Geological Importance of Sand Compatibility for Sustaining Beaches

(Economically Wasteful and Environmentally Damaging Beach "Renourishment")

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The Problem with Sand Sources

Easily available sand (*dredged from offshore*) tends to:

- Be mostly skeletal carbonate sediment that has never been abraded on a beach before;
- Be less dense than equivalent sized quartz;
- Be of shapes that move more easily than equant grains;
- Move in suspension more easily than equivalent (sieve) sized quartz; and
- Not be durable in beach environment

The Right Sand: why does it matter?

- Off Florida's beaches are valuable coral, hard-bottom & fish habitats that are severely degraded or destroyed by sediment smothering, siltation, persistent turbidity & reduced light penetration

Just off the proposed beach fill project in Ft. Lauderdale is a thriving coral reef

The Impacts - Environmental

Rapid **smothering and/or siltation** of offshore sandy & hardbottom communities

Dramatically **increased turbidity** & reduced light penetration in adjacent waters, stressing coral & other light dependent components of hardbottom & softbottom communities

The Impacts - Economic $$$

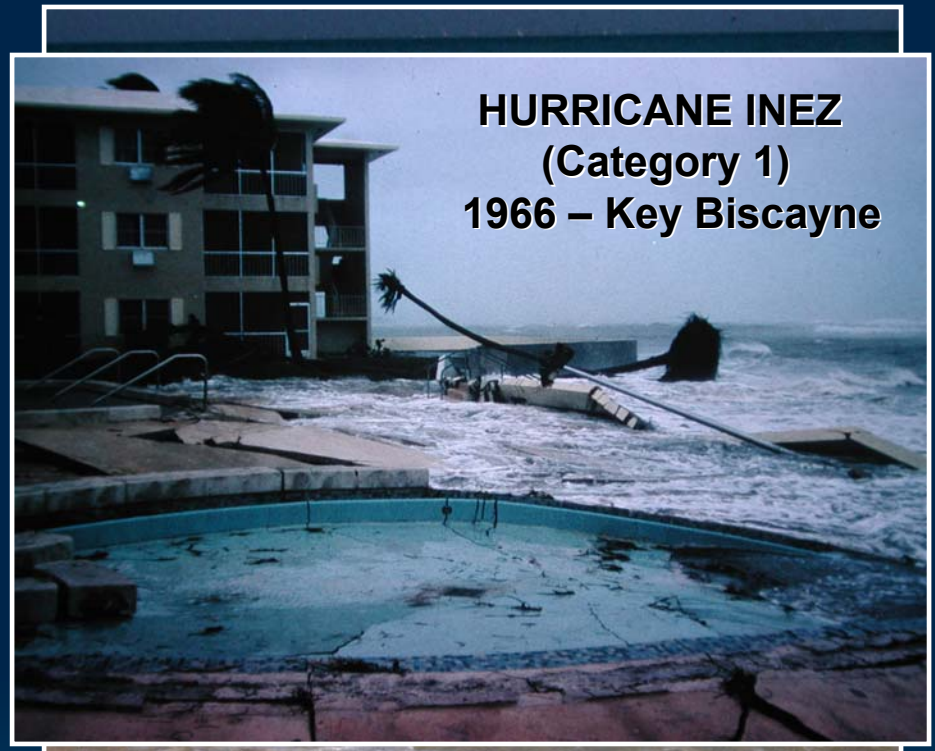
Not using sand of a proper size & durability – so does **not remain on beach $$$$**

Not vegetating beach renourishment projects – so moving *sand behind beach face is lost* shortening lifetime of project, shore is more easily storm eroded

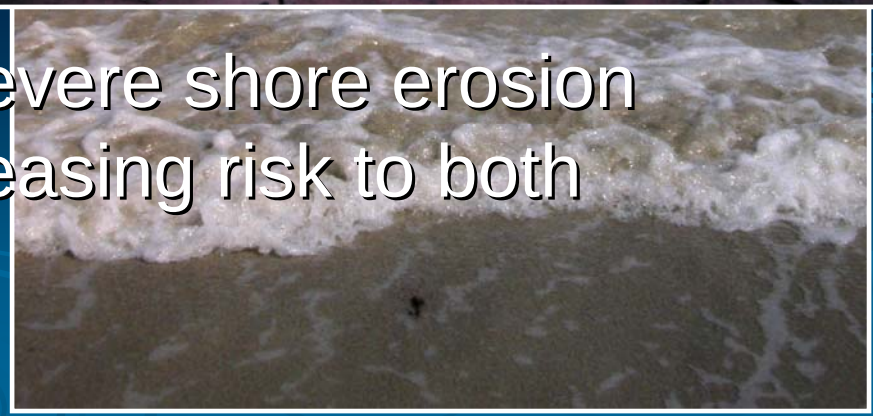
Siltation & turbidity to adjacent water is degrading or destroying adjacent marine communities (reefs and hardbottoms and fish) – **so recreational, tourism, & commercial activities are lost!**

The Impacts - Human Safety

- Persistently murky water increases likelihood of shark attacks & increases difficulty of rescue of swimmers



- Increased likelihood of severe shore erosion during major storms increasing risk to both inhabitant & structures



The Sand

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Most SE Florida beaches have grains **>250 µm** (1/4 mm)
particles <200 µm (1/5 of mm) move in **suspension**

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3 Hardness Matters!

