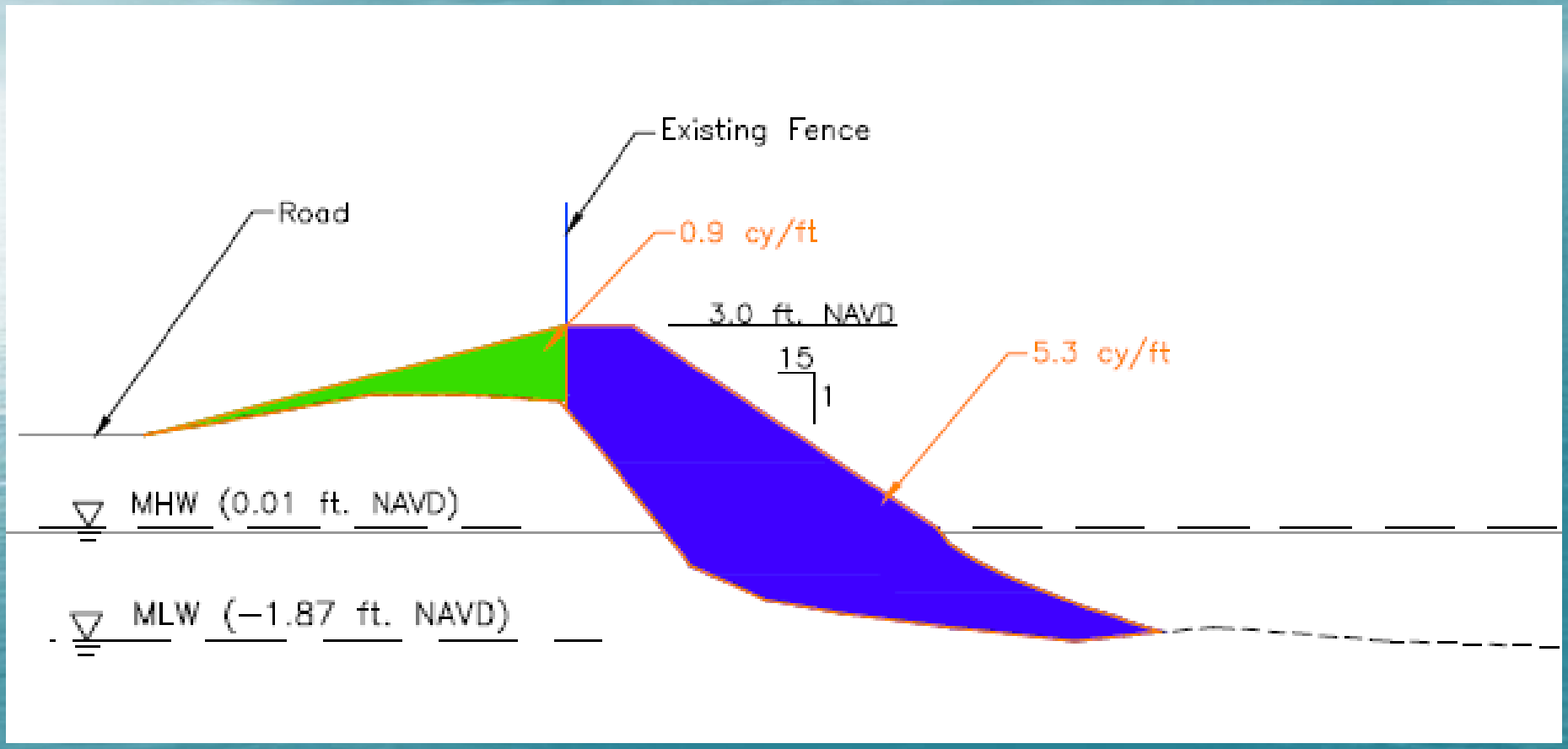
- Native D_{50} is 0.27mm
- Eq. Profile Curve Fit D_{50} is 0.28mm
- Equilibrium Profile (w/ Factor of Safety)

