Dynamics of the Coast from an OBX Perspective

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Image: Village Realty; http://www.villagerealtyobx.com/outer-banks-real-estate/southern-shores

Outer Banks, NC

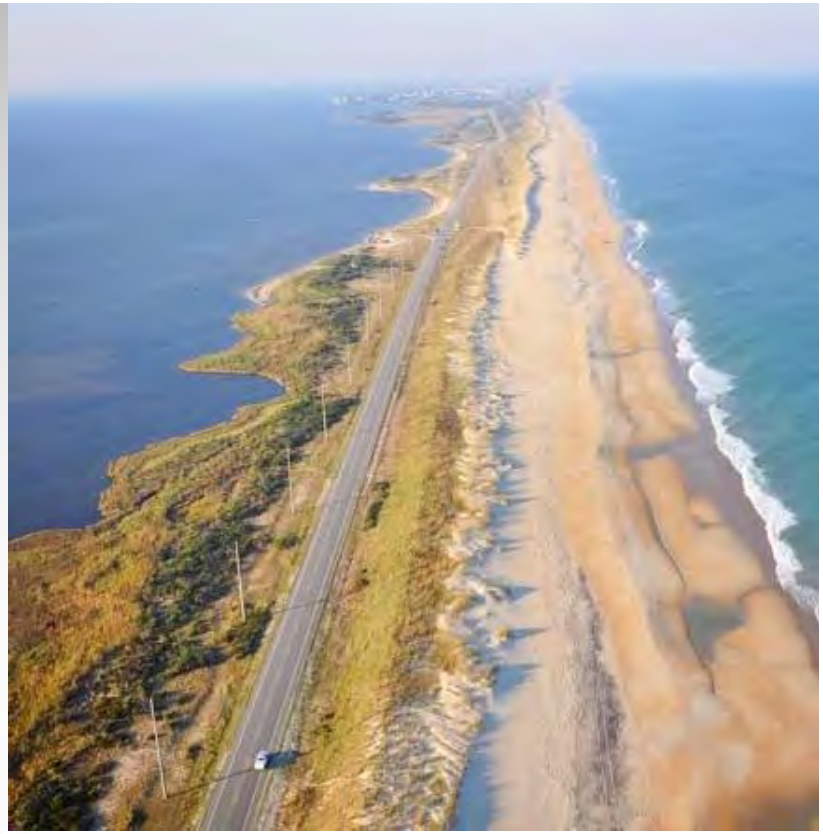
- >320 km of barrier islands
- Albemarle-Pamlico Estuarine System
- Millions of visitors and revenue
- Focus on coastal dynamics
  - Shoreline
  - Influence of nourishment

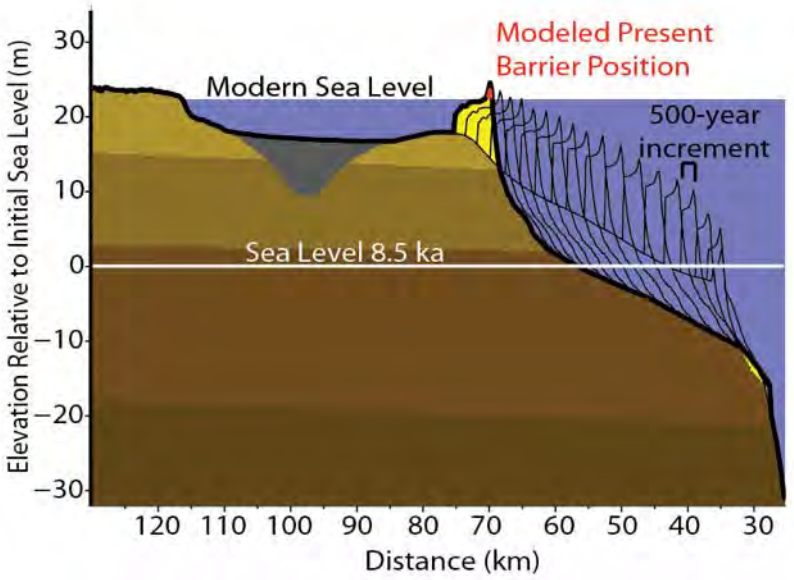
Barrier Islands

- Barrier islands represent 6% of global ocean shoreline…we are not the only ones dealing with these issues!

- **Underlying geologic framework** (Riggs et al. 1995)…Kitty Hawk Erosion hot spot

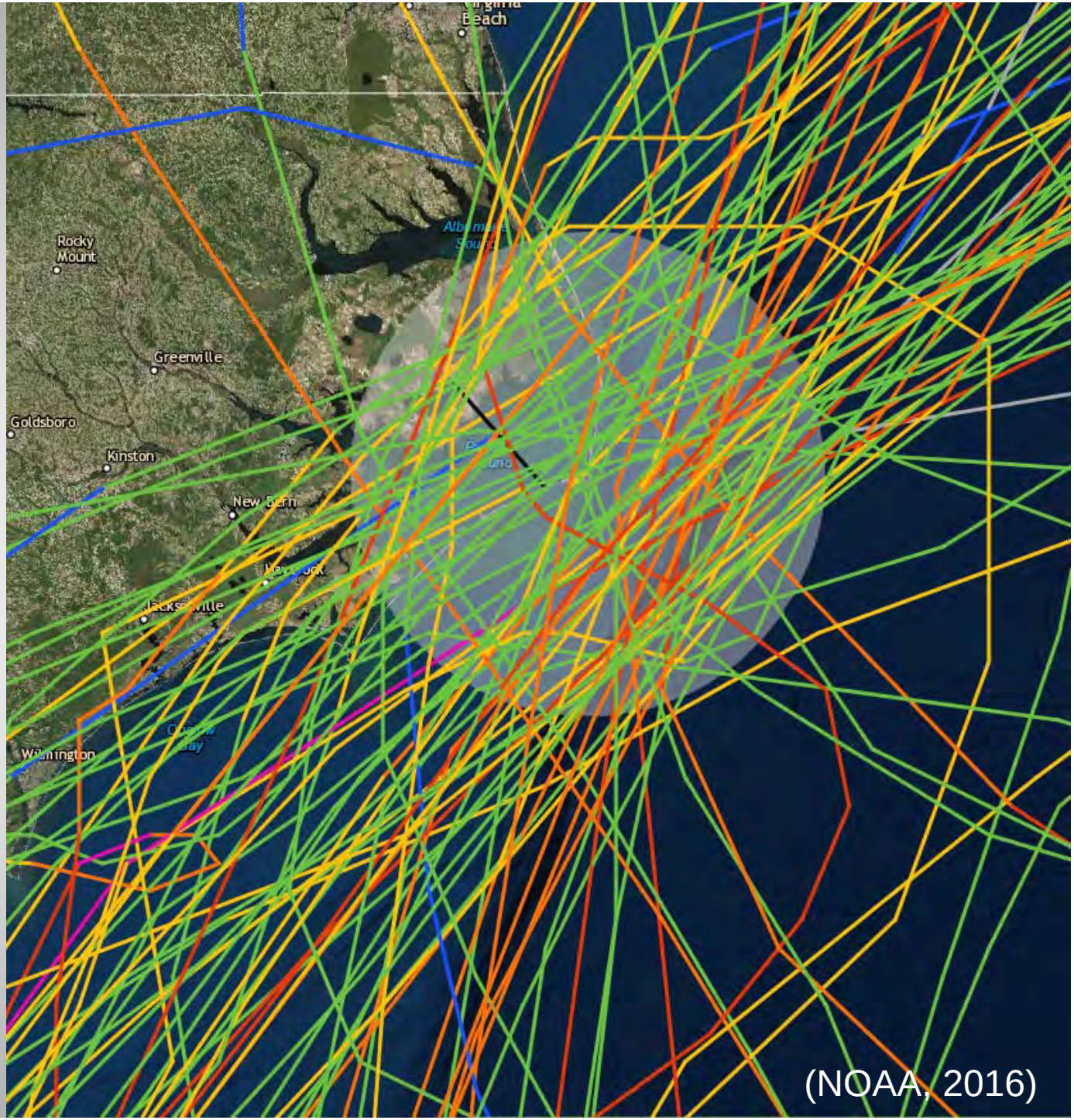
- Morphology is affected by many factors :
  - **storms**
  - wave energy
  - tides
  - aeolian transport
  - sediment supply
  - inlet dynamics
  - sea-level changes
  - vegetation