Durability of offshore carbonate sand different than natural, **not very durable** & break down to form **MUD**

Sand isn't just sand

Size

Density

Shape

Durability

Miami Beach

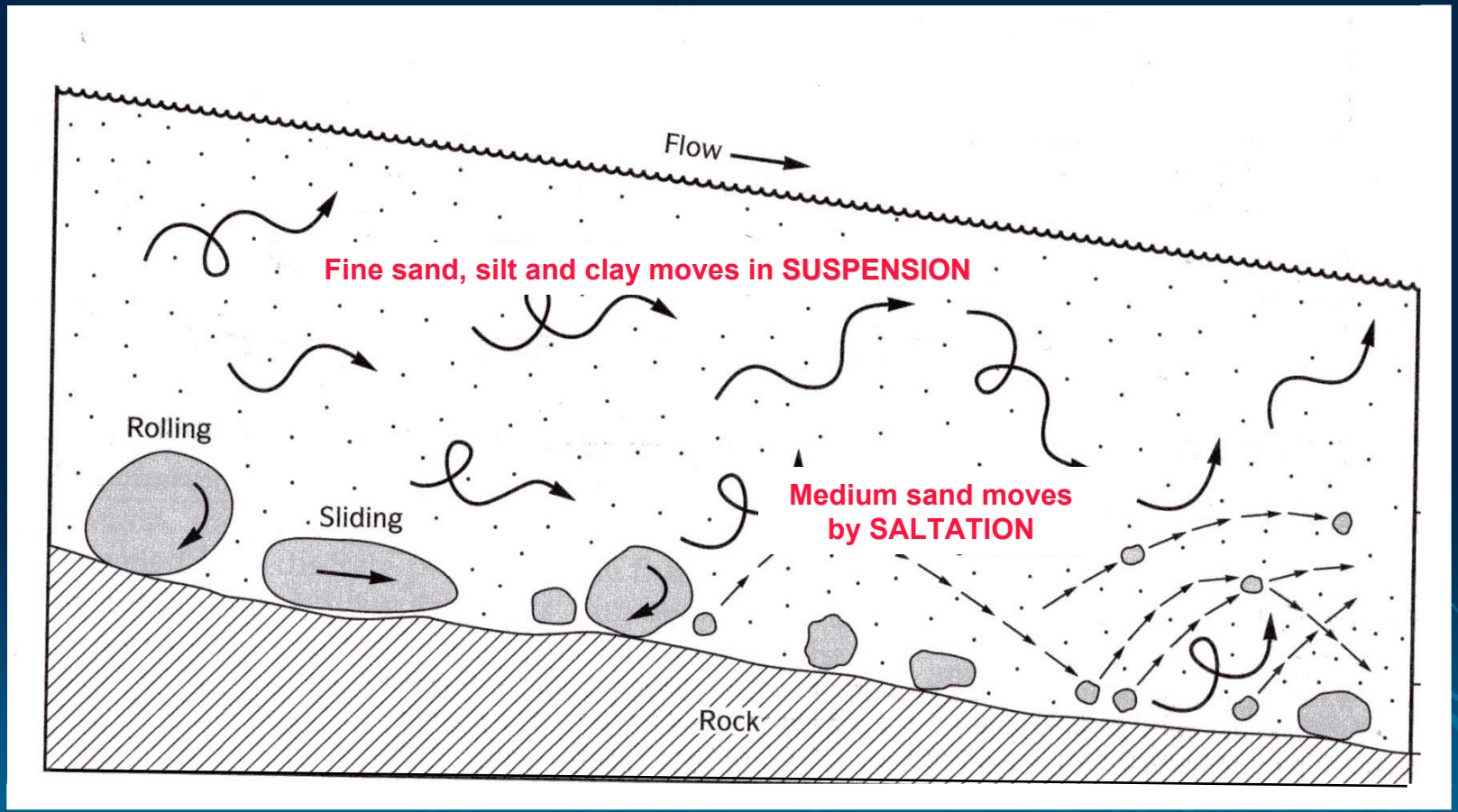
ORIGINAL SAND

NEW SAND

AFTER renourishment

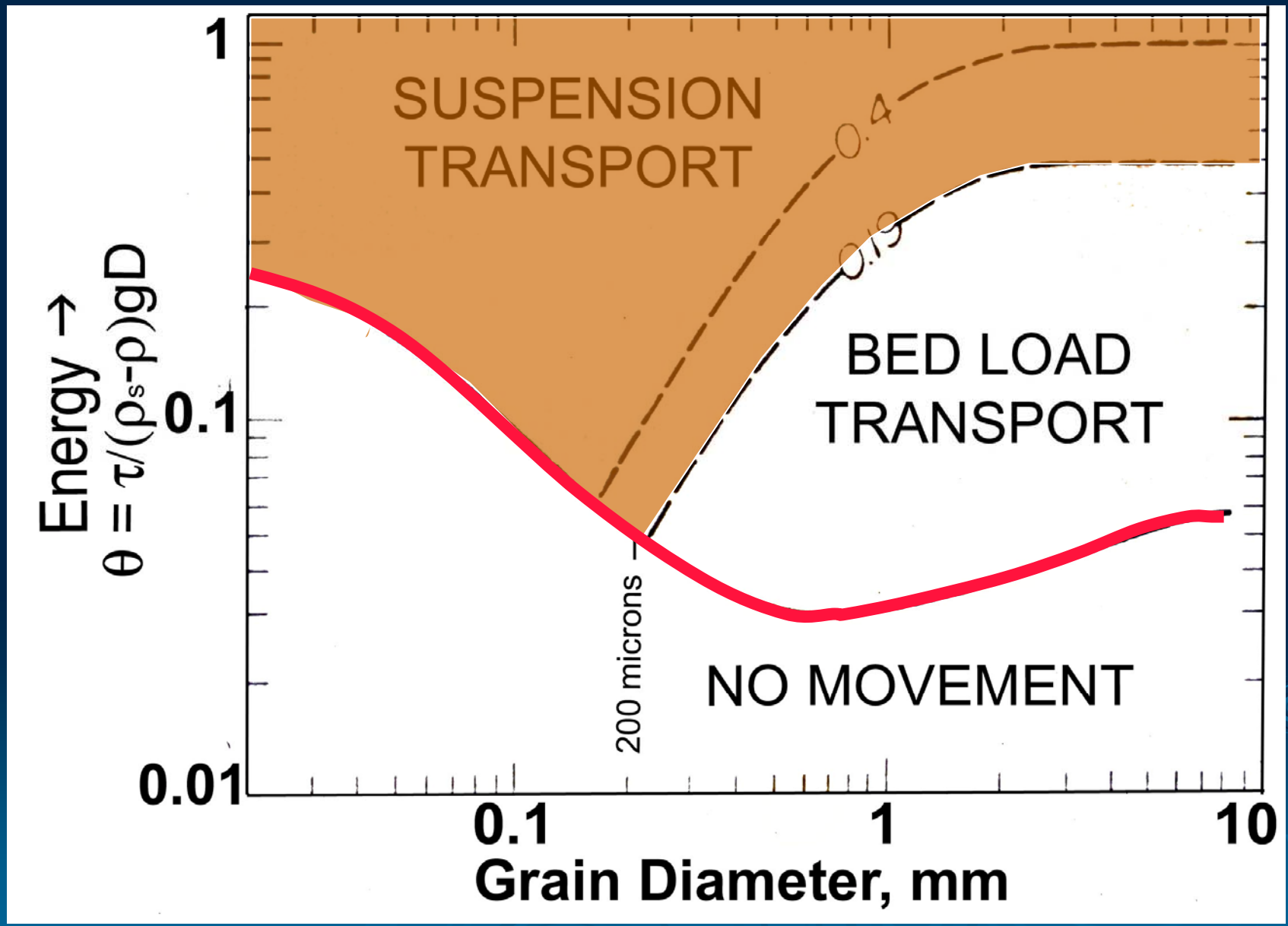
Grains move by:

1) Bedload transport 2) Saltation 3) Suspension



Prothero and Schwab (1996)

Grain finer than 200 microns tend to move in suspension



Entrainment Diagram for Quartz Sand

<200 micron sand particles will move OFF the beach

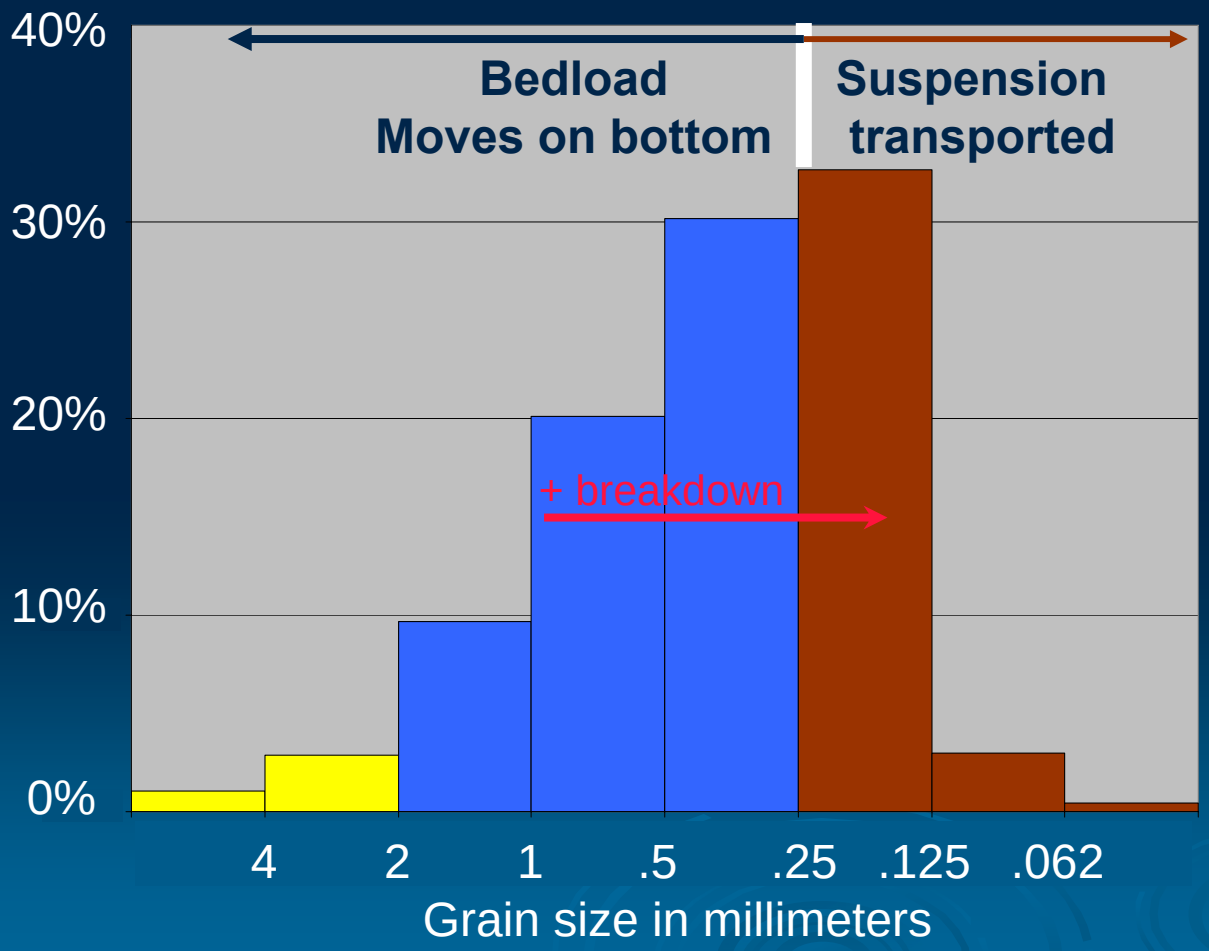
Boca Raton beaches
courtesy Cry of the Water

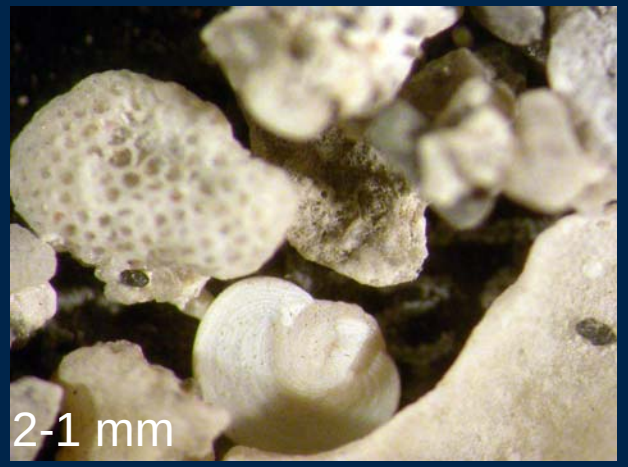
Grains <200 microns in diameter tend to move in suspension

The results of ‘beach renourishment’ at John U. Lloyd State Park, southern Broward County

Suspended mud

PROPOSED BORROW AREA 3
Core BC-01-16 1.5ft
Sieved grain size





Student Katie Maier looked at the durability of proposed Broward County renourishment sand

