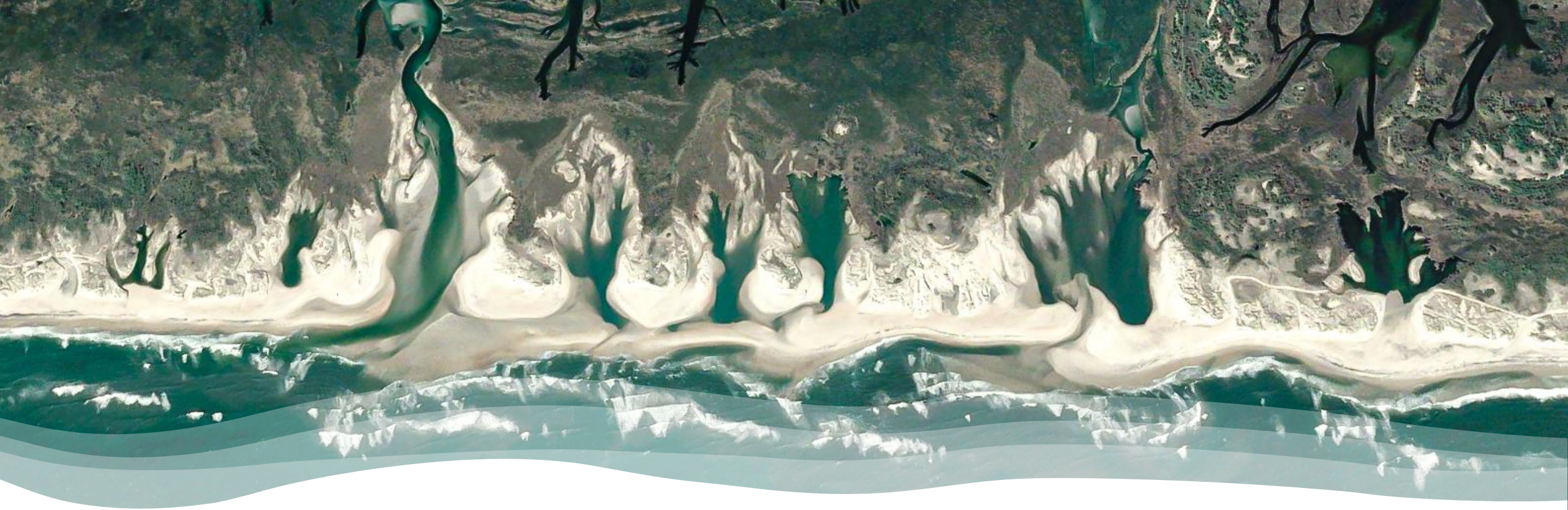




Long-Term Average Annual Erosion Rate & Setback Factor Updates: Oceanfront & Inlets

Ken Richardson - NC Division of Coastal Management

August 28, 2025

Why NC Calculates Erosion Rates

1

Update Ocean Hazard Area Erosion Rates & Setback Factors (SBF)

