THE CANAVERAL SHOALS BLUES:

How beach nourishment using the Canaveral Shoals offshore borrow site has impacted the surf breaks of Cape Canaveral and Cocoa Beach, Florida

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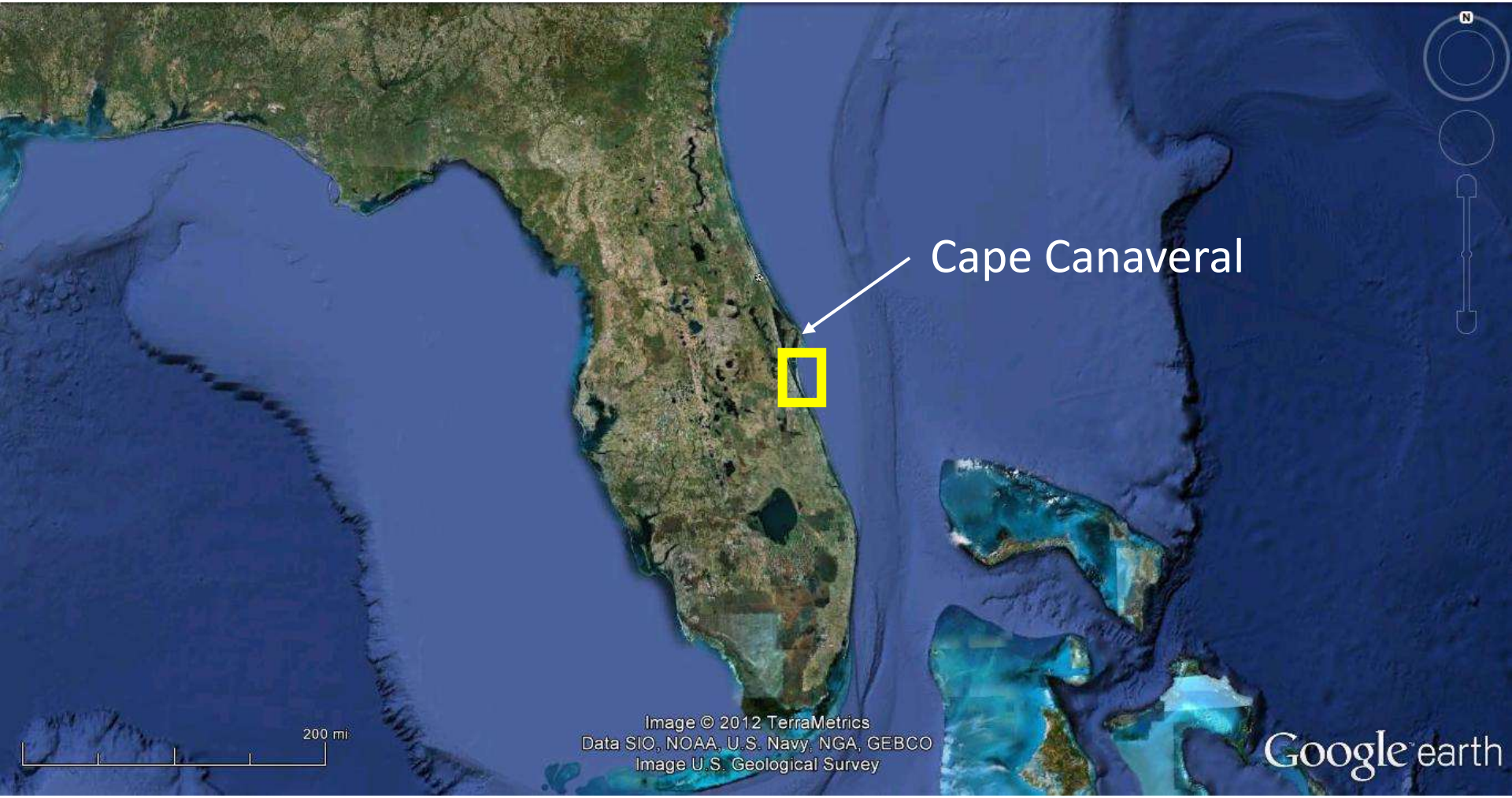
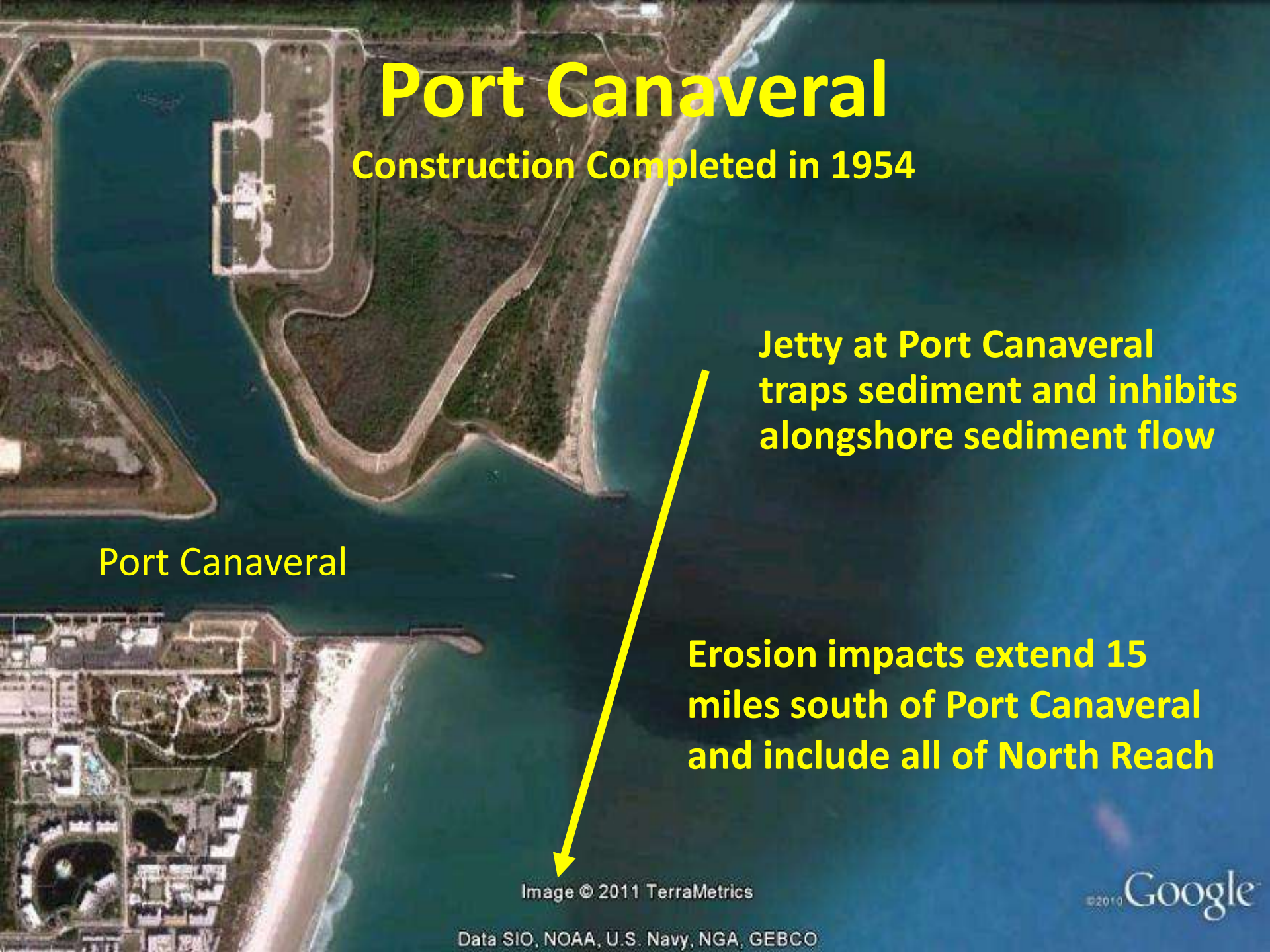
Cities of Cape Canaveral and Cocoa Beach Brevard County, Florida