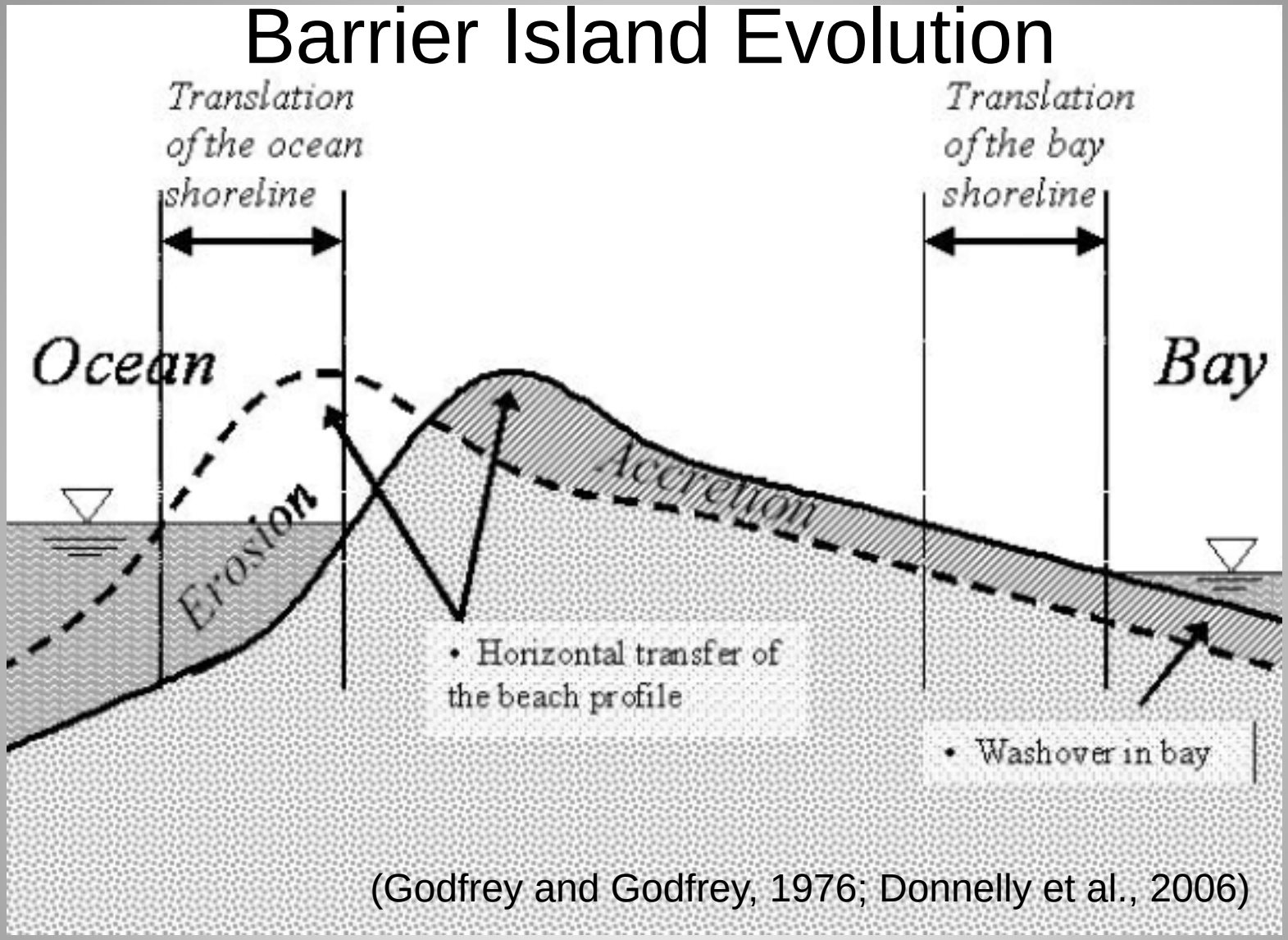
Named storms within 50 miles of Cape Hatteras (~100)

- Long, destructive hurricane history
- Most frequent storms are Nor'easters
- Sea-level rise (~4 mm/yr and likely to increase)



(NOAA, 2016)