2

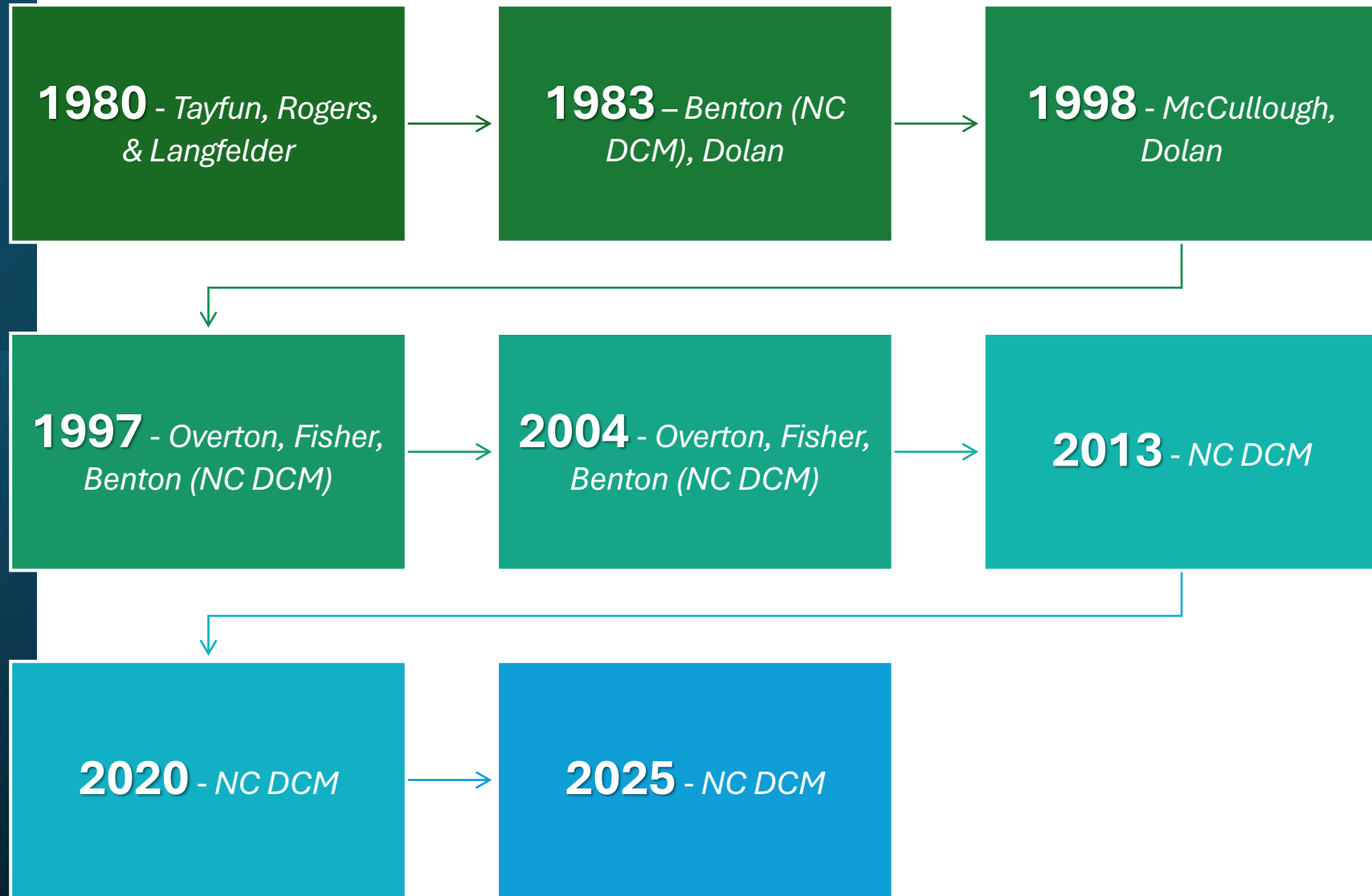
Update Ocean Erovable Area (OEA)

3

FEMA National Flood Insurance Program (NFIP)

- Community Rating System (CRS) Credits (50 points)

North Carolina's Erosion Rate Studies (1980-2025)



Calculating Erosion Rates

Transects

- Shore-Perpendicular
- 10,000+ (spaced 50-meters)

Shoreline Data

- Wet-Dry
- MHW (LiDAR & NOST-Sheet)

Analytical Tools:

- Geographic Information System (GIS)
- USGS's Digital Shoreline Analysis System (DSAS)

