Changes in Beach Profile and Grain Size after Beach Renourishment

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How does beach profile shape change after a beach renourishment event?

How does sand grain size change across the profile after a beach renourishment event?

We’ll contrast Pre- and Post-Project Conditions……and first 2 years after a renourishment.
Sand Grain Size varies across the Natural Beach
Sand Grain Size varies across the Natural Beach

Offshore Beach Nourishment Sand

Brevard Native Beach*

Beach Profile

*Cape Canaveral Air Station
Sand Grain Size Distribution

Native Berm

Fine Sand

Grain Size (millimeters)

Coarse Sand

d50
Canaveral Shoals II offshore sand
The existing post-project sand matches the pre-project sand by depth zone

2013 Samples
(3-8 yrs post renour)

Native Berm (pre-project)

Canaveral Shoals II
defense sand

BERM

Fine Sand

Grain Size (millimeters)

Coarse Sand
The existing post-project sand matches the pre-project sand by depth zone.
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EXPECTED CHANGE IN SAND SIZE?

OFFSHORE MIGRATION
FINER SAND

COARSE R
BERM AFTER
EQUILIBRATION?

Percent Finer by Weight

Percent Coarser by Weight

Grain Size (mm)

Fine Sand

Coarse Sand
Beach Profiles

Pre-Nourishment (1972-2000)

Post-Nourishment (2001-2012)

Cocoa Beach
R-36
Beach Profiles

Composite Profiles
N 3rd St to S 11th St
R-33 to R43

Pre-Nourishment (2000/01)

Post-2005 Nourishment (May 2005)

May 2012 (7-Yrs Post Nour.)
We examined:

• Beach profiles: 6 nourished and 3 non-nourished ….
• Sand grain size at 6 depths along each profile…
  …at…
• pre-construction and
• 0-, 3-, 6- 12-, and 24-months post-construction.
  o 54 beach profile surveys, and
  o 324 sand samples
Beach Fill Areas
Nourished (2014)
Control (No Fill)
Renourishment (Brevard County)
Nourished Profiles (2013-14)
Control Profiles (No Fill)
Sand Samples

North Reach
South Reach

Graphic Scale (Miles)
COMPOSITE PROFILES

Beach profiles shifted to Mean High Water alignment

0 MONTHS

3 MONTHS

Elevation (ft, MSL)

Offshore Distance (ft)
COMPOSITE PROFILES
COMPOSITE PROFILES
BEACH SLOPE ANALYSIS ZONES
SLOPE ANALYSIS: BERM

NR

Profile Slope (1:x)

Pre-con 0 6 12 18 24

Time Elapsed Since Nourishment (months)

SR

Profile Slope (1:x)

Pre-con 0 6 12 18 24

Time Elapsed Since Nourishment (months)
SLOPE ANALYSIS: INTERTIDAL
SLOPE ANALYSIS: SUBTIDAL
SLOPE ANALYSIS: BERM

Elevation (ft, MSL)

Offshore Distance (ft)

Nourished

Control

Average Profile Slope (1:x)

Pre-Con  12 months Post-Con  24 months Post-Con
SLOPE ANALYSIS: INTERTIDAL

Elevation (ft, MSL)

Offshore Distance (ft)

Average Profile Slope (1:x)

Pre-Con  12 months Post-Con  24 months Post-Con

Nourished

Control
SLOPE ANALYSIS: SUBTIDAL

Elevation (ft, MSL)

Offshore Distance (ft)

Average Profile Slope (1:x)

Control

Nourished

Pre-Con

12 months Post-Con

24 months Post-Con
SURF ZONE WIDTH

-9' MSL

+7.5' MSL

surf zone width

upper beach

bar feature

Elevation (ft, NAVD88)

Elevation (ft, MSL)
SURF ZONE WIDTH
GRAIN SIZE DISTRIBUTION

R-36 Beach Fill Profile

US STANDARD SIEVE NUMBERS:

Percent Finer by Weight

Percent Coarser by Weight

Grain Size (millimeters)

24 mos.

0 months

d50

Native 1989

Native 1995 (MHW)

Pre-con (Apr 2013)

0 months post-con

3 months post-con

6 months post-con

12 months post-con

24 months post-con
GRAIN SIZE VS. ELEVATION

Beach Fill Profile

- Pre-con (Apr '13)
- 0 months
- 3 months
- 6 months
- 12 months
- 24 months

Mean Grain Size (mm)

Elevation (ft, MSL)

R-20
GRAIN SIZE VS. ELEVATION

Beach Fill Profile

Mean Grain Size (mm)

Elevation (ft, MSL)

R-125
GRAIN SIZE VS. ELEVATION

Control Profile

- Pre-con (Apr '13)
- 0 months
- 3 months
- 6 months
- 12 months
- 24 months
MEAN GRAIN SIZE

**BERM**

- **Nourished**
- **Control**

**+3’ MSL**

- **Nourished**
- **Control**

- **Native (pre-2001)**
- **Pre-con**

**Time Elapsed Since Nourishment (months)**

- 0
- 3
- 6
- 9
- 12
- 15
- 18
- 21
- 24

**Mean Grain Size (mm)**

- 0.1
- 0.2
- 0.3
- 0.4
- 0.5
MEAN GRAIN SIZE

-3’ MSL

-6’ MSL

Nourished

Control

Time Elapsed Since Nourishment (months)

Native (pre-2001) Pre-con

Mean Grain Size (mm)

Mean Grain Size (mm)

Native (pre-2001) Pre-con
MEAN GRAIN SIZE

-9’ MSL

Nourished
Control

-12’ MSL

Nourished
Control
Summary – Profiles

- Post-project beach profile conforms to native pre-project profile, except for steeper beachface slope (as expected from restoration of eroded beach).
- Negligible difference in average beach profile shape between nourished and non-nourished, at 0- to 24- months.
- Change in nourished beach slopes similar to or lesser than non-nourished profiles from pre- to 12- to 24-months.
- Temporal changes in profile slope and surf zone width similar between nourished and non-nourished profiles.
- Surf zone widths increasingly converged at 12- to 24-months.
Summary - Sand

- Existing post-project sand matches native sand, by depth.
- Grain size at nourished berm slightly increased at 0-6 months, returned to pre-renourishment within 12-24 months.
- Little net change in grain size at/below MHW.....changes were less than non-nourished profiles.
- Negligible changes below -9 ft MSL anywhere.
- Temporal variations in grain size are significant -- mostly greater at non-nourished profiles, and obscure trends..... though there is limited indication of increasing coherence at 12- and 24-months post-construction.
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