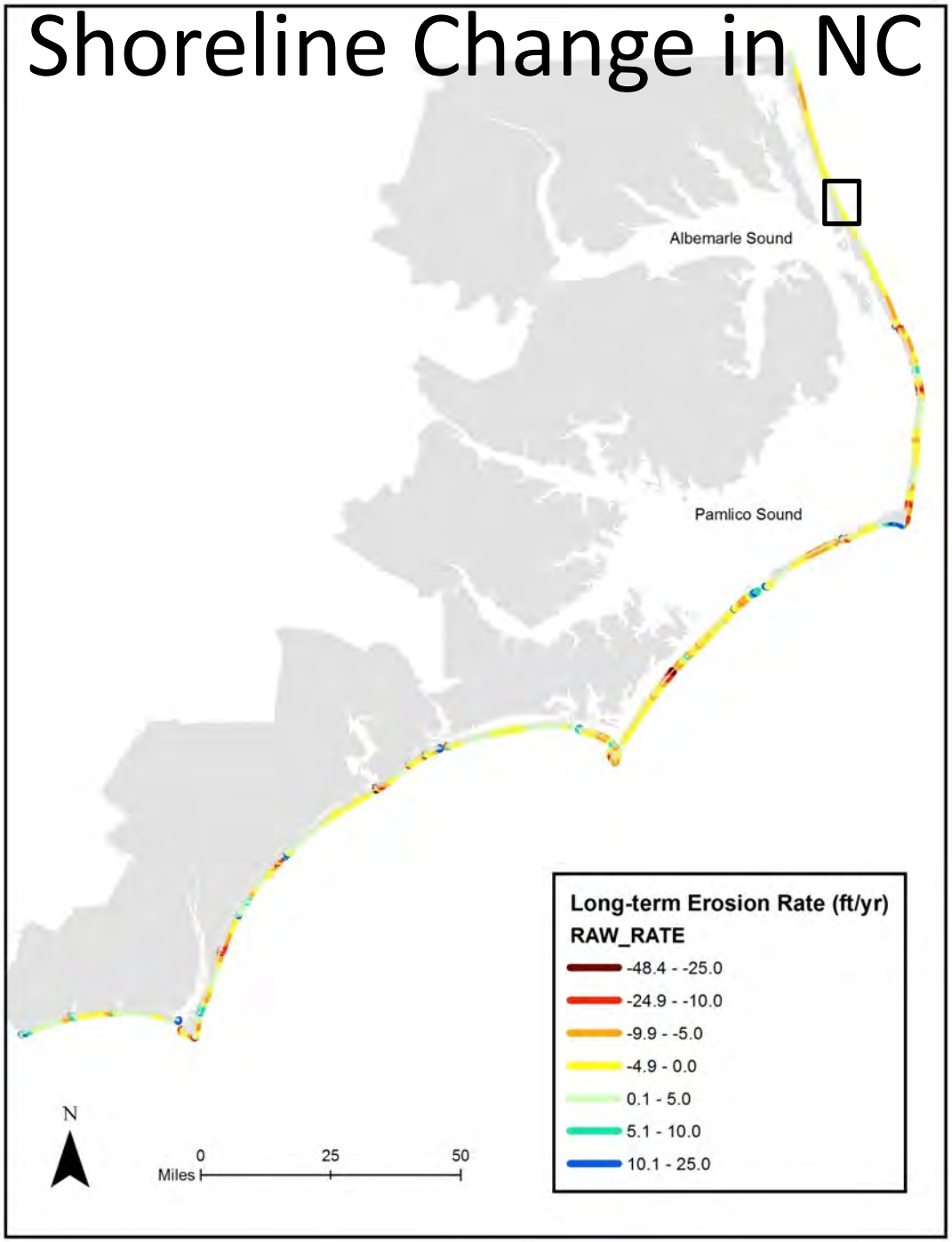
Barrier Island Evolution

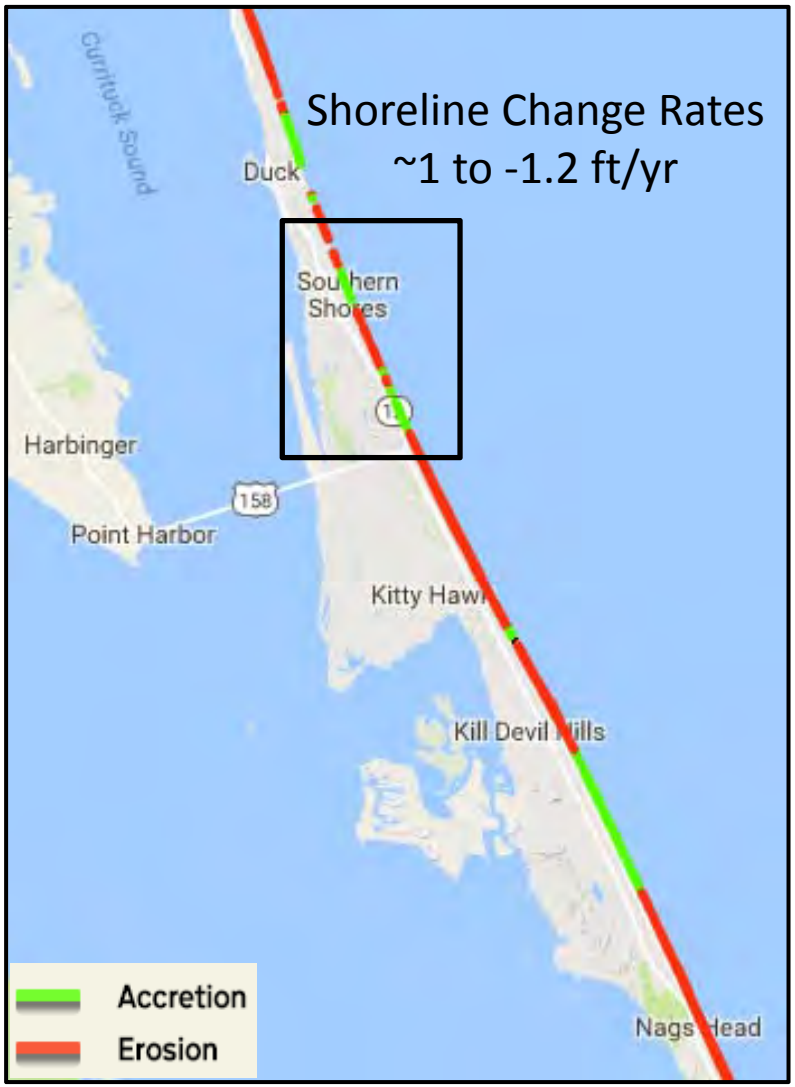


(Godfrey and Godfrey, 1976; Donnelly et al., 2006)

- Beach and dune volume change
- Vertical island growth and back-barrier accumulation
- **Long-term landward island migration and preservation**