Calibration Sand – 1-2 mm sieved size fraction used

Sample split A – mixed with coarse sand

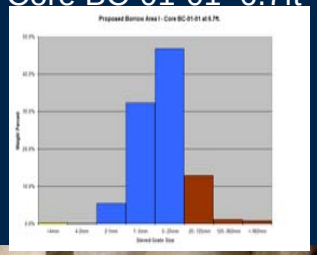
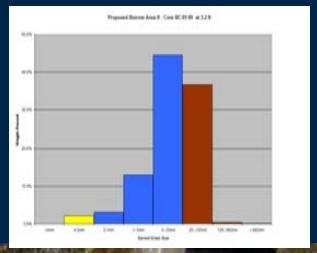
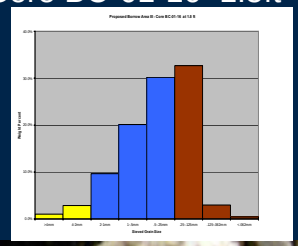
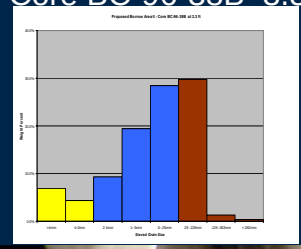
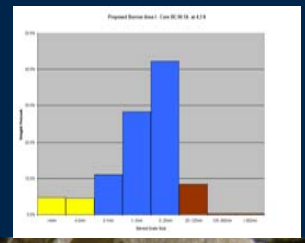
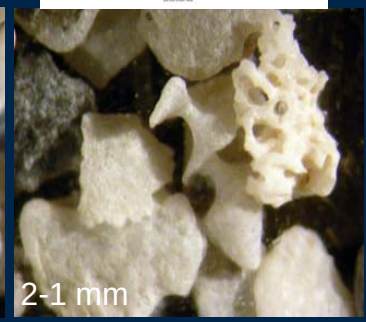
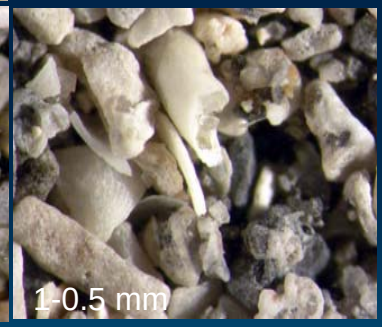
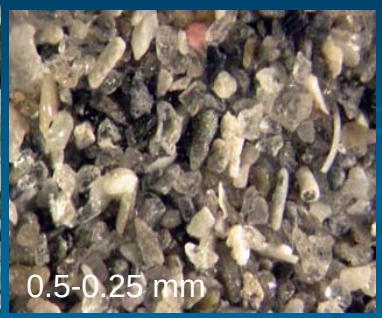
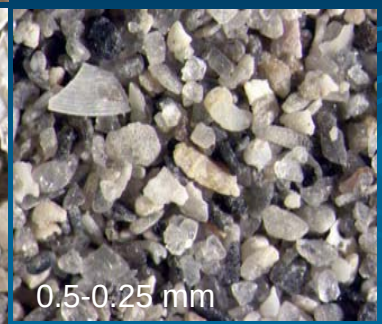
Sample split E – mixed with ooids

Sample split E after one week tumbling

Sample split A after one week tumbling

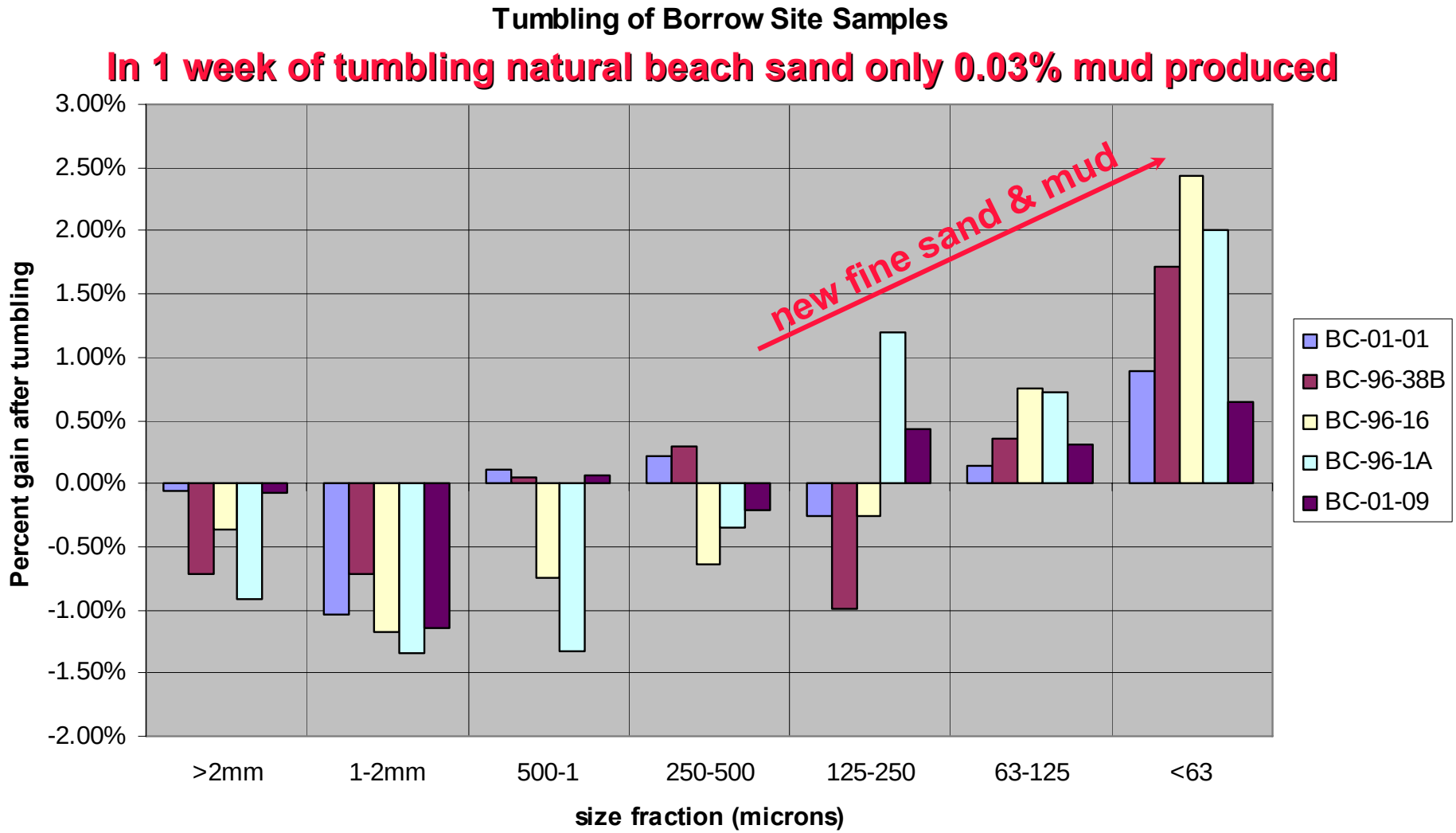
Durability tests were run on 5 proposed borrow site samples

