

# The road to adaptation is jug-handle shaped

A **coastal road** is any road that is located adjacent to an ocean shoreline. They can be located on the mainland or on barrier islands separated from the mainland by a backbarrier lagoon (figure 1).

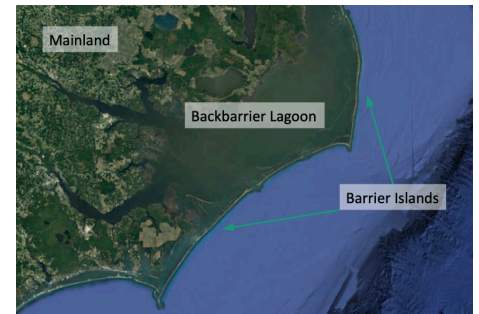
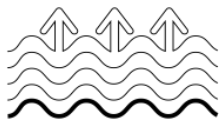


Figure 1. Barrier islands off the coast of North Carolina

Coastal roads on barrier islands are **threatened** by multiple factors



## Sea level rise

- Climate change drives higher sea levels in many areas around the US, putting coastal roads closer to the ocean and more vulnerable to waves and tides.



## Long-term shoreline erosion

- Long-term shoreline erosion is common to most open-ocean shorelines.
- It is primarily due to continuous exposure to wave energy and tides, and spatial patterns of sediment supply.



## Storms

- Storms produce higher-than-normal water levels and waves onshore.
- During storms, waves and water levels can lead to **overwash** (figure 2) and/or **breaching** (figure 3) over the road.

Figure 2. Overwash during hurricane Florence



Figure 3. Breach during hurricane Irene

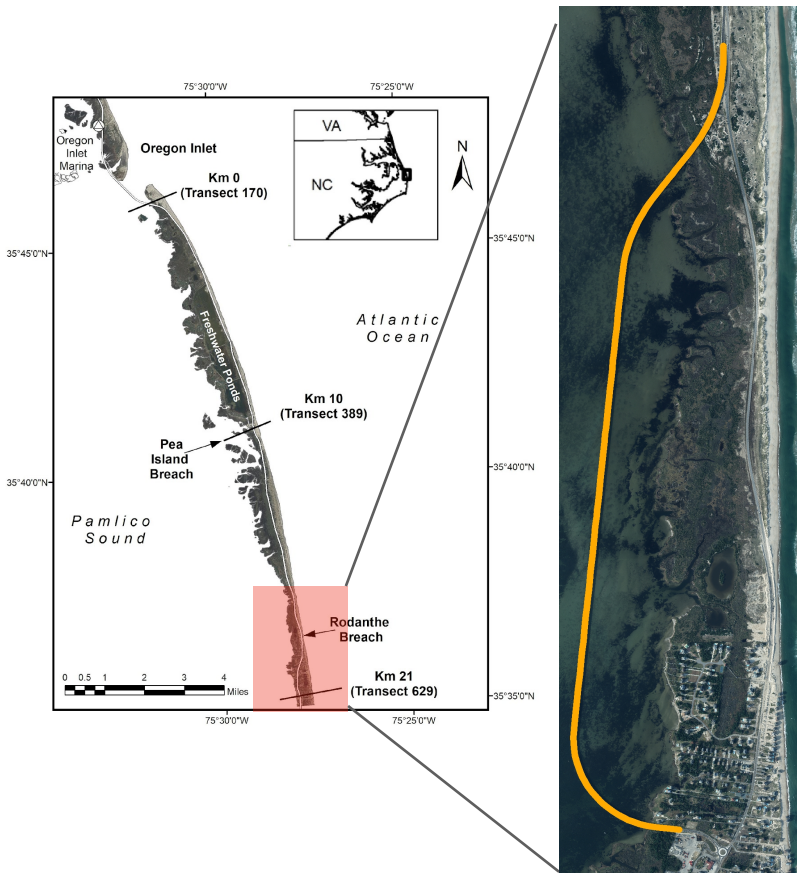
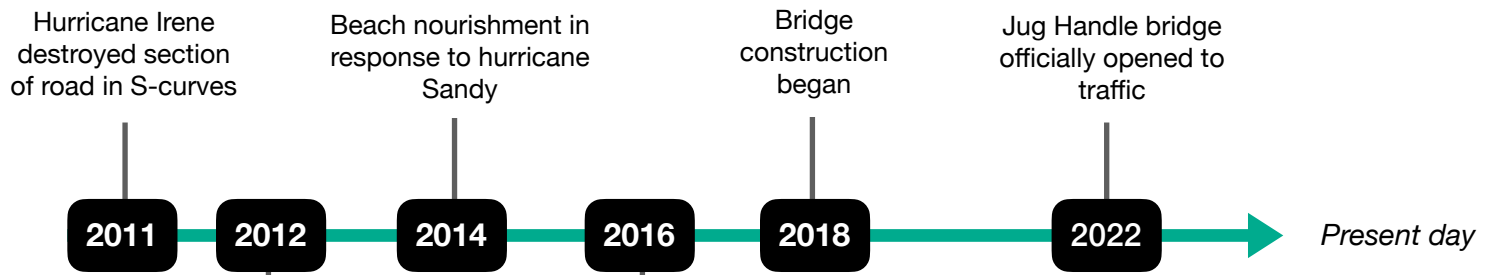
*Climate change is expected to lead to higher sea levels and more frequent and more severe storms in the next century, further increasing coastal roadway vulnerability*

A stretch of highway in North Carolina known as the “S-curves” is one of the most vulnerable coastal roads in the U.S.



- The S-curves is extremely vulnerable to overwash and flooding even during mild storm and high water events
- Known as a proxy for storm strength by locals
- Is part of a critical evacuation route off the Outer Banks of North Carolina for tourists and locals

In order to protect access to the roadway for years to come, the North Carolina Department of Transportation relocated NC 12 onto a 2.4-mile bridge cutting through the back barrier sound



**FAQ**

**Why was a new solution needed?**

- Climate change projections and historic vulnerability of the road necessitated a more permanent solution
- Past actions had only been temporary solutions that required maintenance after only a few years
- Road closures disrupted daily life
- Frequent bulldozing of sand off roads and rebuilding dunes incurred a high economic cost
- The S-curves is part of a critical evacuation route off the barrier island for locals and tourists

**What was done with the area occupied by the previous road?**

- 1.8-miles of pavement from the previous road was removed, and the land returned to the Pea Island National Wildlife Refuge. The dunes will no longer be maintained alongshore

**What are the long-term implications?**

- More frequent overwash events caused by gradually lower dunes may create optimal habitat for local wildlife and support resilience for long-term barrier island survival

**Relocation of critical infrastructure will likely become more common in the future as climate change forces more extreme protection measures on developed barrier islands**