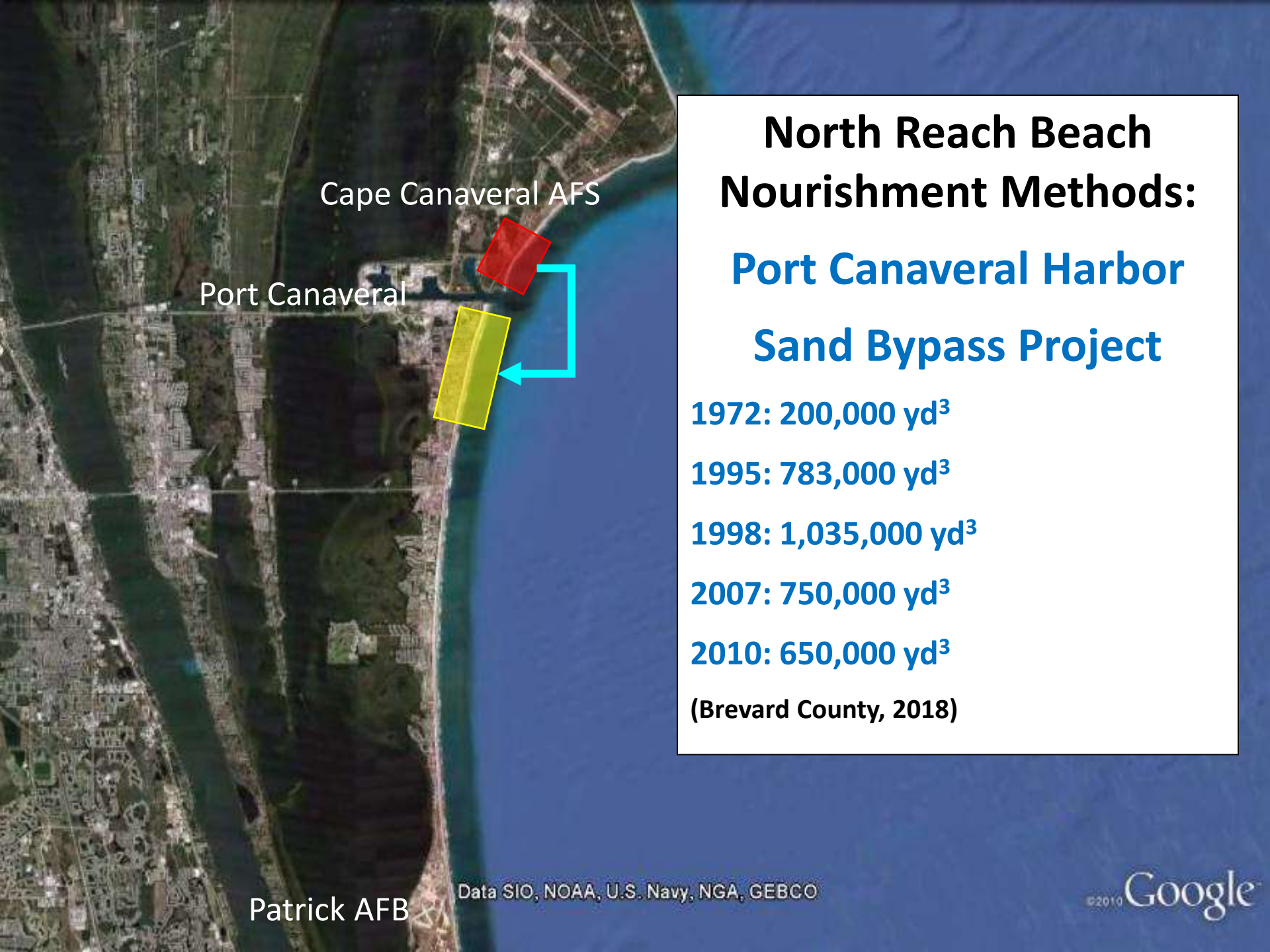


Brevard County, FL

Port Canaveral

Construction Completed in 1954





North Reach Beach Nourishment Methods:

Port Canaveral Harbor Sand Bypass Project

1972: 200,000 yd^3

1995: 783,000 yd^3

1998: 1,035,000 yd^3

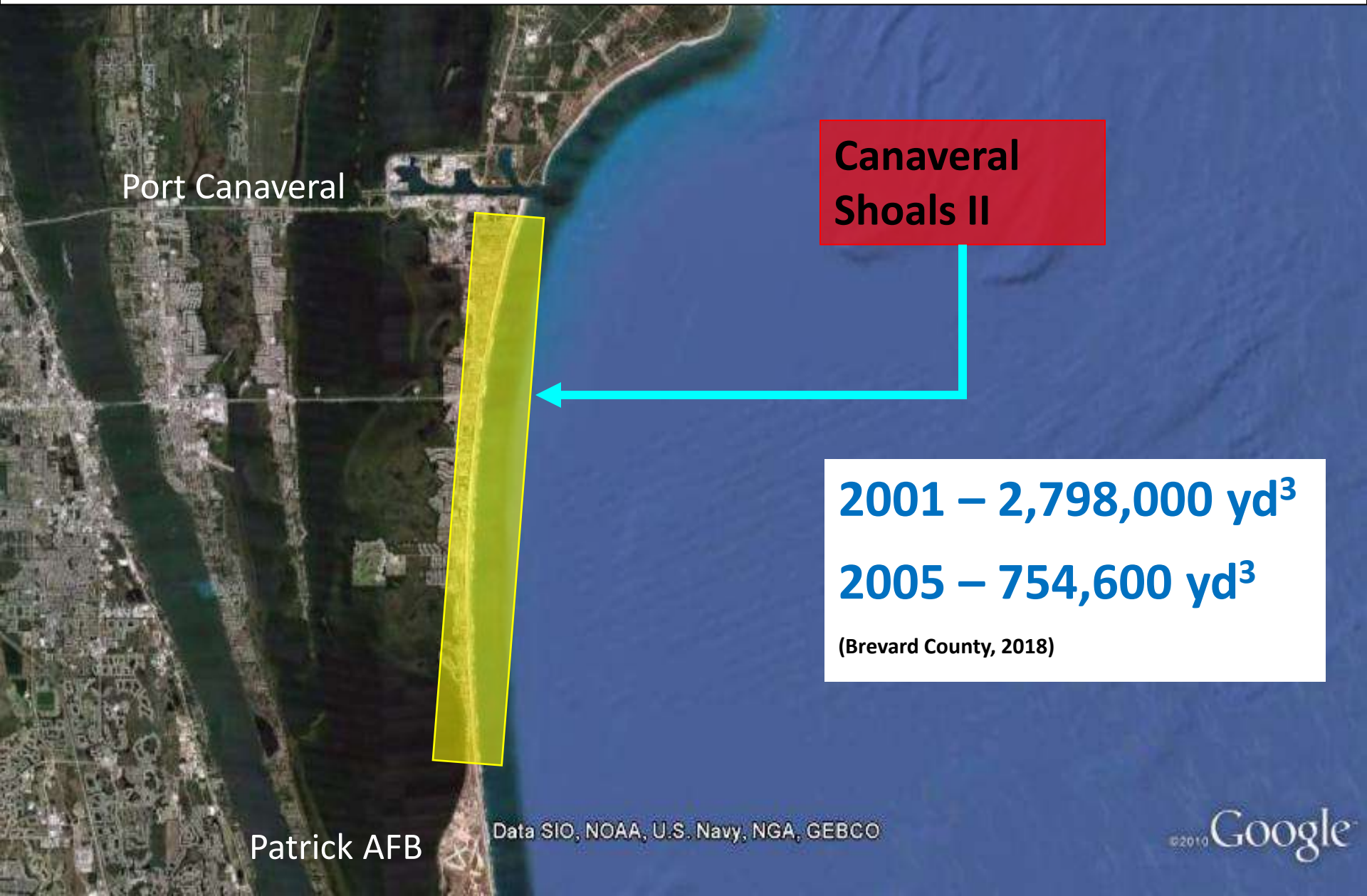
2007: 750,000 yd^3

2010: 650,000 yd^3

(Brevard County, 2018)

