GAINING **GROUND**

Florida spends millions to rebuild beaches threatened by erosion

Shorelines are in constant flux; moving, building up and eroding in response to waves, winds, storms and relative sea level. This natural process eventually leaves some beaches so narrow that development – and tourism– are at risk. The latest major South Florida beach renourishment project is expanding the sand in southern Broward County from Hallandale Beach to Hollywood, including a small testing area with sand that's made from recycled glass.

HOW SHORELINES ERODE

The movement of beach sand is primarily caused by the energy of waves breaking against the shoreline.

1. A deepwater wave moves toward the shore.

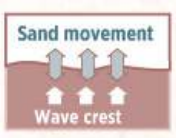
2. When the wave force reaches shallow water, it runs up against the shore bottom, loses momentum and collapses, or breaks.

3. The breaking action releases energy, creating an explosion of turbulence.

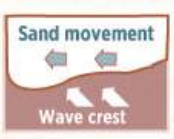
4. Sand is stirred up and lifted into suspension.

5. The wave flows back to the sea, carrying sand with it.

Direction and force of the wave determine the volume of sand moved and where it is dropped. Waves can also carry sand back to the beach.



Waves approach head on, creating little sand drift in either direction.



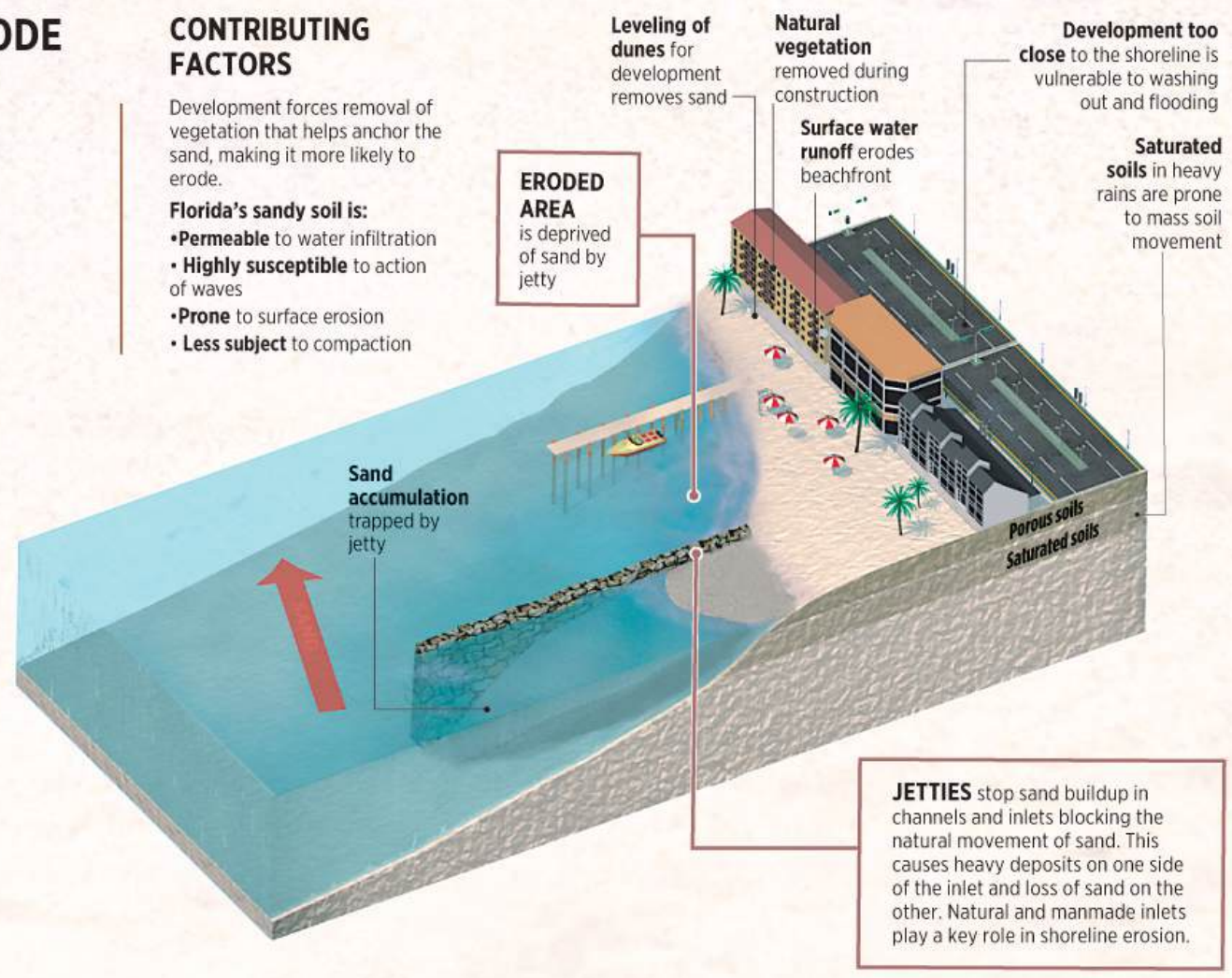
Waves approach beach at angle, moving sand parallel to the shoreline.