  $d_{50}+\sigma$

  - Sorting is Standard Deviation
- Equilibrium Profile: 0.2 mm

  $(0.27\ mm + 0.49\phi)$

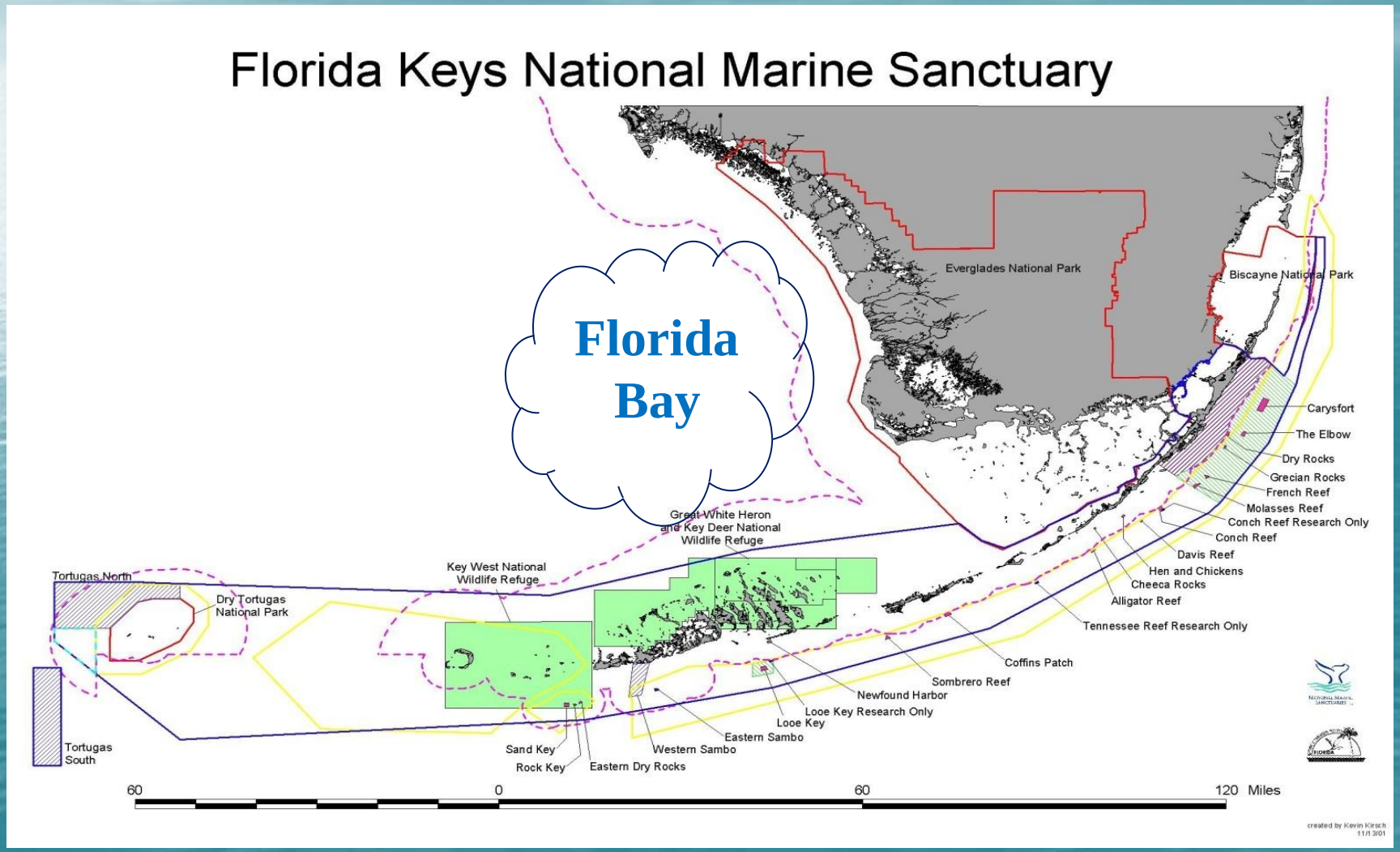
Beach Template Design



Sand Sources

- Native Sand – 100% Oolite Aragonite
- Domestic Sources
  - Offshore Borrow Areas
  - Upland Sand Mines
    - Not 100% Aragonite
  - Upland 'Manufactured Sand'
    - Costly screening and washing
    - Possibility of lithifying
- Non-Domestic Sources