(mixed with = weight of 1 mm glass spheres & tumbled in water for one week)

Core BC-01-01 6.7ft	Core BC-01-09 3.2ft	Core BC-01-16 1.5ft	Core BC-96-38B 3.3ft	Core BC-96-1A 4.3ft
				
 2-1 mm	 2-1 mm	 2-1 mm	 2-1 mm	 2-1 mm
 1-0.5 mm	 1-0.5 mm	 1-0.5 mm	 1-0.5 mm	 1-0.5 mm
 0.5-0.25 mm	 0.5-0.25 mm	 0.5-0.25 mm	 0.5-0.25 mm	 0.5-0.25 mm

Sand from Proposed Broward Borrow Area

IN 1 WEEK OF TUMBLING – 1 to 3% TURNED TO MUD !!



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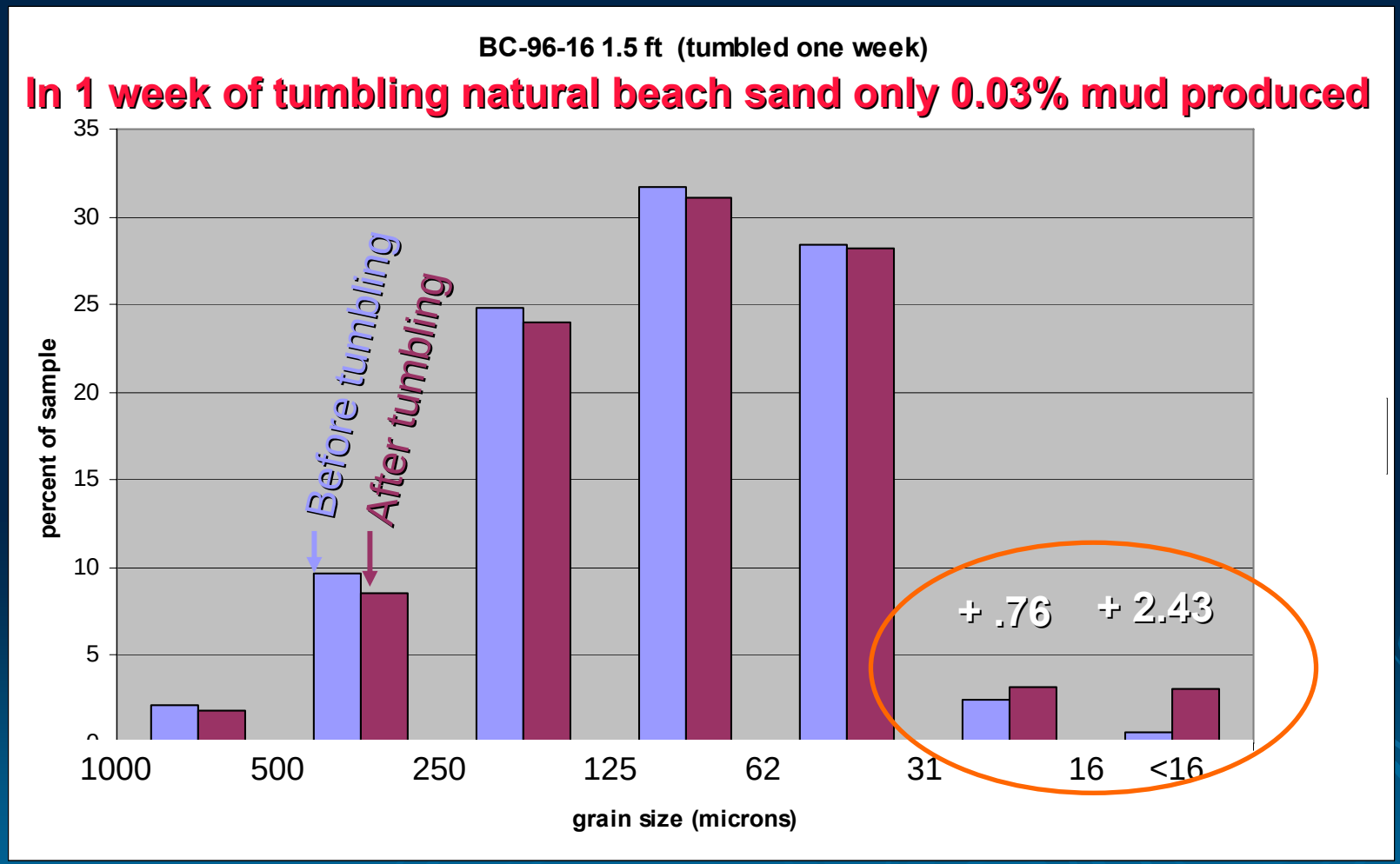
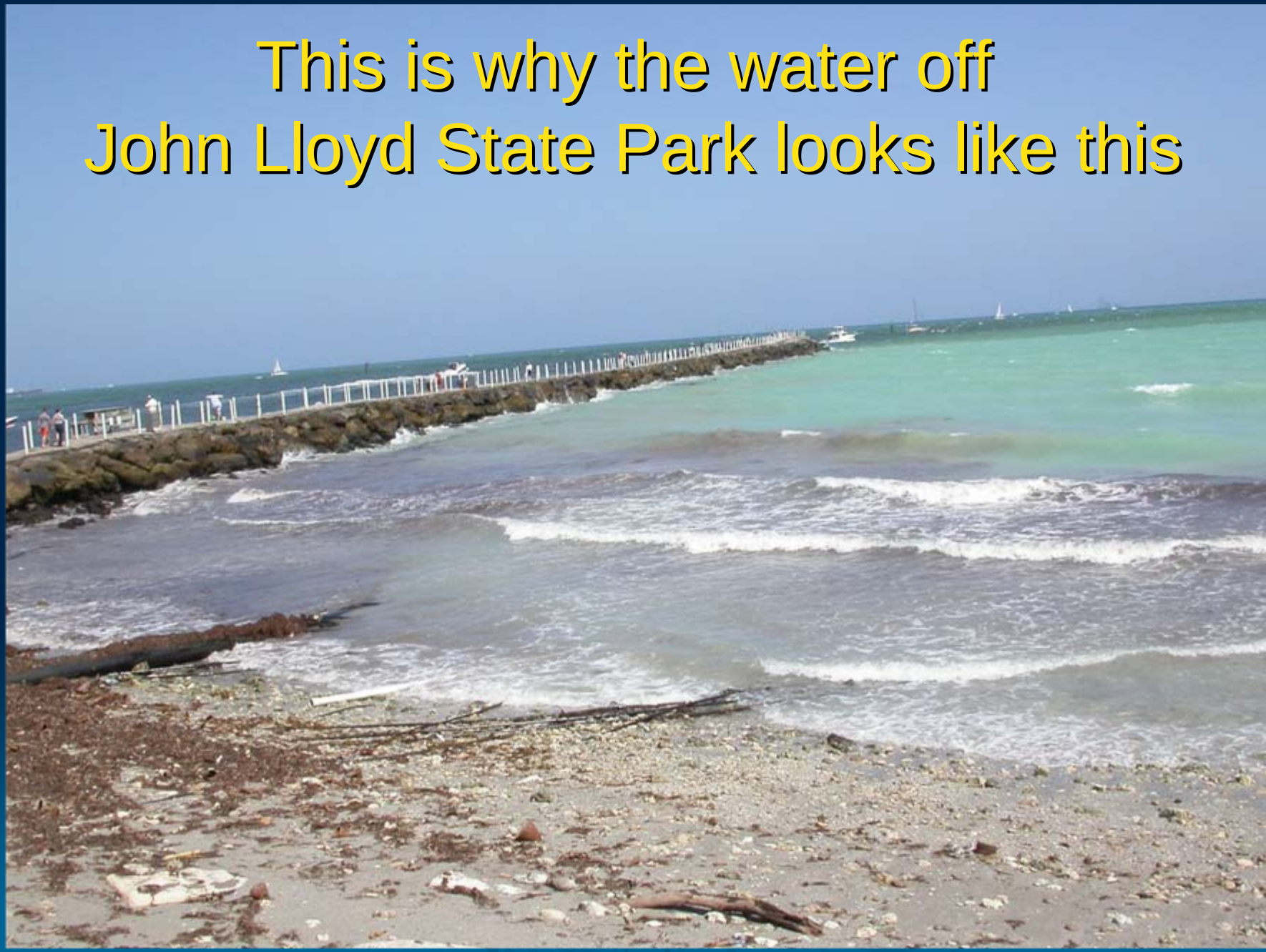