CONTRIBUTING FACTORS

Development forces removal of vegetation that helps anchor the sand, making it more likely to erode.

Florida's sandy soil is:

- **Permeable** to water infiltration
- **Highly susceptible** to action of waves
- **Prone** to surface erosion
- **Less subject** to compaction



JETTIES stop sand buildup in channels and inlets blocking the natural movement of sand. This causes heavy deposits on one side of the inlet and loss of sand on the other. Natural and manmade inlets play a key role in shoreline erosion.

RESTORATION STRATEGY

1. Sand is dredged off Broward's northern coast.

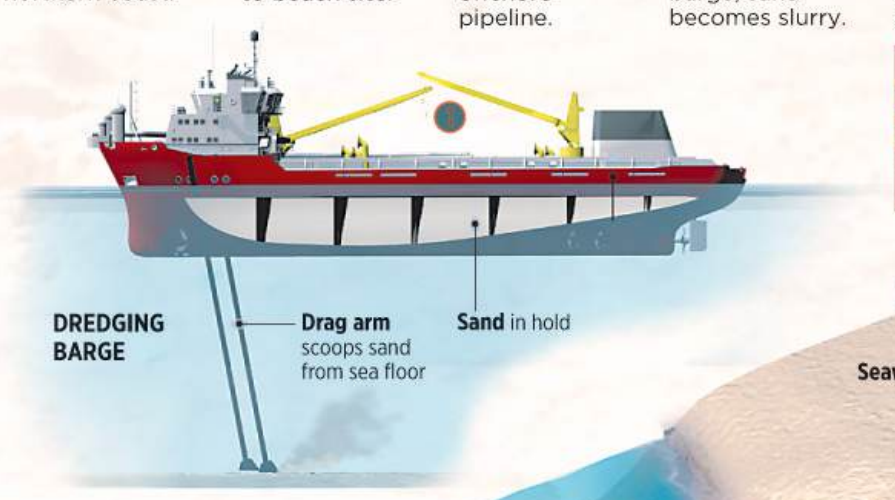
2. Dredge barge transports sand to beach site.