North Reach Beach Nourishment Methods:

Brevard County Shore Protection Project



North Reach Beach Nourishment Methods:

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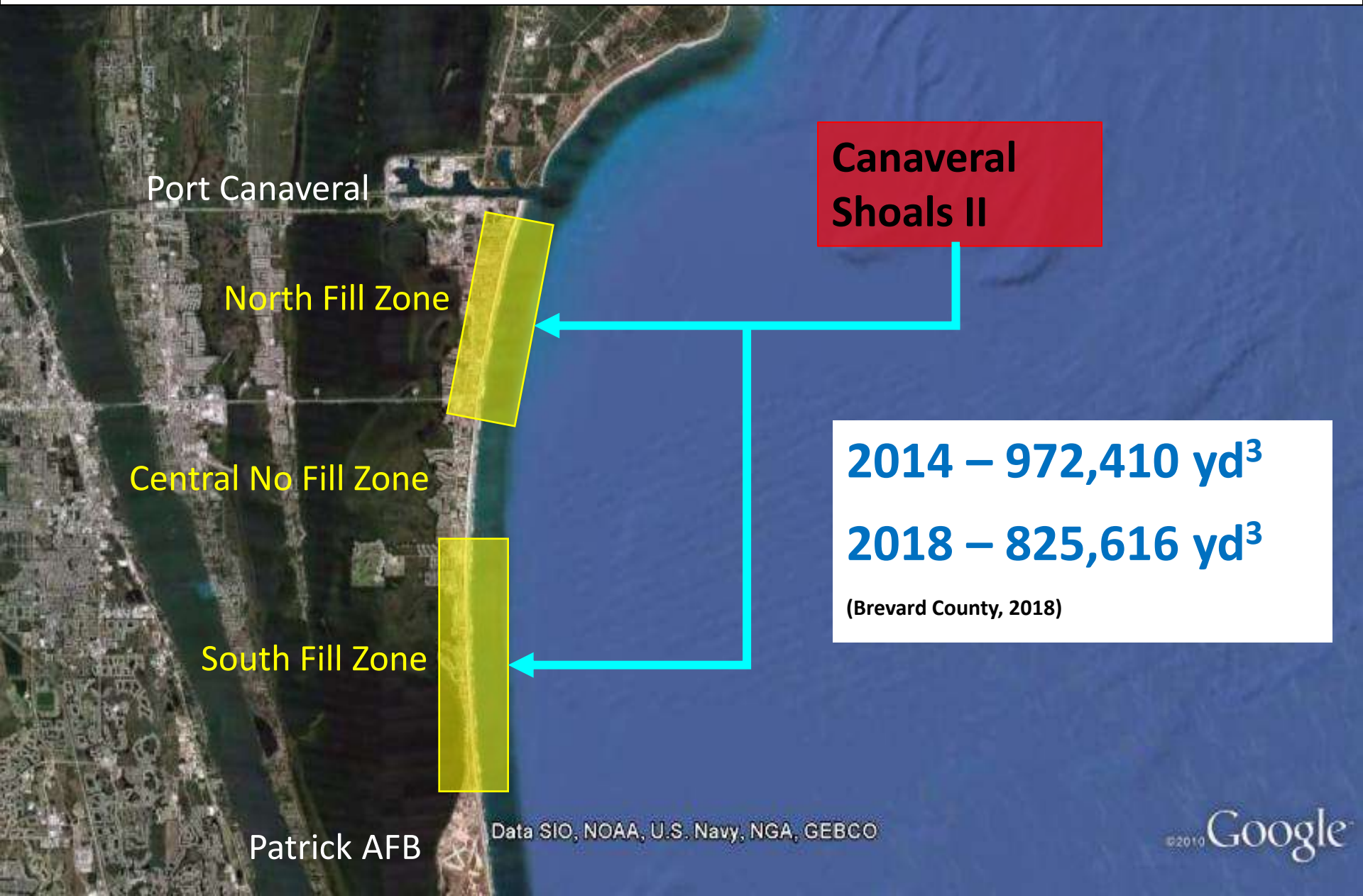
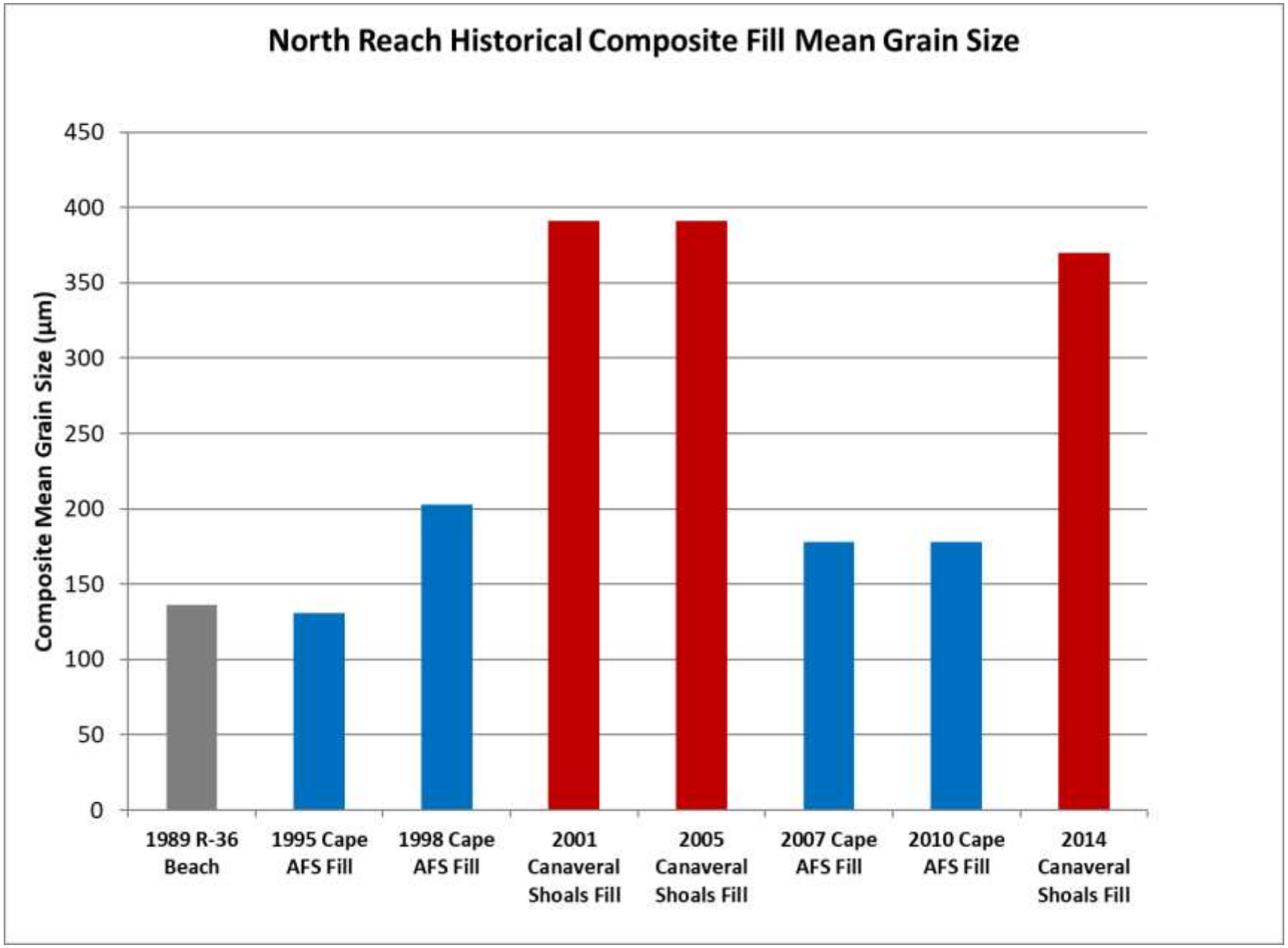