Durability Results

- Within one week of tumbling abrasion, **3% of the sand had turned to mud !**

- Sand from proposed borrow areas creates fine sand & mud at rate up to **two orders of magnitude (100 times) faster** than adjacent natural beach sand !

This is why the water off John Lloyd State Park looks like this



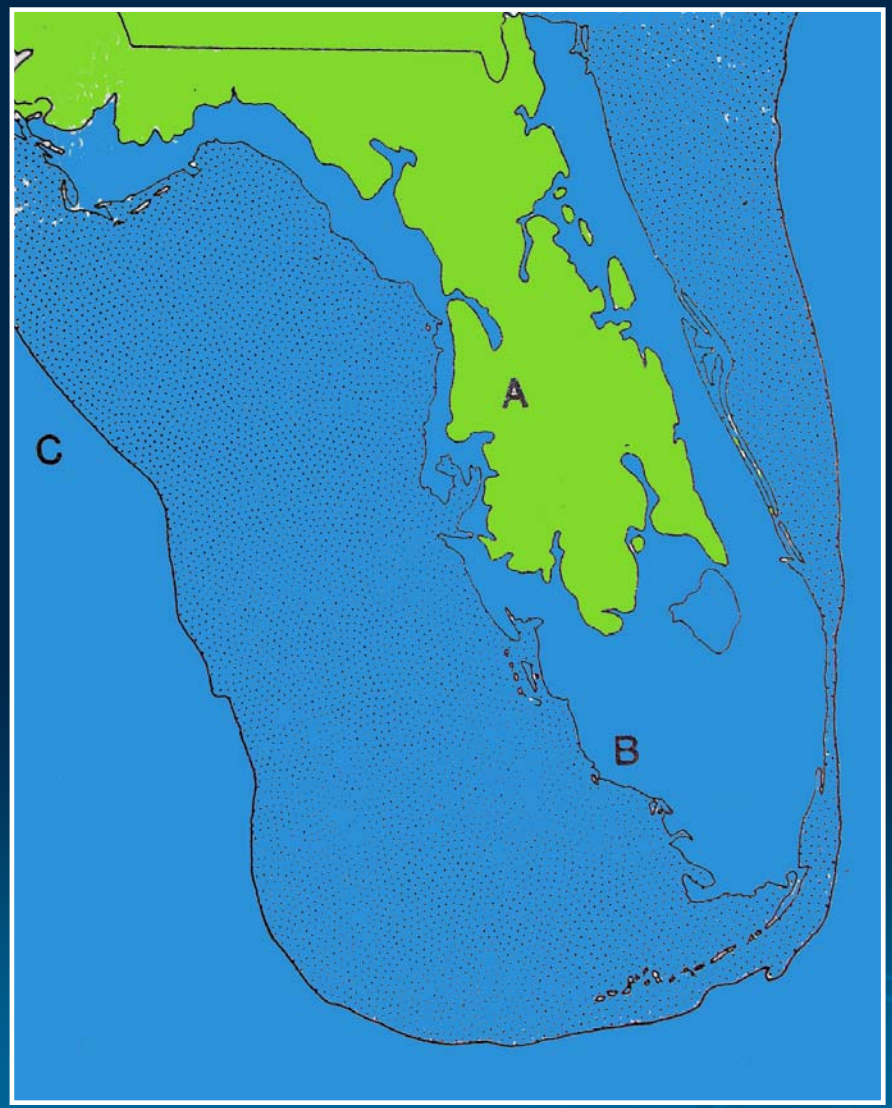
What we end up with….