Shoreline Change in NC



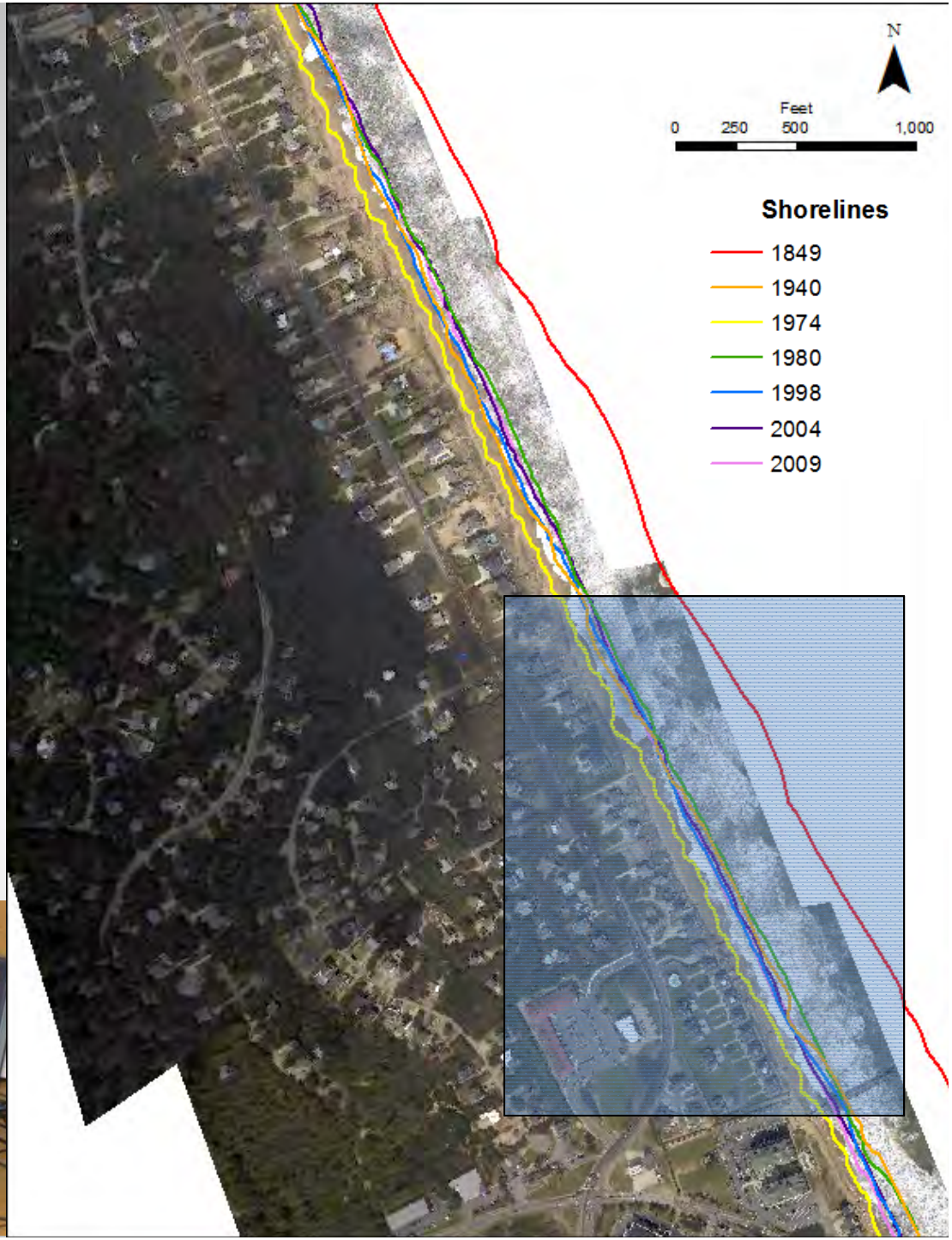


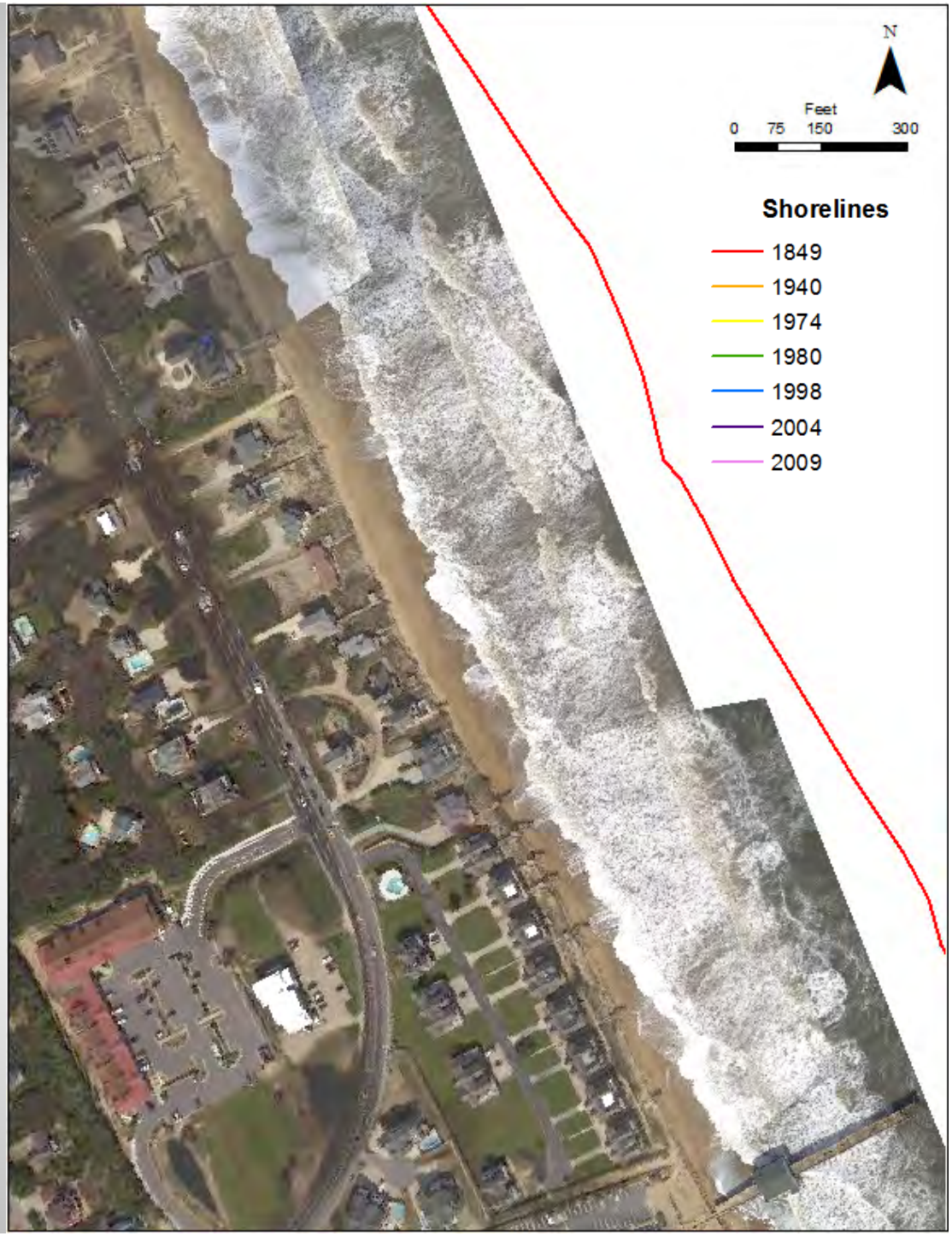
Atlantic-side Erosion Rates
"Long-term Rate"
~50 years

NC Division of Coastal Management

Historic Shorelines
Southern Shores

- Base map – 2016 Post Mathew
- Colored lines represent digitized shoreline from the year noted
- Shoreline is digitized manually based on the wet/dry line using georeferenced aerial photographs