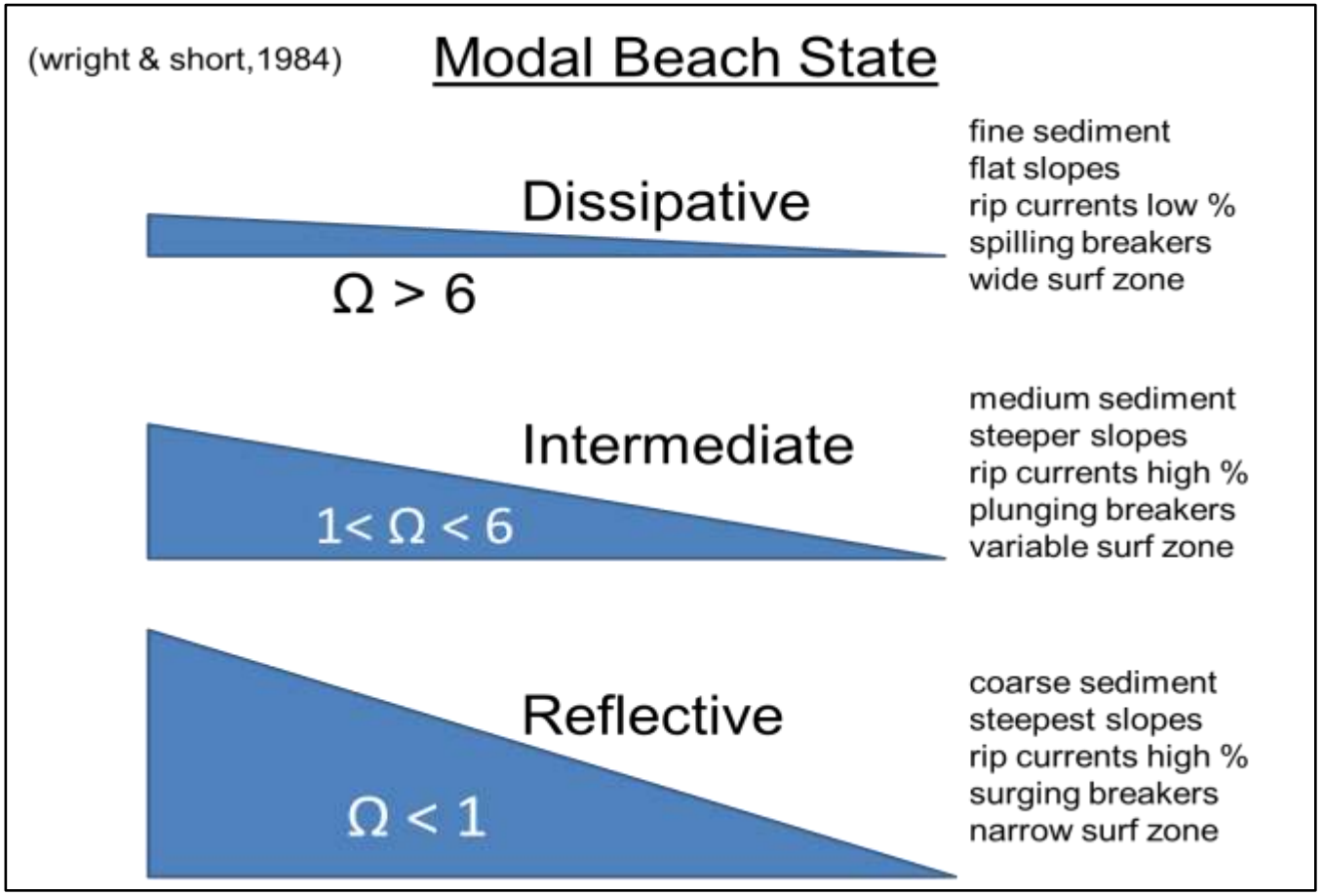


(Olsen, 1989) (FDEP, 1995) (Hearin, 2005) (USACE, 2006) (USACE, 2003) (Olsen, 2008) (SEA Inc., 2013) (SEA Inc., 2014) (Olsen, 2014)

Brevard County Shore Protection Project Post Fill Analysis Report:

"The in-place beach fill material along the North Reach and Patrick AFB is slightly coarser than the native berm and significantly coarser than the native (beach) profile"

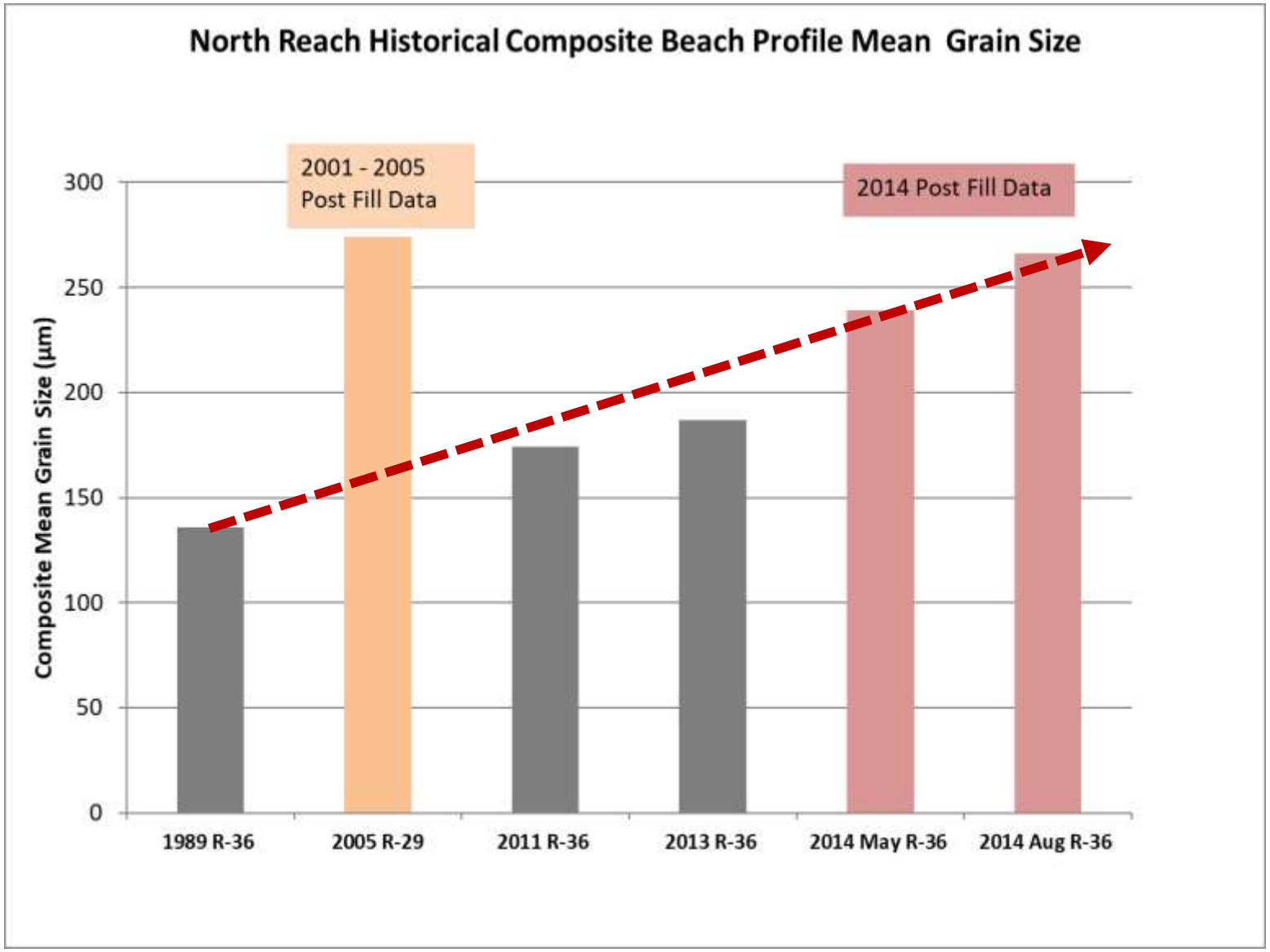
(Olsen, 2002)