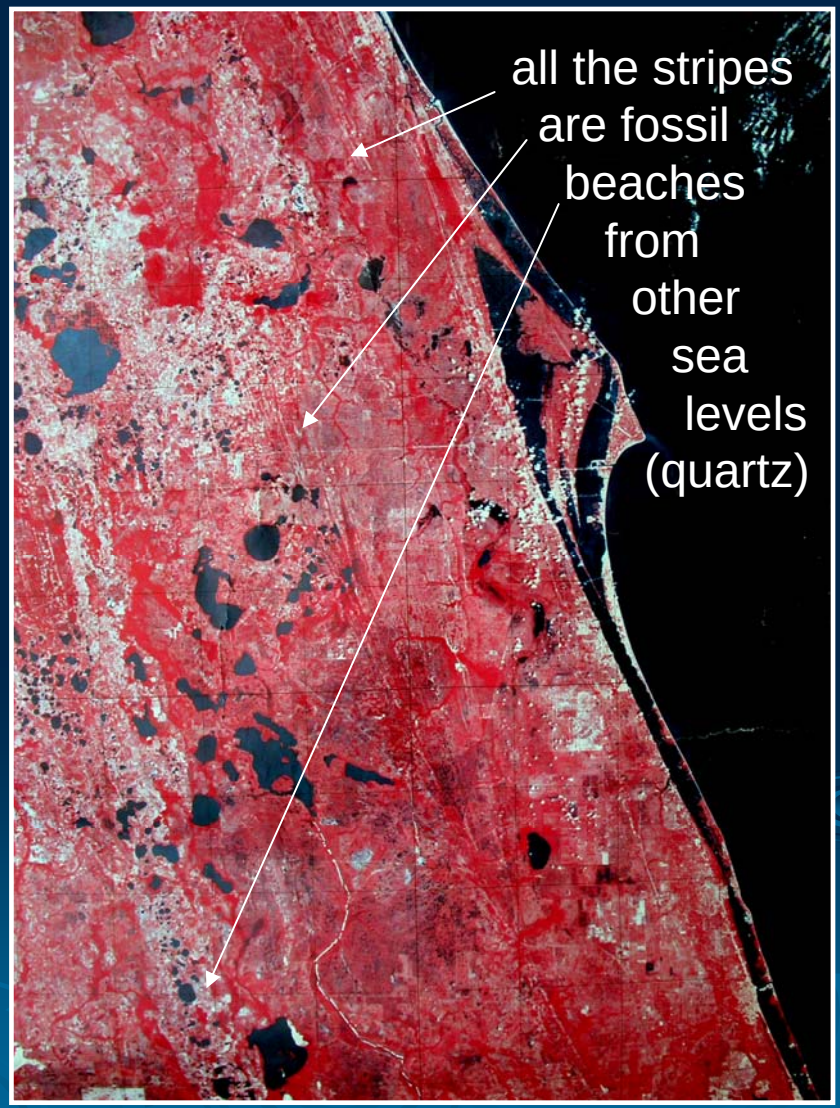
A beach filled with offshore-derived carbonate sand invariably becomes a long-term source of persistent fine-sediment release & persistent degraded nearshore water quality

What to do?

- Demand that renourishment projects contain only excellent quality, durable sand with NO material that is <200 microns
- NO longer permit borrow areas offshore Florida
- All samples should be analyzed wet for grain size
- Demand that settling analyses & durability analyses be conducted on any sands with >5% carbonate particles (and establish procedures & criteria)
- follow FAC Rule 62B-41.007 "…shall be similar in color and grain size distribution (sand grain frequency, mean and median grain size, and sorting coefficient) to the material in the existing coastal system…"