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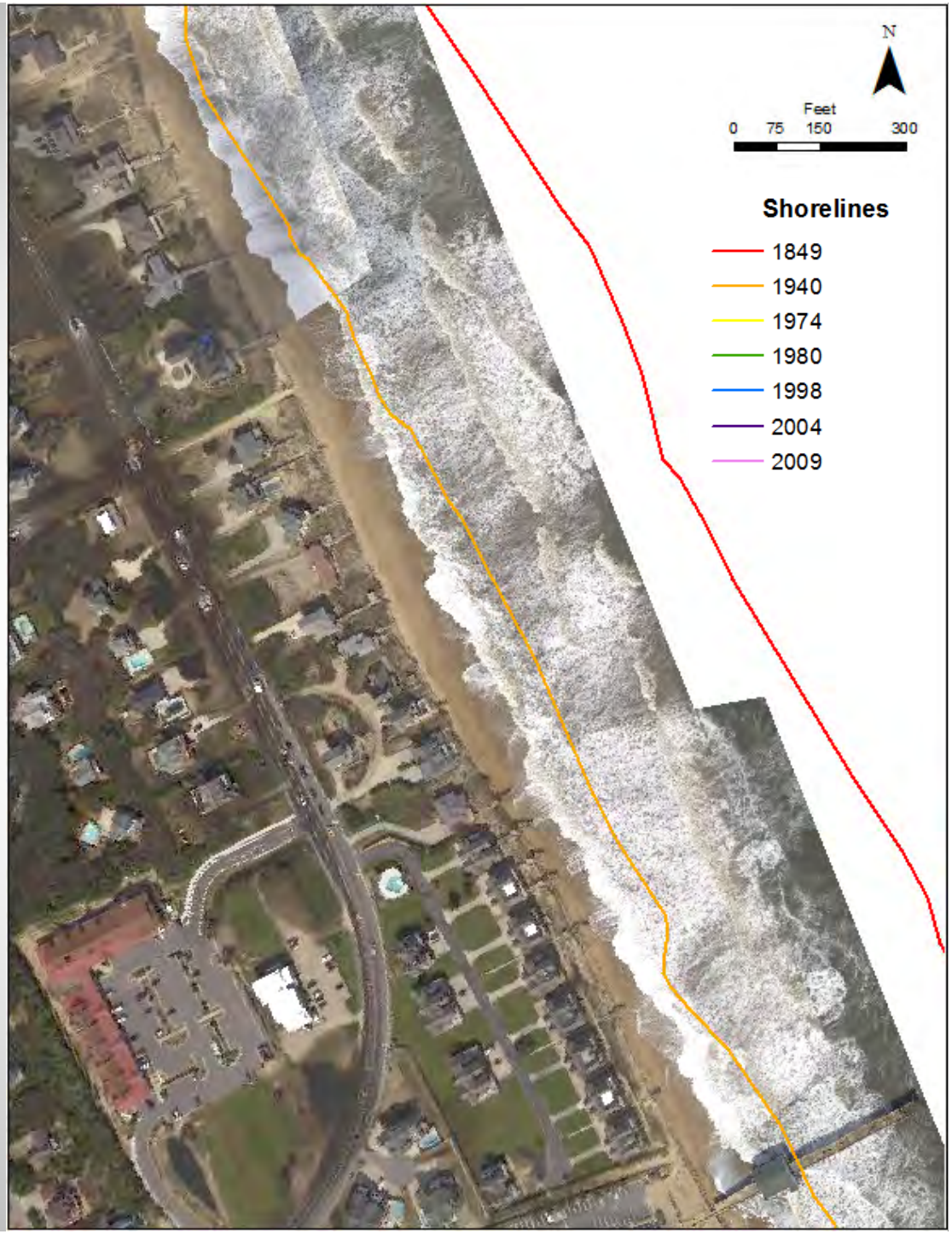
Feet
0 75 150 300
Shorelines
1849
1940
1974
1980
1998
2004
2009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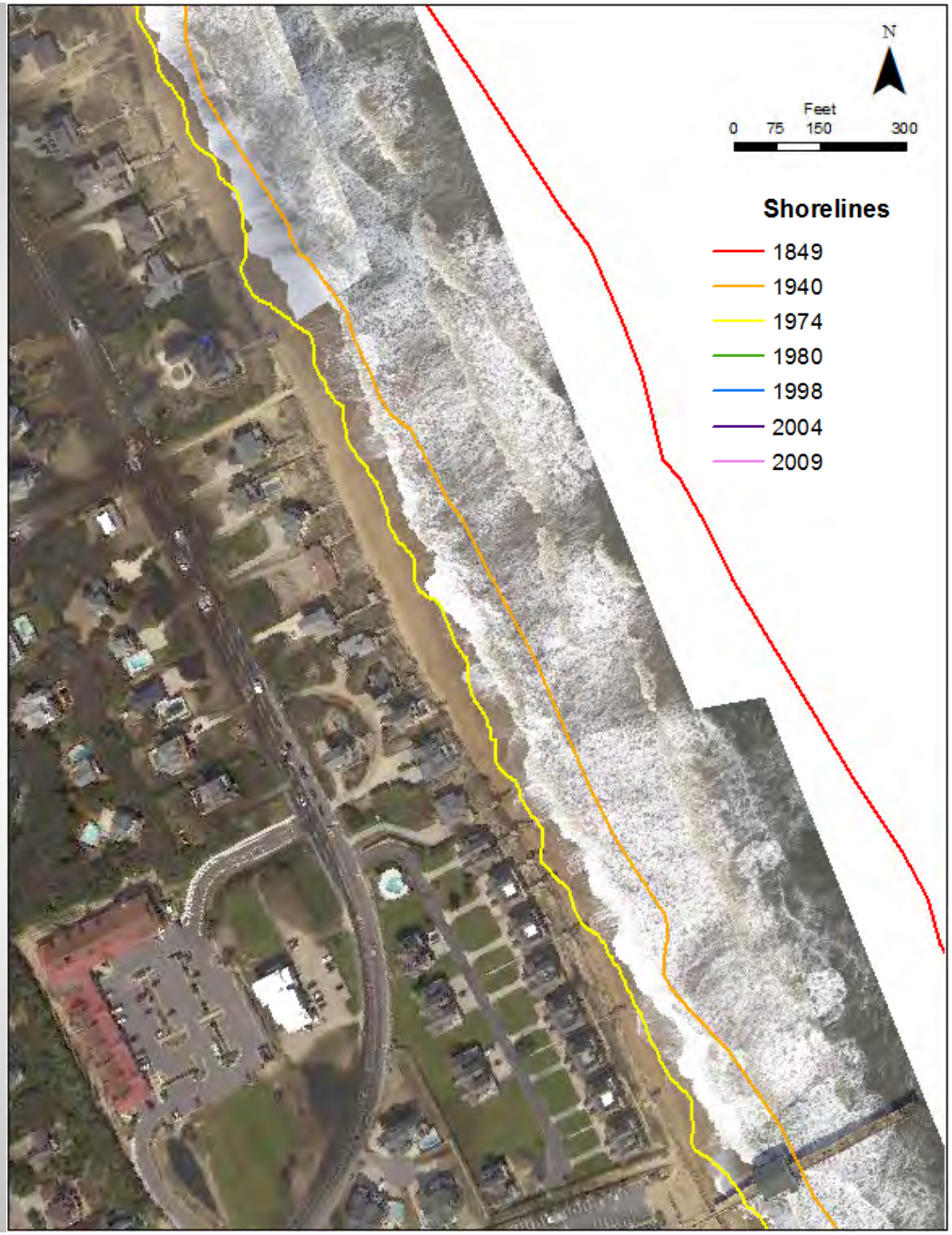
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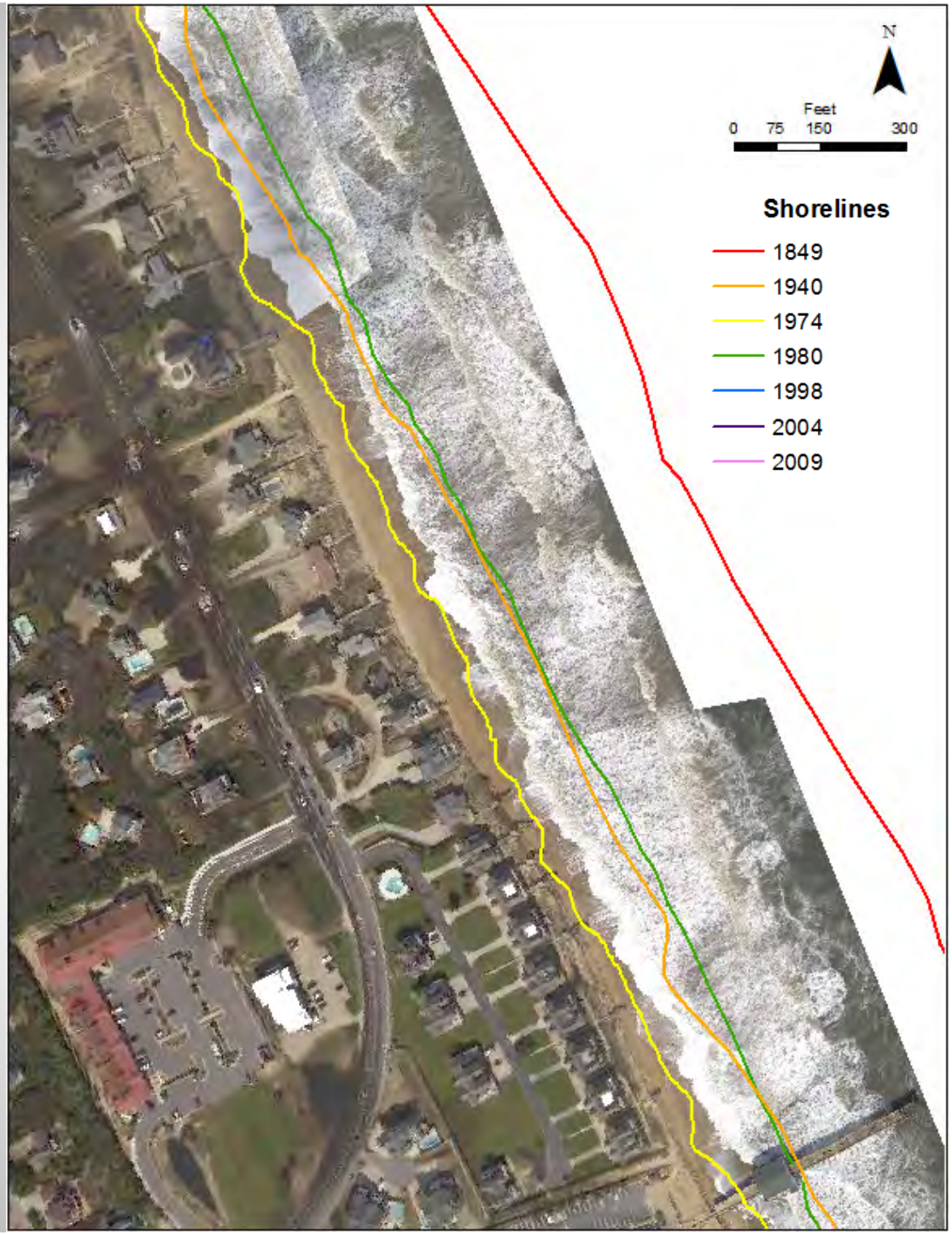
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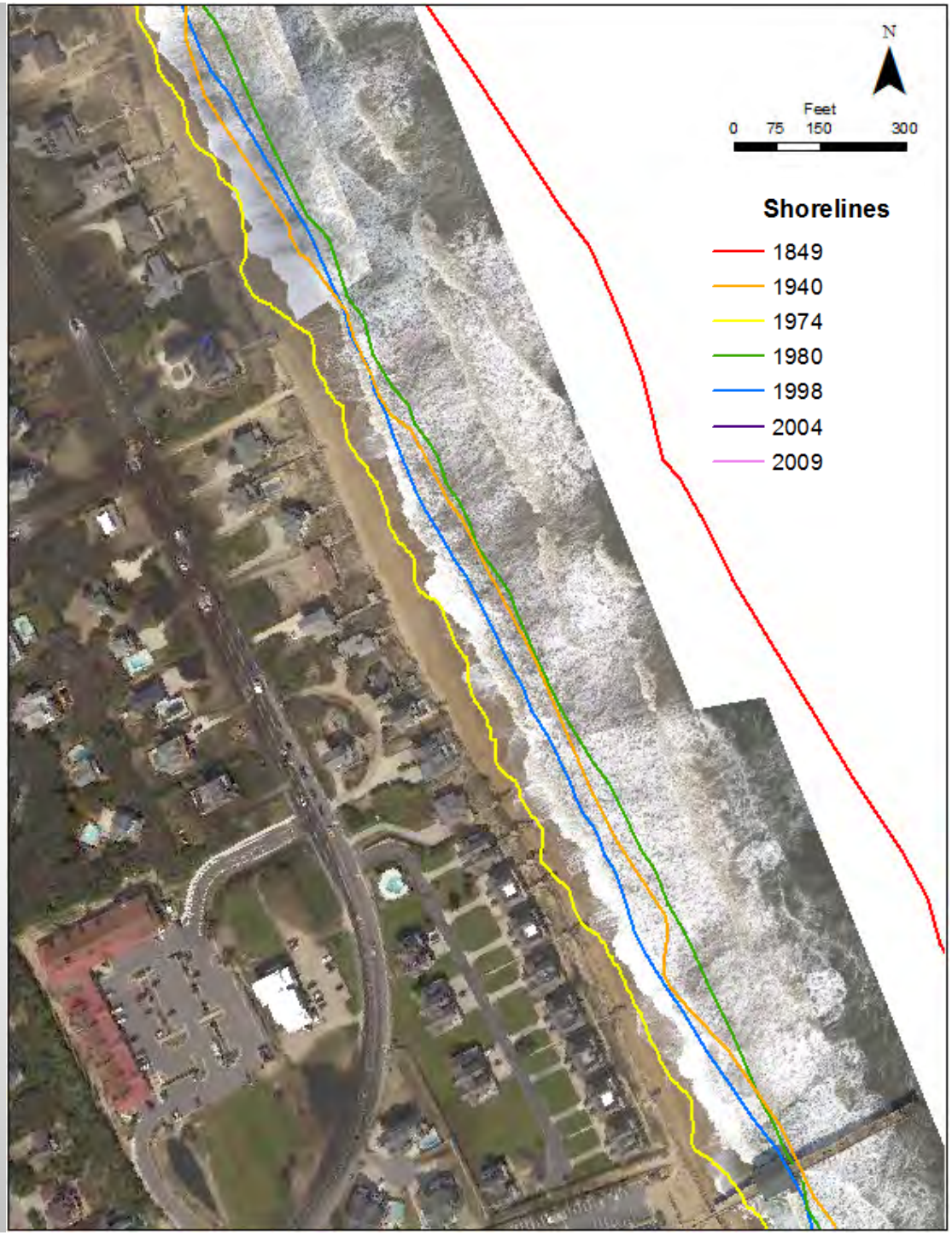
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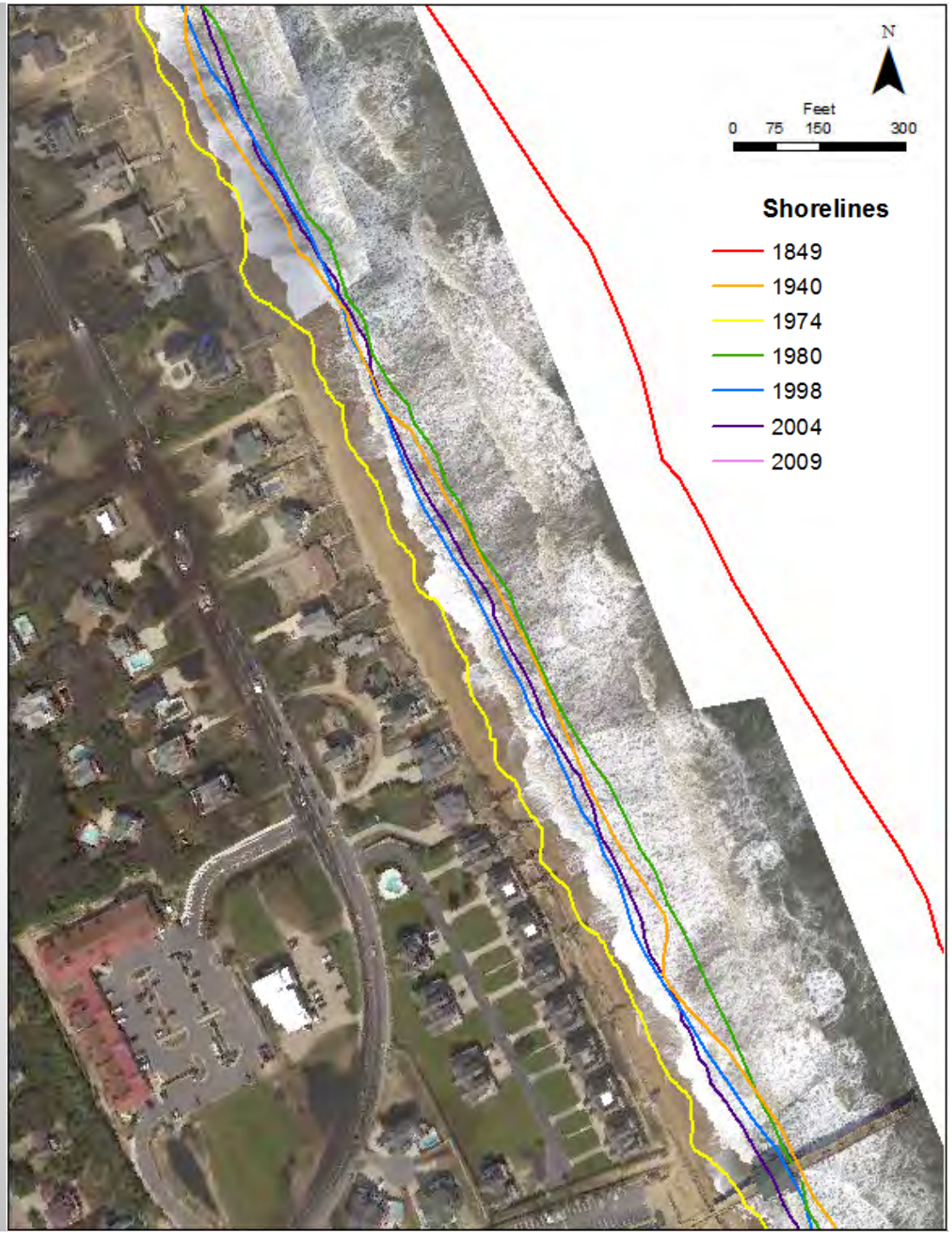
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Post Mathew Shoreline (2016)