Finer sediment = flatter beach slope

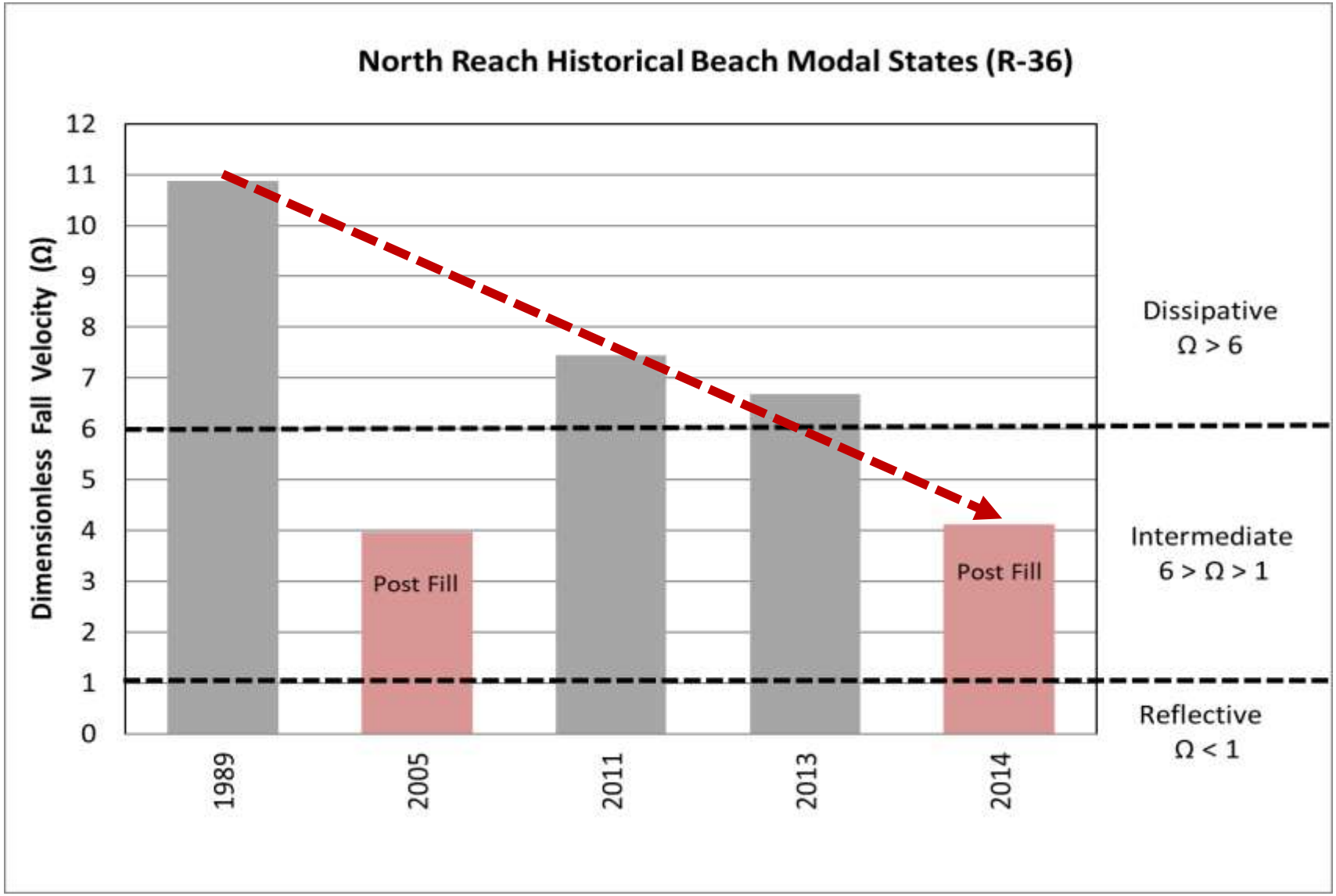
Coarser sediment = steeper beach slope

2014 Beach Sediment Data Analysis



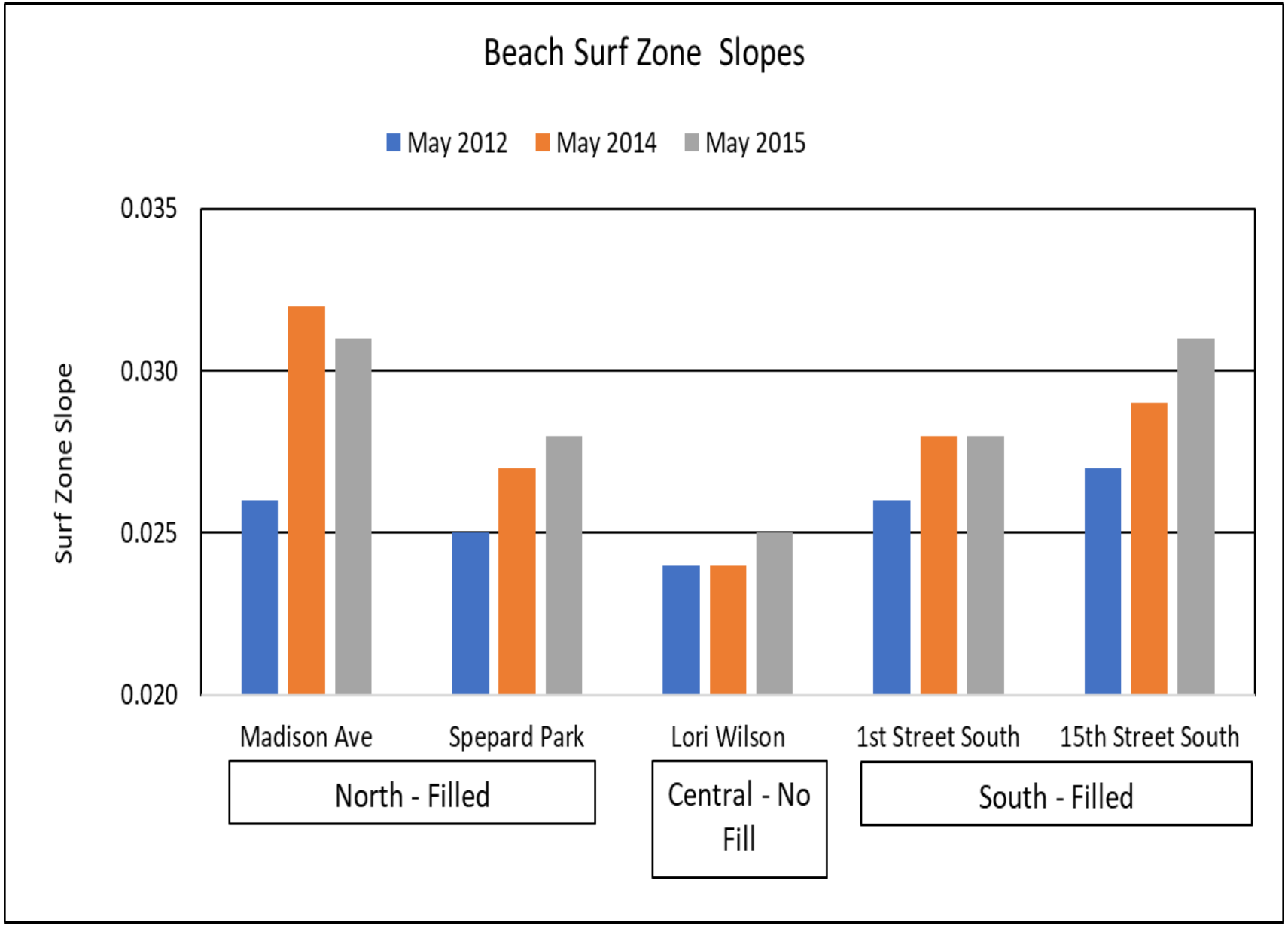
(Hearin, 2012) (SEA Inc., 2013) (SEA Inc., 2014)