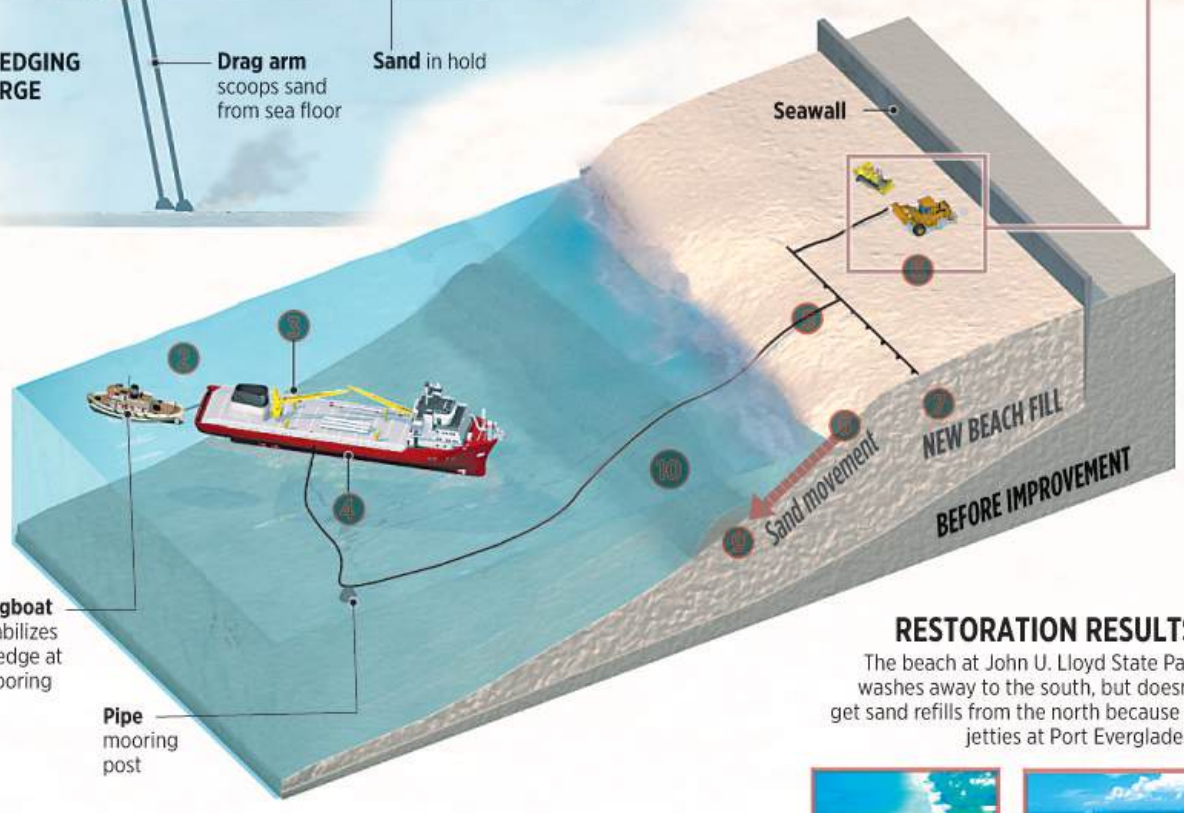
3. Dredge barge connects to offshore pipeline.

4. Ocean water is pumped into barge, sand becomes slurry.

5. Dredged sand is pumped through a large pipe onto the beach.

6. Bulldozers level off the sand, shaping the new beach.





7. Material is deposited offshore, building a gradual undersea ramp to the beach.

8. The new slope reduces wave impact and minimizes future erosion.

9. Wave action creates a submerged sand bar just offshore.

10. The offshore bar helps block sand from washing out to sea.

RESTORATION RESULTS

The beach at John U. Lloyd State Park washes away to the south, but doesn't get sand refills from the north because of jetties at Port Everglades.