- Erosion of dune
- Likely to see some recovery

Rates of Erosion (ft/yr)

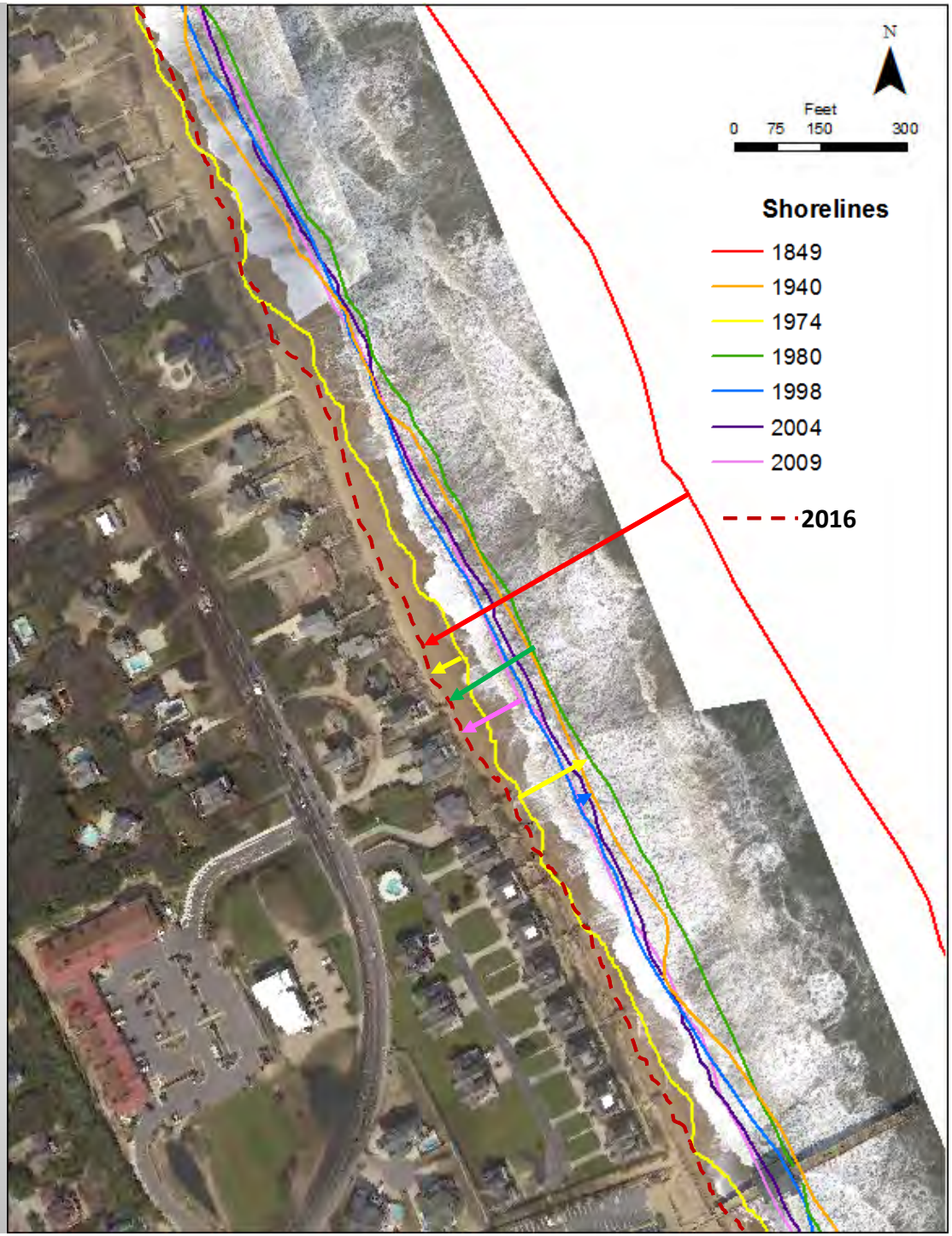
- 1849-2016 3.2
- 1974-2016 1.2
- 1980-2016 5.0
- 2009-2016 17.0

Rates of Accretion (ft/yr)

- 1974-1980 20.0
- 1998-2004 4.0

This region has shown significant shoreline dynamics over the last century, not simply a stable shoreline that has only recently changed.