Morphological Modal Beach State Calculations



(Olsen, 1989) (Hearin, 2005) (Hearin, 2012) (SEA Inc., 2013) (SEA Inc., 2014)

Analysis of Bathymetric Profiles



(FDEP, 2017)

Littoral Environment Observations (Surfing Wave Observations)

- The Littoral Environment Observation Program (LEO) was instituted by the Coastal Engineering Research Center of the USACE in 1968 (Smith & Wagner, 1991)

- Mesa (2006) also confirmed that visual observations were a valid method for obtaining wave data in the surf zone

- Presently no instrumentation exists to accurately measure surfing wave quality

- Daily observations of the waves were conducted in all three zones (north fill, central no fill, south fill) by volunteers with significant experience in analyzing surfing wave parameters

Littoral Environment Observations (Surfing Wave Observations)

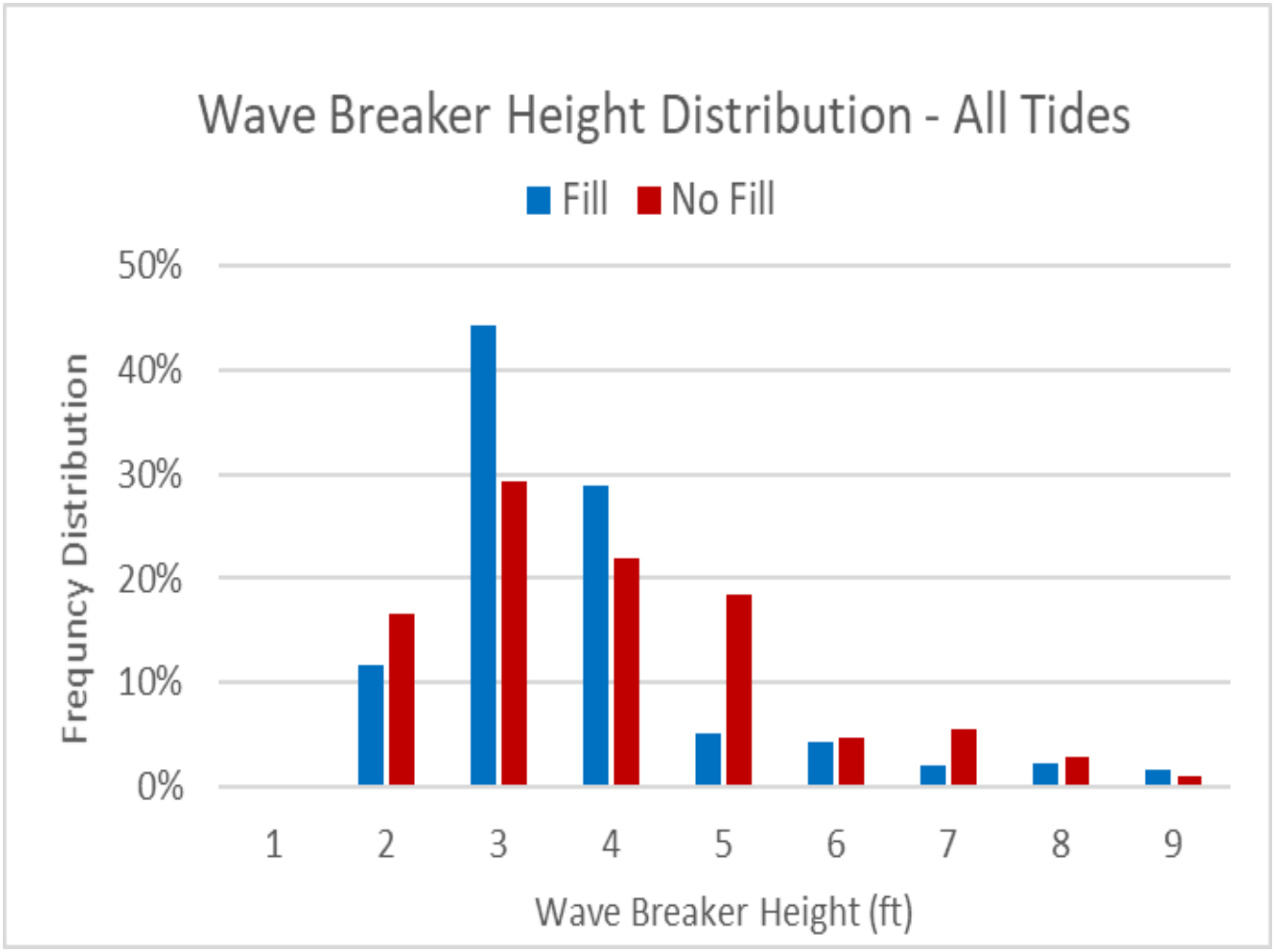
Volunteers utilized a modified version of the USACE LEO data sheet to record:

- Tide
- Wind direction / speed
- Wave surface condition
- Wave direction
- Wave breaker height
- Wave breaker type / wave peel angle
- Surf zone width
- Average surfing ride duration
- Overall surfing wave quality

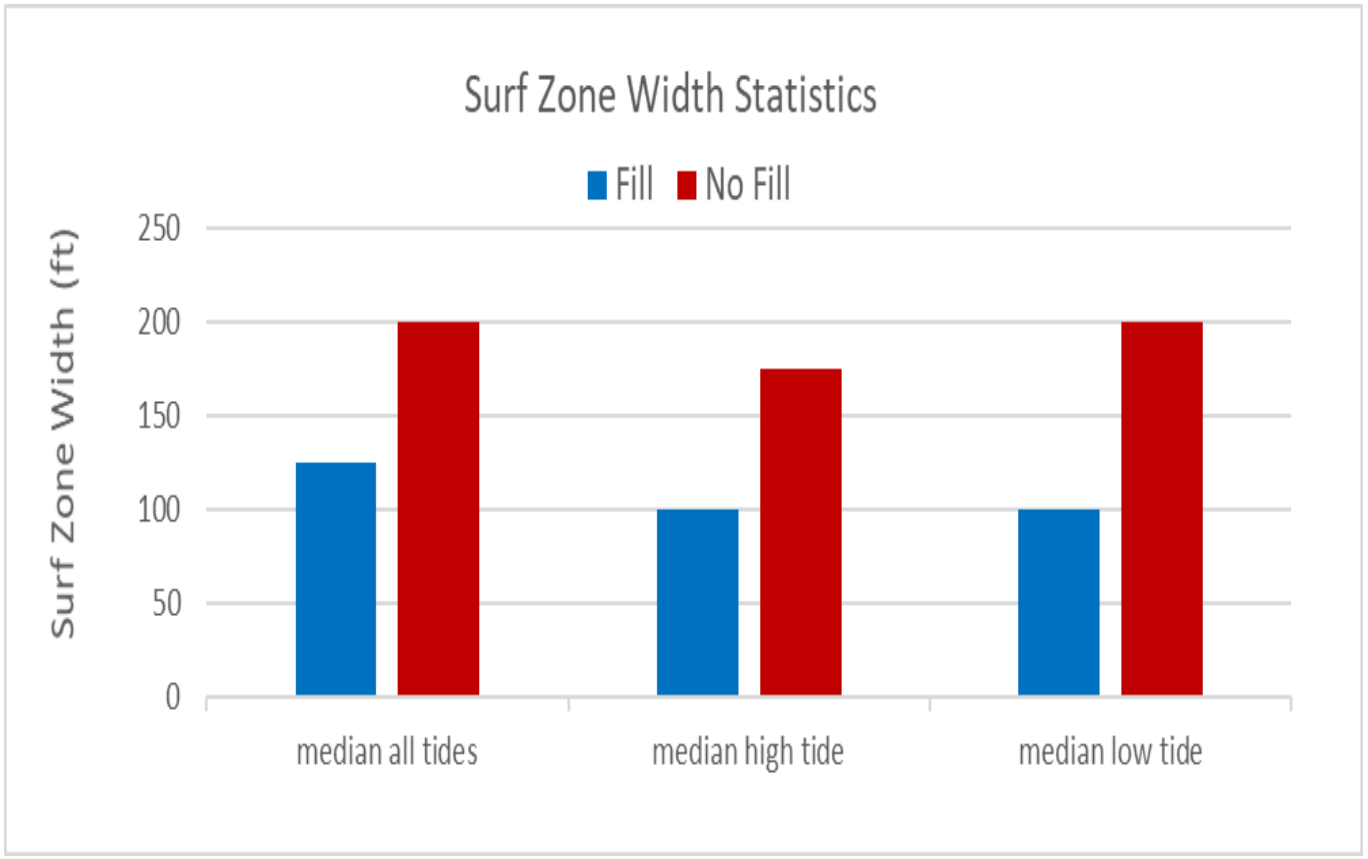
Littoral Environment Observations (Surfing Wave Observations)