Statistical Processing

- Calculate Rates
- Statistical Smoothing: 17-Point Running Average
- Blocking



Mapping Shorelines

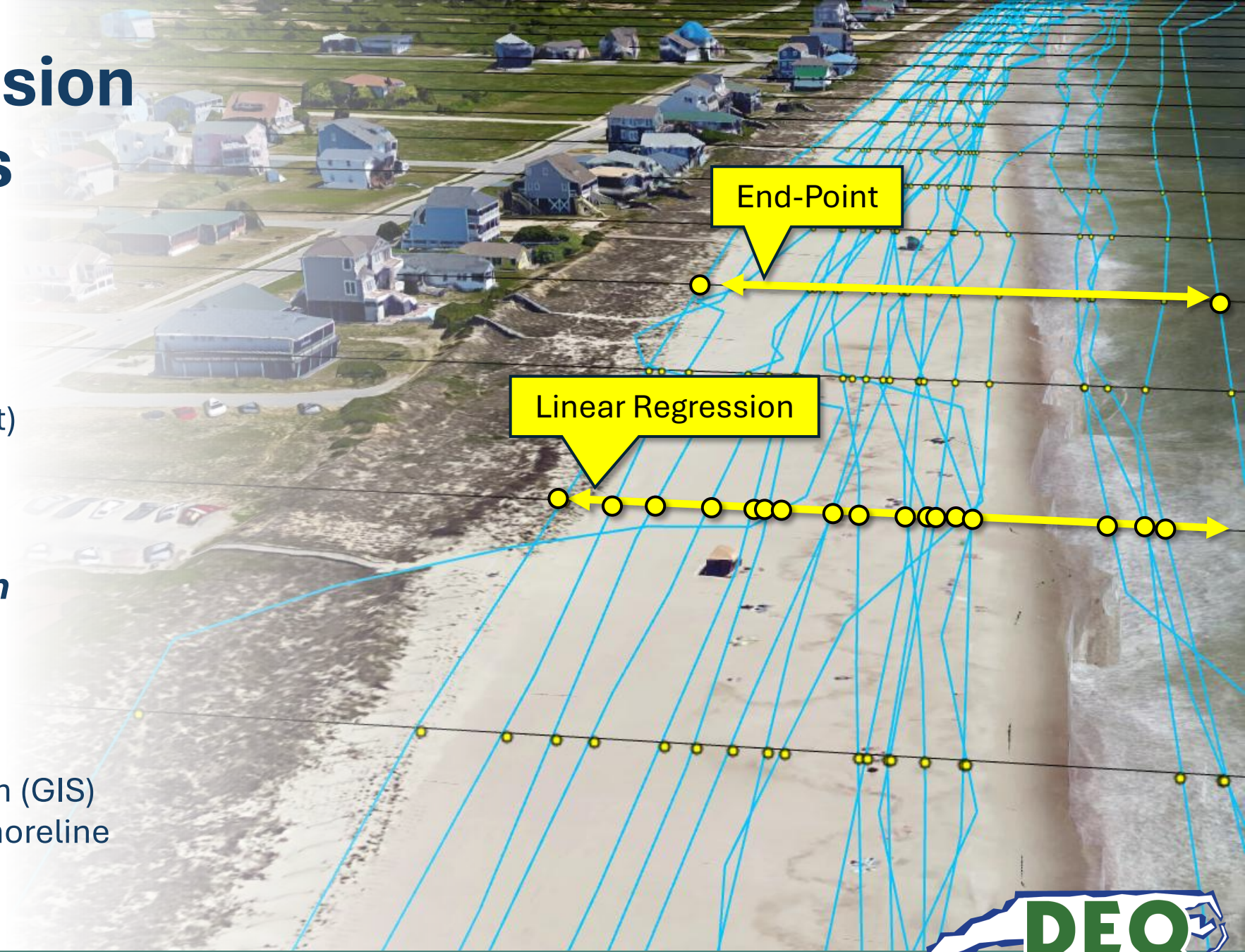
- **Wet-Dry**
 - Imagery
 - 1940s to Present Day
- **Mean High Water (MHW)**
 - NOS T-Sheet 1930s & 1940s (“Early”)
 - LiDAR (1997)