Storms play an important role!



Example Project - Rodanthe/Pea Island nourishment - Summer 2014

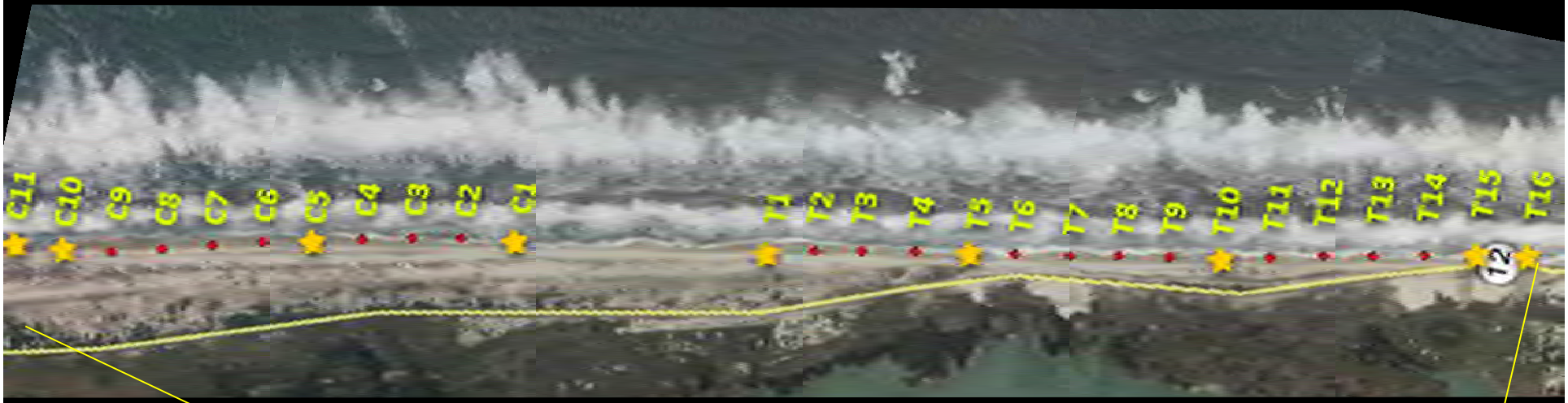
"Provide a 3-year short term level of protection to NC Highway 12 against ocean storm events which currently results in frequent closures… until a long-term solution can be implemented for NC Highway 12 in this location."

- USACE Notice:
SAW-2013-01129

- **~$18 million**
- **11,250 linear feet (~1.5 miles of beach)**
- **1.62 million yds^3**
- **77% in Refuge**

https://youtu.be/FQ5tm1Bwhz8

USFWS Nourishment Study – Pea Island



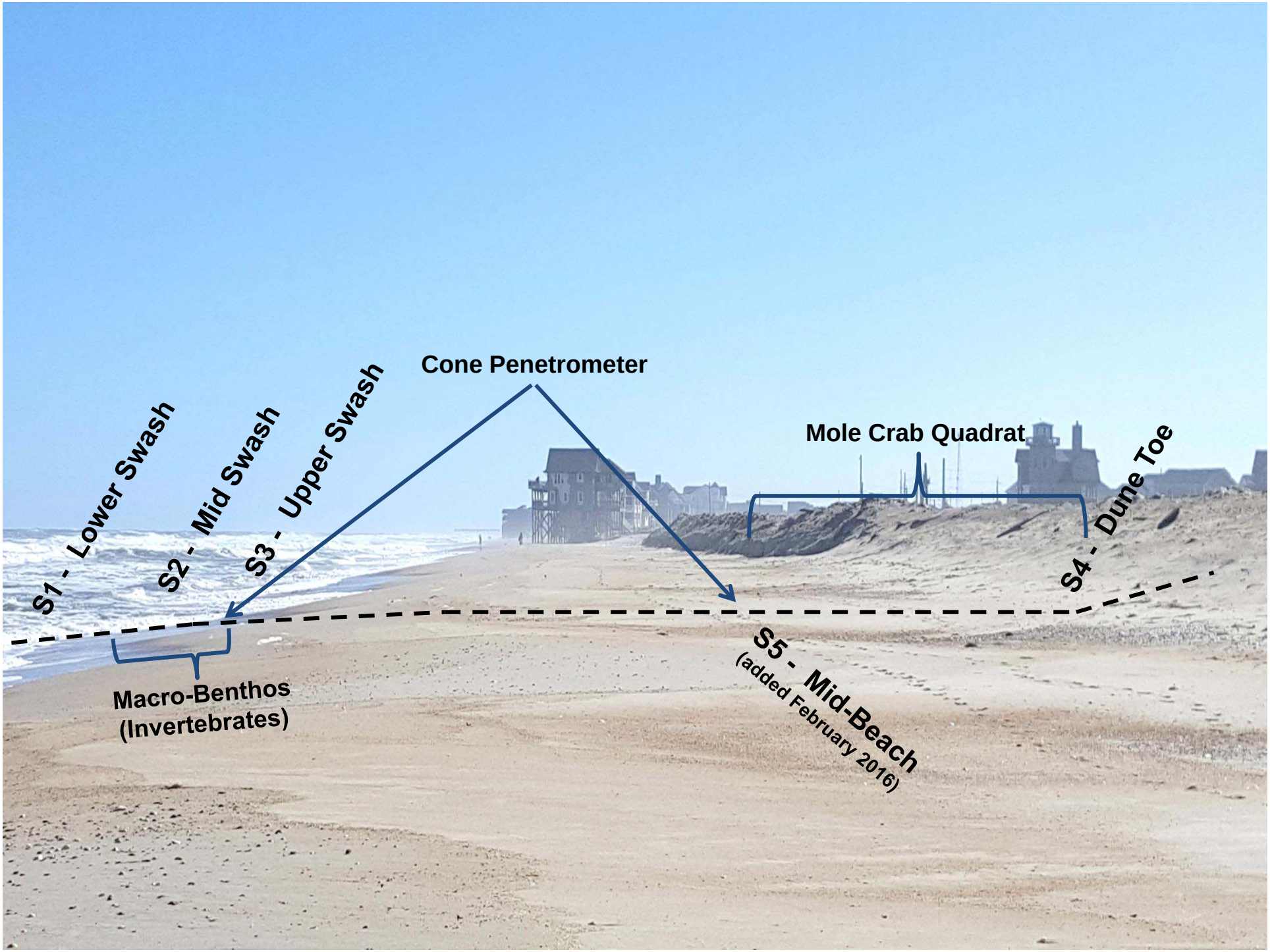
EXAMPLE STUDY

Key Questions for the Study

- **Are there differences sediment (i.e., grain size, heavy mineral content, compaction) between the control and nourished areas?**