- 372 independent observations - post fill
- May to December 2014
- Observations entered into an online database
- Used to draw qualitative comparisons between the filled and non-filled sections of the beach

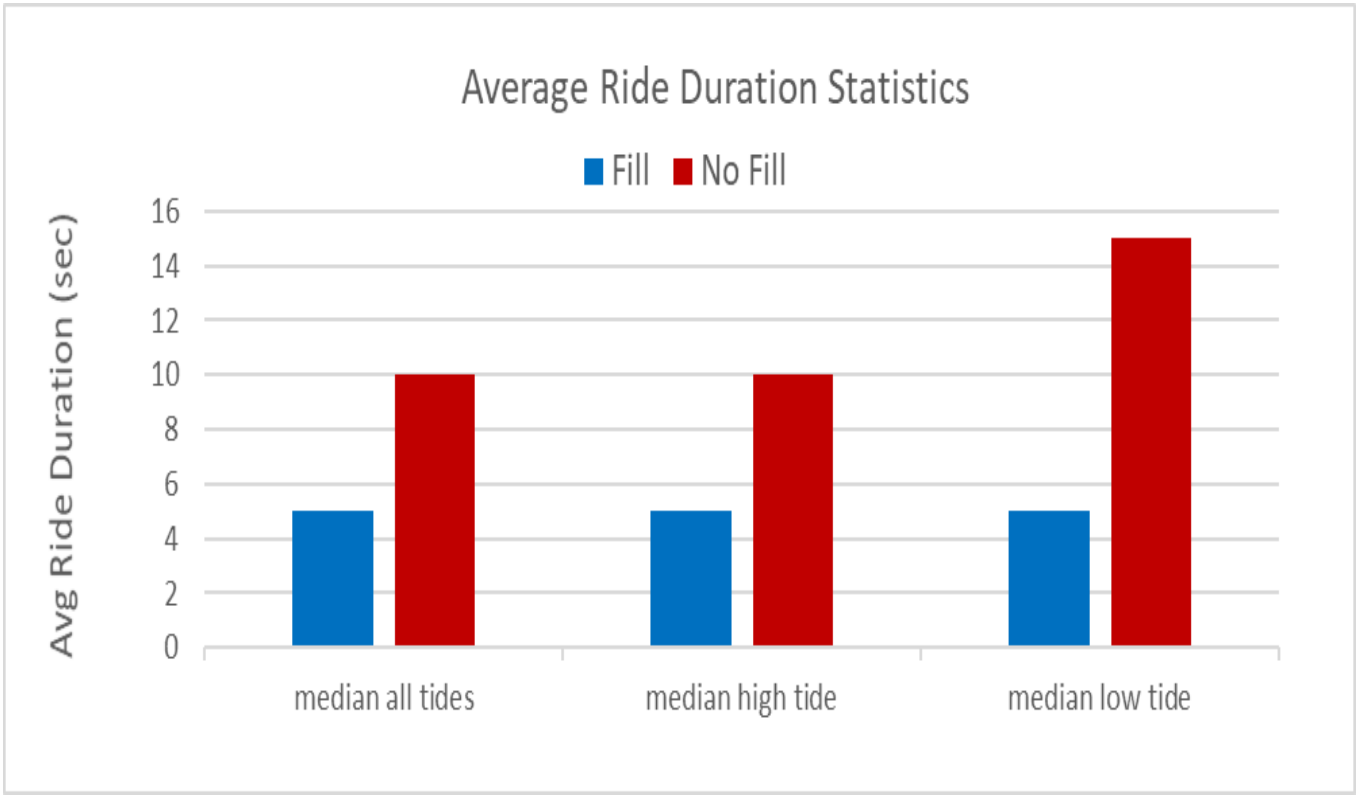
Wave Breaker Height
No statistically significant difference



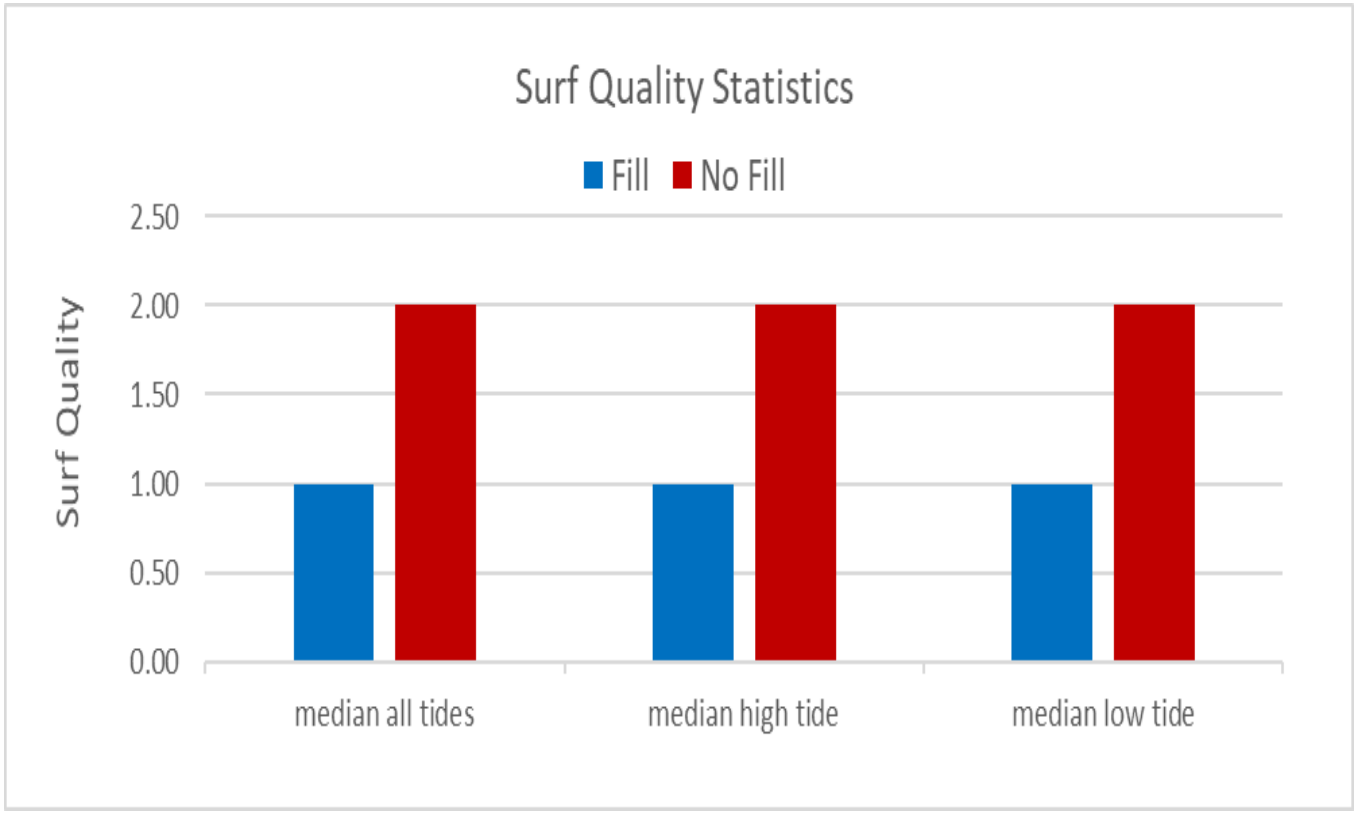
Surf Zone Width
≈ 100 feet narrower in filled sections