Calculating Erosion Rates: Methods Comparison

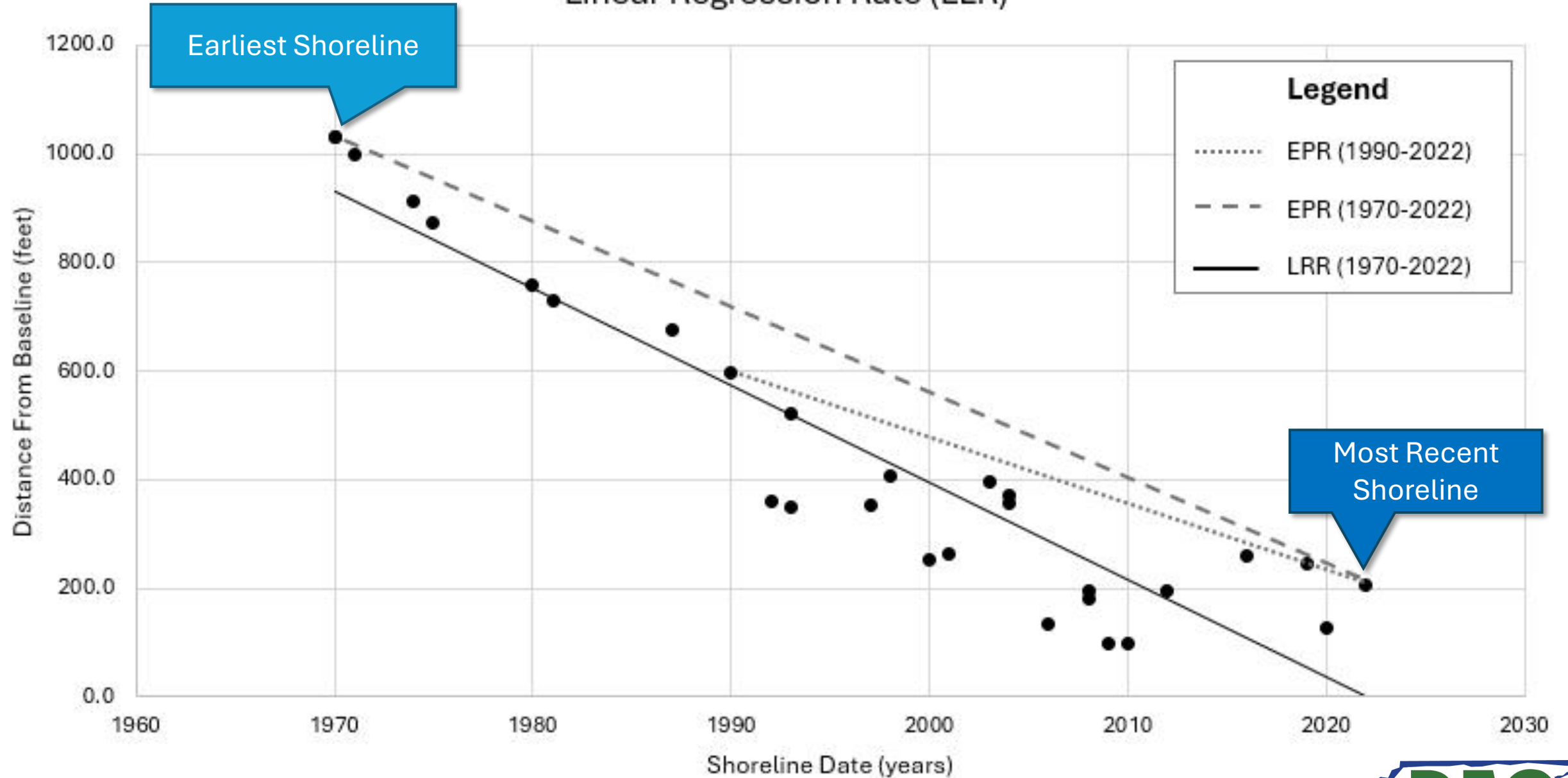
- **End-Point**
 - 2 Shorelines (early& recent)
 - Rate = Distance/Time
 - Used since 1979 study
- **Least Squares Regression (Linear Regression)**
 - Multiple Shorelines

Analytical Tools:

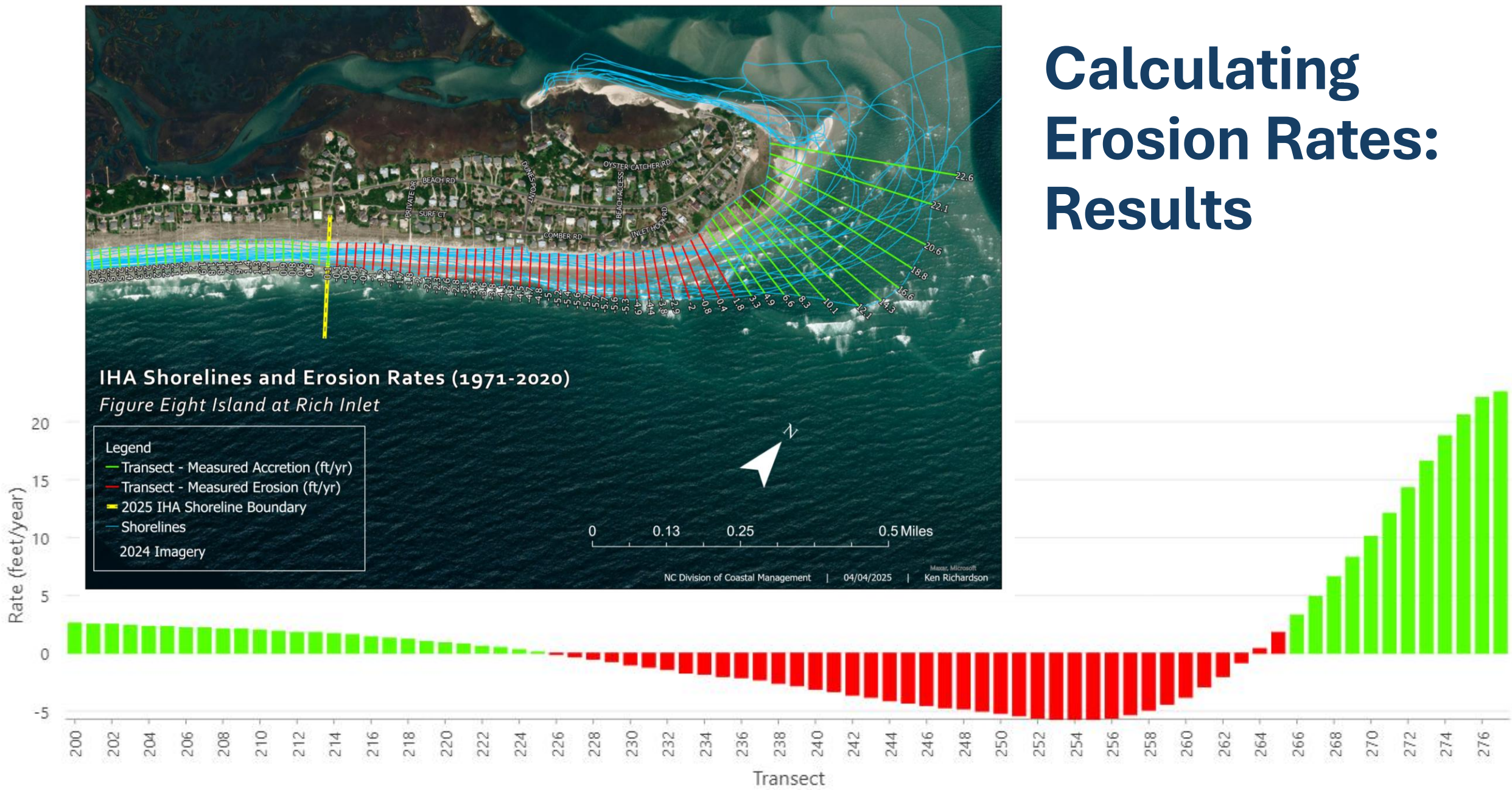
- Geographic Information System (GIS)
- US Geologic Survey's Digital Shoreline Analysis System (DSAS)



Linear Regression Rate (LLR)