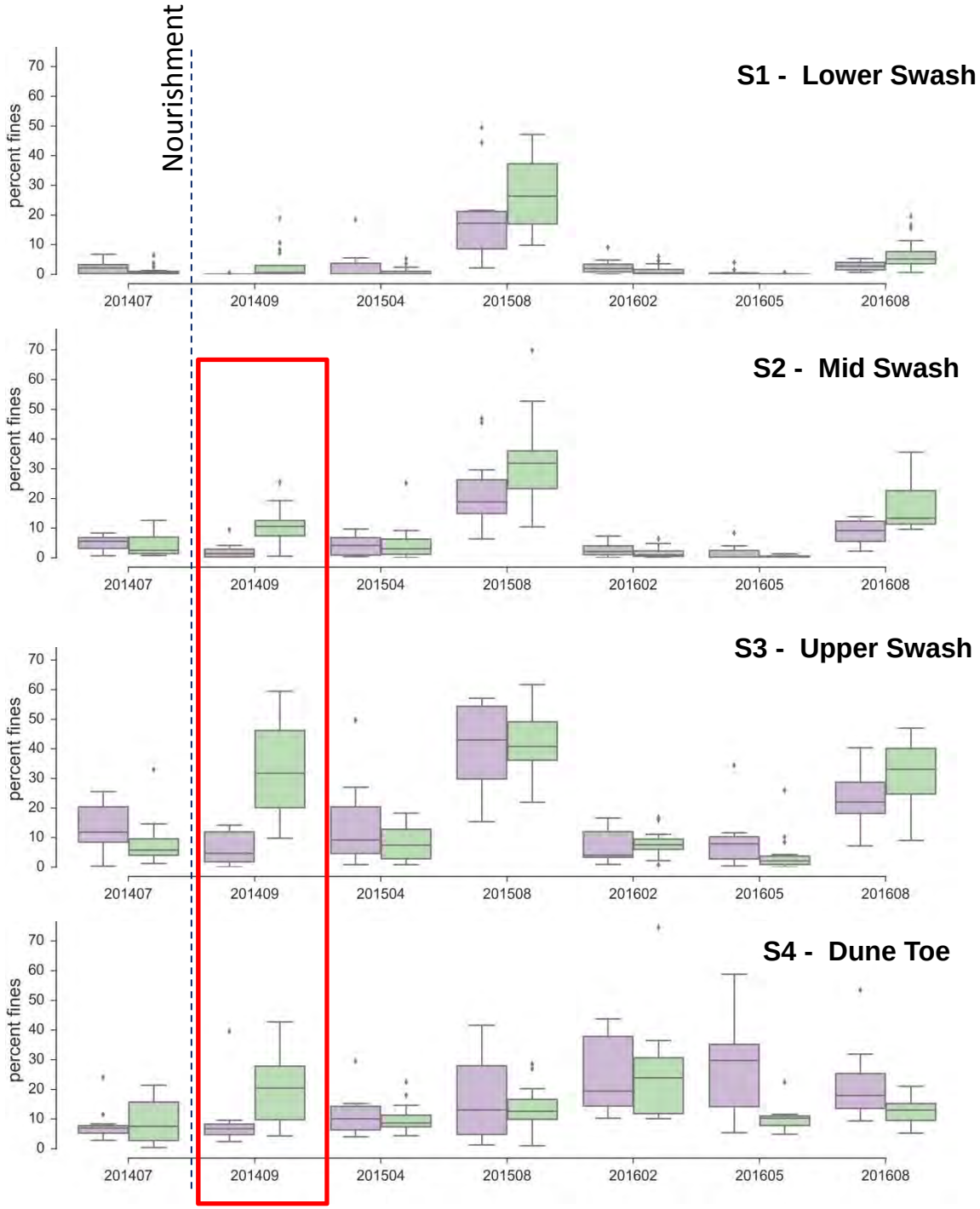
- **Did nourishment have an impact on the distribution of swash zone macro-invertebrates (i.e., coquina, amphipod, polychaete) and ghost crabs?**

- **Is there "recovery" of the sediment and biological community following the nourishment?**


S1 - Lower Swash
S2 - Mid Swash
S3 - Upper Swash
Cone Penetrometer
Mole Crab Quadrat
S4 - Dune Toe
Macro-Benthos
(Invertebrates)
S5 - Mid-Beach
(added February 2016)

Time Series
Control vs. Treatment

% ~Fine Sand



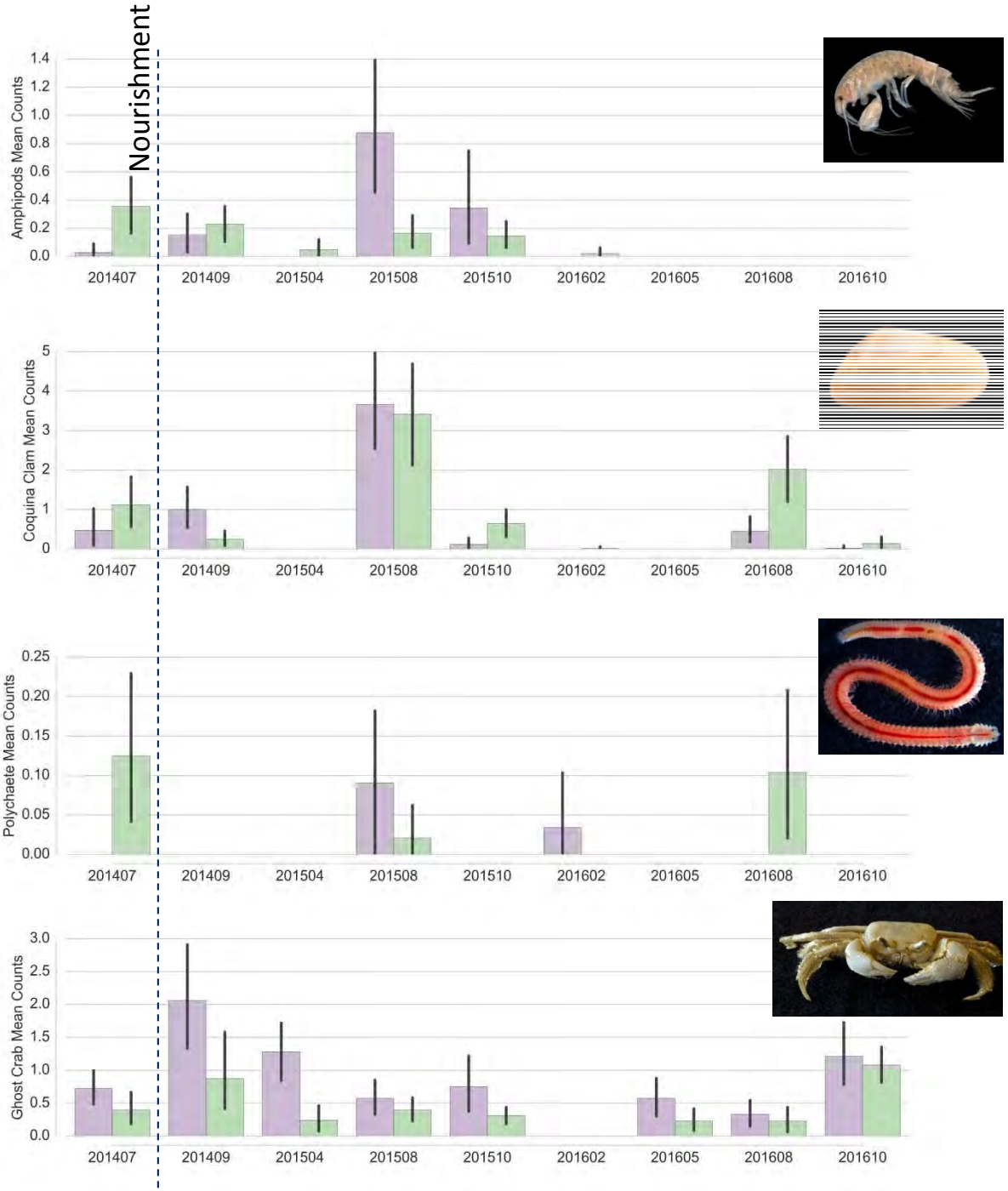
Control Group

Treatment Group

Gravel Fraction ≤ -1ø

Fines Fraction ≥ 2.5ø

Biological Counts Mean (+/- 1 SD)



Preliminary Assessment

- Are there differences sediment (i.e., grain size, heavy mineral content, compaction) between the control and nourished areas?
  - Yes, although maybe not lower swash
- Did nourishment have an impact on the distribution of swash zone macro-invertebrates and ghost crabs?
  - Yes (coquina, ghost crabs), no others.
  - However, lack of significant data prior
- Is there "recovery" of the sediment and biological community following the nourishment?
  - **Sediments show quick recovery**.
  - No significant difference between control and treatment. However, there is limited data prior to project.

- **Compatibility of material is a important parameter to consider.**
  - **Good match for this project.**
- **Timing of the project is critical to recovery of macro-invertebrates.**
  - **Difficult for OBX**

Summary

- Coastal Shoreline Dynamics
  - **Shoreline 'Reality Check'**
    - Based on best available data, the shoreline along the southern-end of Southern Shores is an dynamic as much of the OBX.
    - Timeframe of evaluation is critical (short- vs. long-term rates)
      - *rates ranged from +20 to -17 ft/yr*
    - Likely to see same sort of dynamics in future
  - **Influence of nourishment**
    - Sand compatibility and timing of placement are critical for a "successful" nourishment project