Average Surfing Ride Duration
5 to 10 seconds shorter in filled sections



Overall Surf Quality
50% lower in filled sections



Research Conclusions

- Canaveral Shoals borrow site is much coarser than the native beach profile sediment in the North Reach
- Coarser fill sediment changed the modal beach state of the filled zones from dissipative to intermediate
- Changes in modal beach state resulted in steeper seabed slopes in the filled zones
- Beach Profile surveys confirmed beach slopes were steeper post fill

Research Conclusions

- Littoral Wave Observations conducted by experienced surfers confirmed negative impacts to surfing wave environment

- Previous research suggests that the adverse impacts from the coarser fill will continue for at least 5 years

- If nourishments from the Canaveral Shoals borrow site continue, the beach modal state will trend more intermediate/reflective and at some point, the beach may not be able to recover to its natural dissipative state

Other Impacts of Canaveral Shoals Fill

- Steeper beach = more dangerous beach
- 130% increase in preventative rescues after fill in 2014
- Reduced sea turtle nesting: 50% less nests in years after fill
- Reduced sea turtle nesting success: 10% more false crawls

(Brevard County Ocean Rescue) (Florida Fish and Wildlife Commission)

Other Impacts of Canaveral Shoals Fill

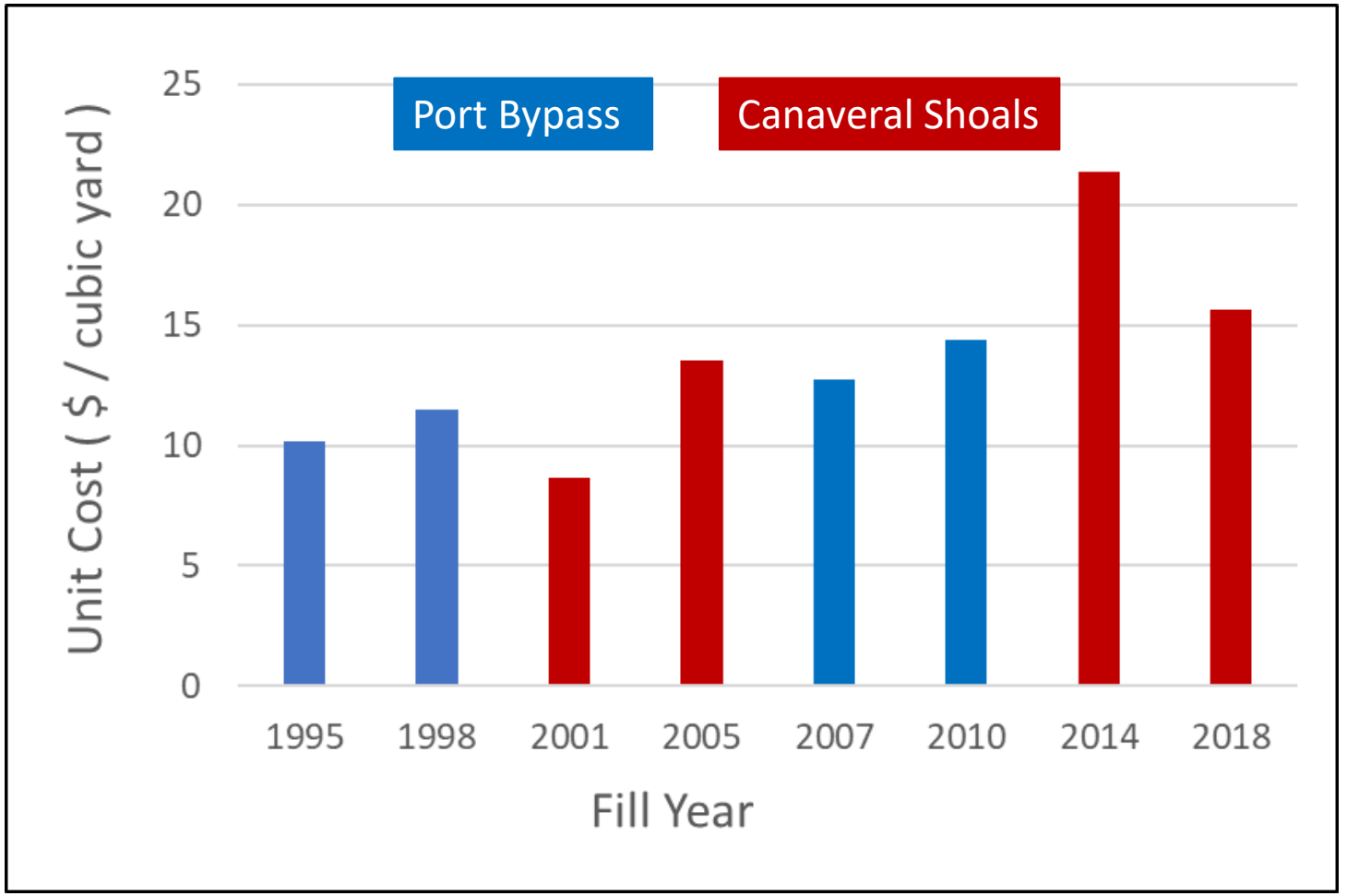
- Steeper beach = waves collapsing on shore at high tide
- A local Surf School was forced to cancel 248 lessons in 2018 because the waves were un-rideable or unsafe during high tide
- 17% loss in revenue
- School only schedules surf lessons at low tide now

Recommendations

- Improve beach fill compatibility
  - Use fill from beach north of Port Canaveral (Cape Canaveral AFS)
- Install a Fixed Sand Bypass System at Port Canaveral
  - Restore a more natural flow of sediment around Port Canaveral
  - Bypass beach compatible sand
  - Eliminate need for disruptive dredge and fill projects

Total Unit Cost of Dredge and Fill has increased over 50% since 1995

(2018 dollars adjusted for inflation)



Tweed River Sand Bypass Project
New South Wales, Australia

Unit Cost of Sand Bypass Stations are significantly lower than Dredge and Fill

Sand Bypass System	Years	Total Volume Bypassed (yd^3)	Total Cost (construction and maintenance) (USD millions)	Unit Cost adjusted for inflation 2018 (USD / yd^3)
South Lake Worth Inlet, Florida	2015 - 2045 Projected	2,100,100	14.8	**7.05**
Tweed River, Australia	1999 – 2015 Actual	10,464,000	90.5	**8.65**

Sand Bypass Station at Port Canaveral could save more than $74 million over 30 years (45% savings)

Future Cost Estimate Dredge and Fill versus Fixed Sand Bypass (30 year projection based on 358,000 cubic yards per year)			
Beach Nourishment Type	Estimated Total Fill Volume (yd^3)	Unit Cost	Total Cost
Dredge and Fill	10,740,000	$15.61	$167,651,400
Fixed Sand Bypass	10,740,000	$8.65	$92,901,000
Fixed Sand Bypass Cost Savings			**$74,750,400**
Fixed Sand Bypass Percentage Savings			**45%**