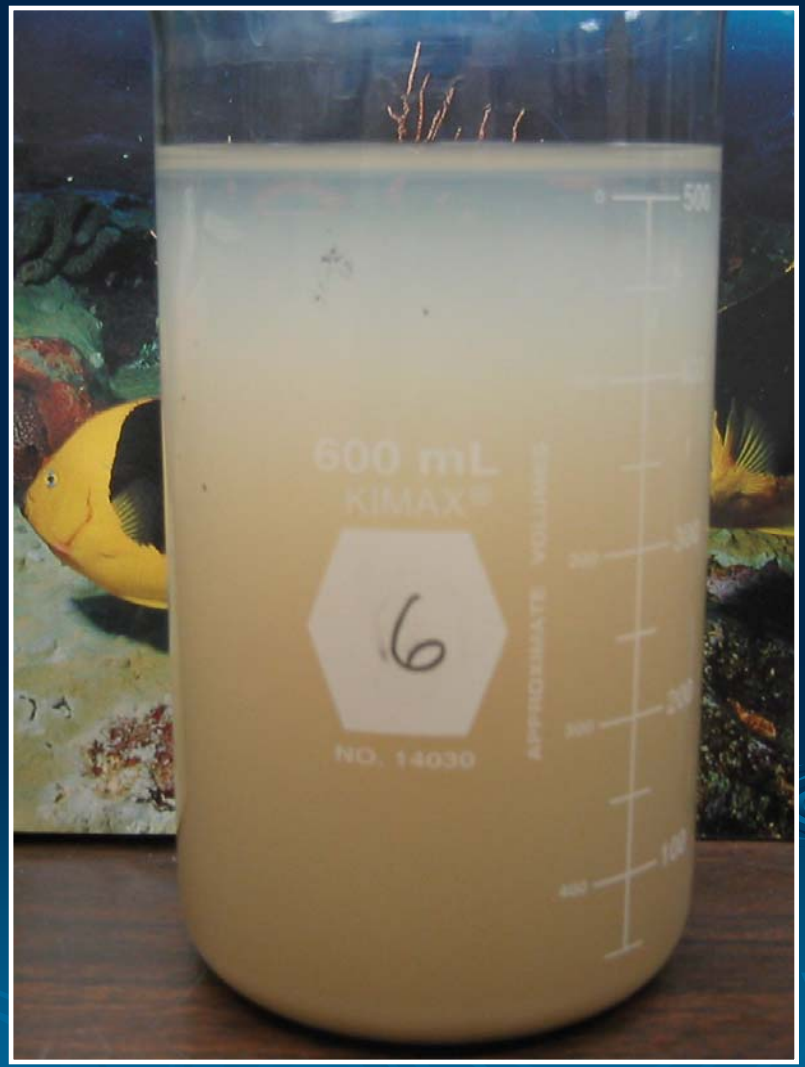
There are places to get good sand



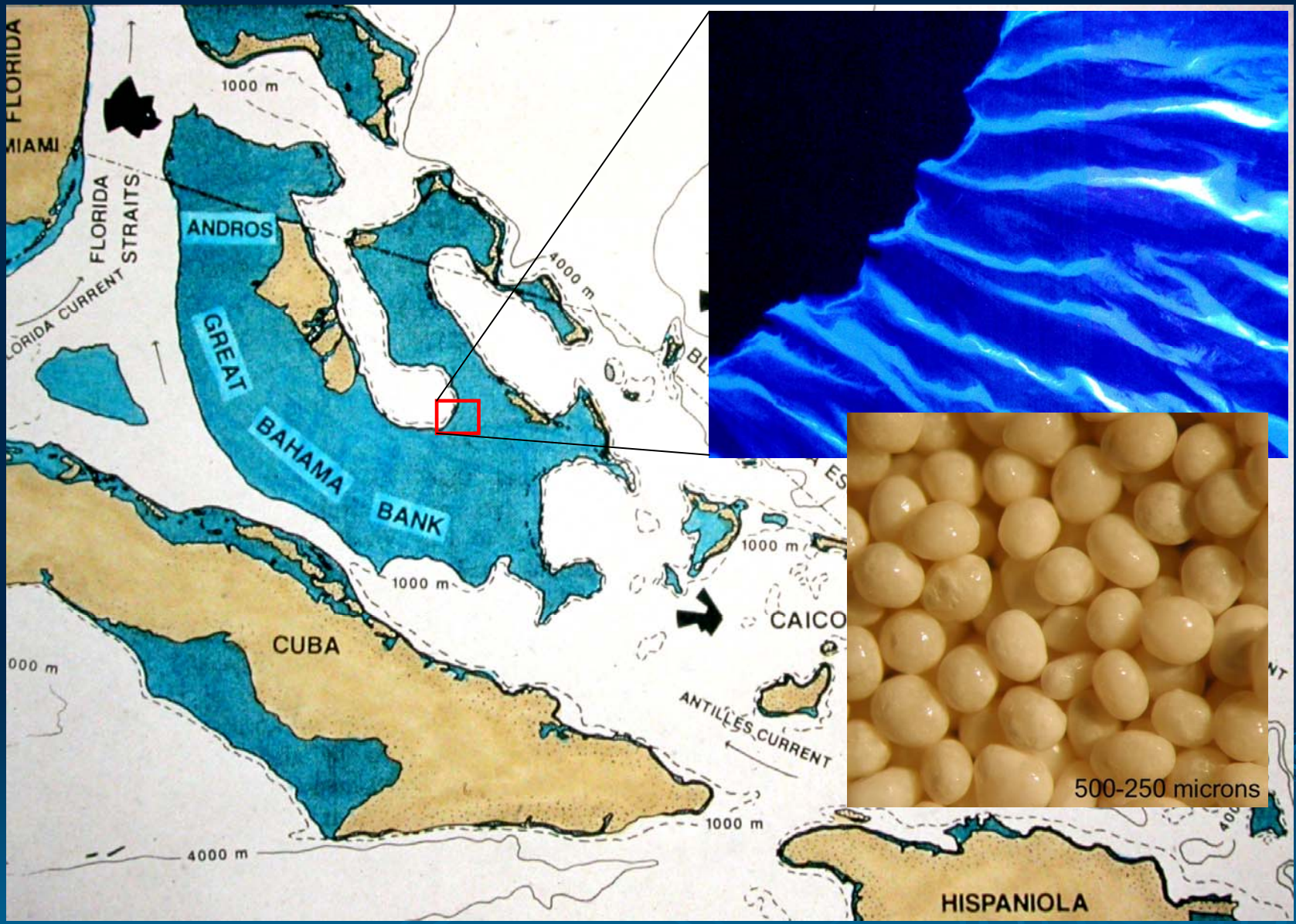


But, even upland sources (non carbonate) are not being properly evaluated prior to placement

St. Lucie fill project completely eroding away as it is being placed on the beach



Spoonful of St. Lucie beach fill – **24 hours** after stirring into water



The Bahamas may now be willing to sell

EXAMPLE OF A SUITABLE CARBONATE BEACH NOURISHMENT SAND

- Sand is **between 1mm - 0.25mm**

- Carbonate particles are **rounded & polished** skeletal fragments (already worn).
  - Will not be prone to rapid abrasion and release of silt- and clay-sized particles.

- Carbonate skeletal particles are **solid**, not full
- of open pore space.
  - Will behave as indicated by sieved size.
  - Will not be prone to rapid abrasion and breakdown on beach.

- Carbonate particles are fairly **equant shaped**, not thin rods & flat plates.
  - Will move as indicated by sieved size.
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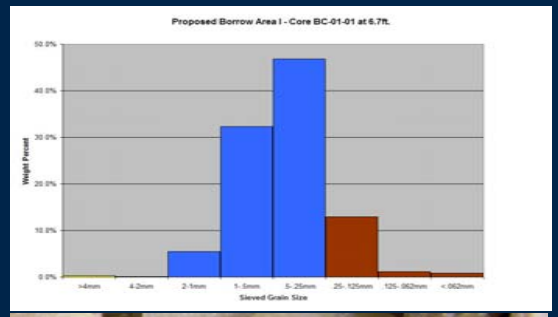
Core BC-01-01 6.7ft



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In the End it's the Sand

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