Offshore Borrow Areas



Non-Domestic Sources

- Bahamas
- Turks and Caicos
- Mexico
- Barbuda/Guadeloupe
- Excluded Sources (Cuba, Haiti, Dominican Republic, South America)

Haul Routes


ATM
APPLIED TECHNOLOGY & MANAGEMENT
Shipping Routes and Mileage Throughout Bahamas and Eastern/Western Caribbean
Non-Carbonate Source
Route
Distances to Long Key S.P.
Nassau, Bahamas 230 miles
Grand Bahama 200 miles
Turks & Caicos 600 miles
Barbuda 1350 miles
Guadeloupe 1450 miles
Cozumel, Mexico 500 miles
Distances are approximate.
UNITED STATES
TEXAS
New Orleans
Galveston
Jacksonville
FLORIDA
Orlong
Fort Myers
Fort Lauderdale
Miami
LONG KEY
Key West
Nassau
THE BAHAMAS
Gulf of Mexico
Atlantic Ocean
MEXICO
Havana
Maria La Gorda
CUBA
Turks & Caicos
Progreso
Cancun
Cozumel
MEXICO
Cayman Is
Luperon
HAITI DOMINICAN REPUBLIC
Puerto Rico
St. Thomas
Virgin Is
Anguilla
St. Martin
Antigua & Barbuda
St. Kitts & Nevis
Montserrat
Guadeloupe
Dominica
Martinique
St. Lucia
St. Vincent & The Grenadines
Barbados
Grenada
Ixtapa
Acapulco
Huatulco
Gulf of Tehuantepec
Ameigris Cay
BELIZE
Roatan
JAMAICA
GUATEMALA
HONDURAS
EL SALVADOR
NICARAGUA
Caribbean Sea
Aruba
Netherlands Antilles
COSTA RICA
Isla Moin
Cartagena
Trinidad & Tobago
Puerto de La Cruz
VENEZUELA
PANAMA
COLOMBIA
Panama Canal
0 500 Miles
0 500 km
Parallel scale at 20°N 0°E
GUYANA

Sand Source Screening

- Grain Size
- Composition (Aragonite)
- % Silt
- Aesthetics (Color, Grain Shape)


Native
Mexico (Cancun)
Ortona (US Upland)
Barbuda
Bahamas
Bahamas (Manufactured)

Sand Source - Aragonite

Source	Grain Size	Fines/Silts
Bahamas	0.34 to 0.40 mm	0.1 to 2.4%
Barbuda	0.27mm	~1%
Mexico	??	??
Turks and Caicos	??	??

Estimated Costs (2010)

Source	Distance (mi)	Delivered Cost ($/ton)	Sand Cost
Ortona, FL	200	$50.00	$1.4 M
Barbuda	1,350	$62.50	$1.7 M
Guadaloupe	1,450	$65.50	$1.8 M
Bahamas	200	$33.00	$0.9 M
Central Bahamas	230	$39.20	$1.1 M
Turks and Caicos	600	$54.00	$1.5 M
Mexico (Yucatan)	500	$45.00	$1.3 M

Issues with Non-Domestic Sources

- Government Approvals
- QA/QC – Physical and Biological
- Availability
- Market Forces

Ocean Cay Source for Long Key

- FDEP – Permit Pending, and has substantially approved source
  - Fines/Silts remain a concern
- USACE Commenting Agencies
  - Non-native organisms
  - Completed Infauna Testing

Summary

- Long Key project area shoreline losses are storm driven
- Native sand is 100% Oolite Aragonite
- No domestic aragonite sand sources viable for beach nourishment
- Non-domestic cost-effective sources exist, but have ongoing issues and concerns