1988, BEFORE renourishment

1989, AFTER renourishment

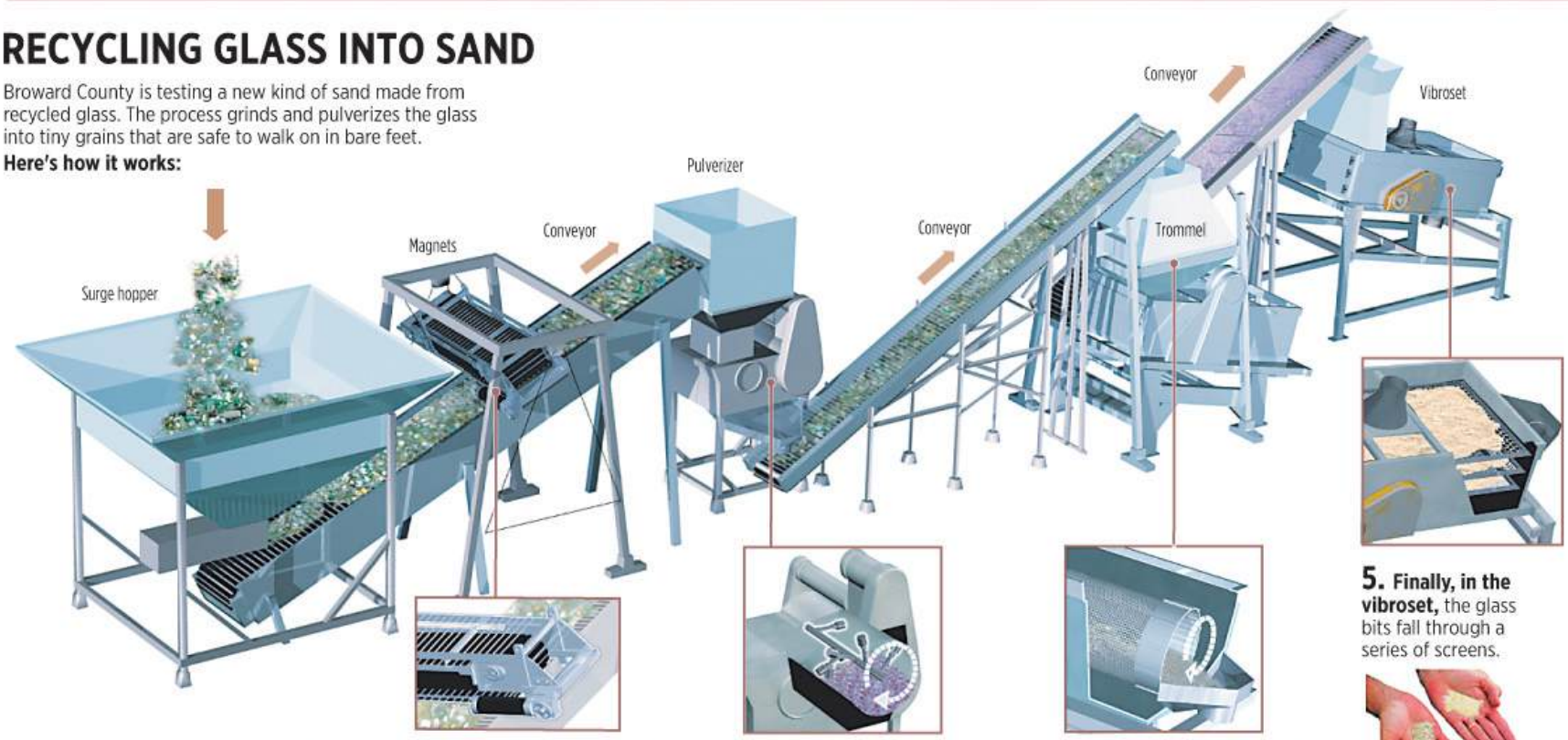
CRITICAL EROSION SOUTH FLORIDA

Beaches at risk

RECYCLING GLASS INTO SAND

Broward County is testing a new kind of sand made from recycled glass. The process grinds and pulverizes the glass into tiny grains that are safe to walk on in bare feet.

Here's how it works:



1. Recycled glass enters hopper. No pre-sorting of glass from other materials is necessary, saving labor costs.

2. A conveyor carries glass and other debris under magnets. Iron and steel are picked up and separated.

3. Glass enters the pulverizer and is pummeled into small, smooth-edged pieces by the flailing action of rotating hammers.

4. Glass goes to the trommel, which separates it from paper, plastic and other contaminants.

5. Finally, in the vibroset, the glass bits fall through a series of screens.

Recycled glass and sand mixture

100% recycled glass

SOURCE: Environmental Engineering firm of Malcolm Pirnie, Inc.; David Hula Andela Products, Ltd.; Bureau of Beaches and Coastal Systems, State of Florida; Stephen Higgins, Broward County beach erosion administrator; Florida Department of Environmental Protection, Great Lakes Dredge & Dock Co. Oak Brook, Ill.

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