Calculating Erosion Rates: Results





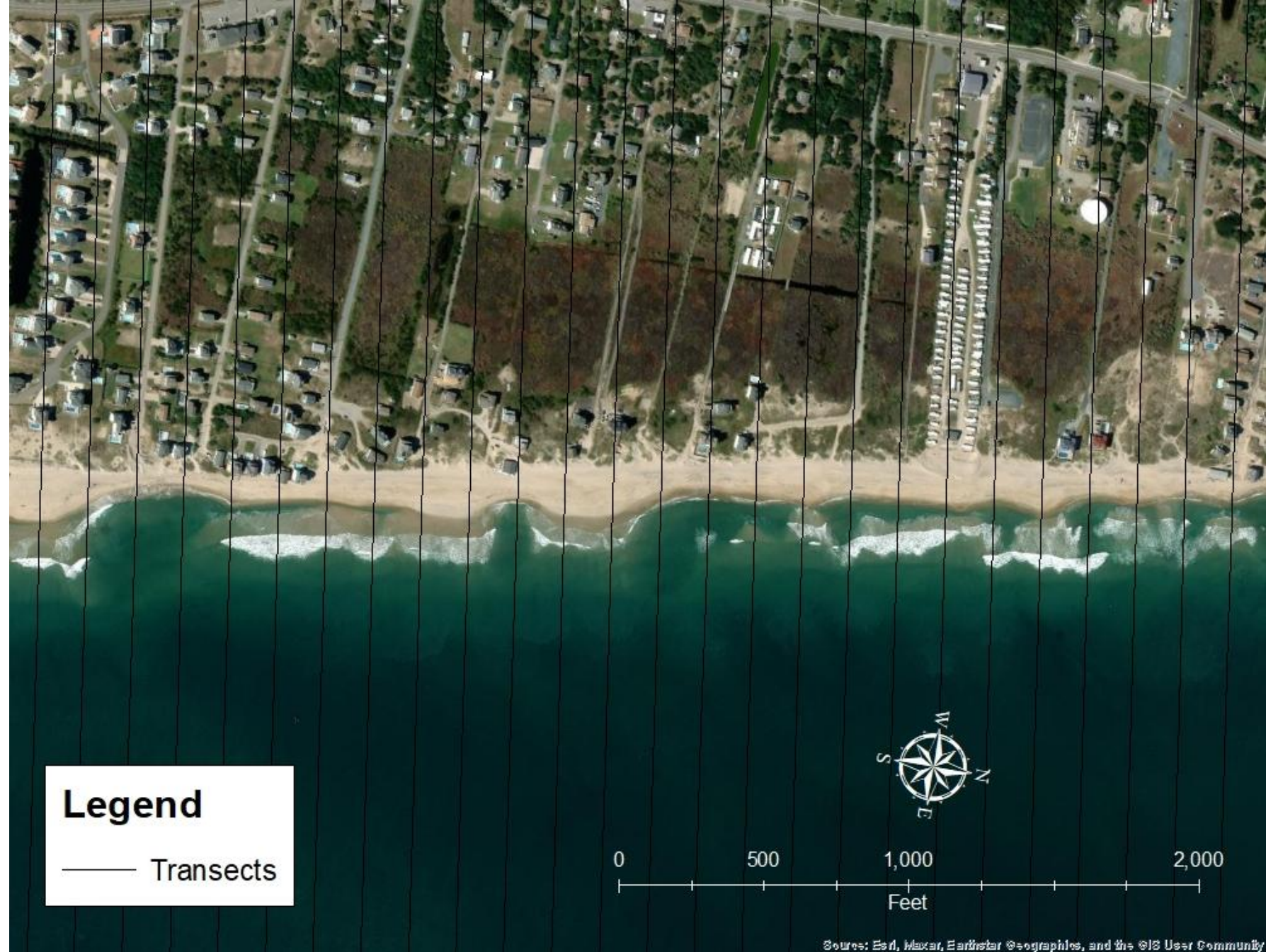
Erosion Rates to Setback Factors

Data Processing:

- Raw data statistical smoothed
 - 17-Point Running Average
- Block smoothed data
- Where parcels are split, shift boundary in favor of lower value

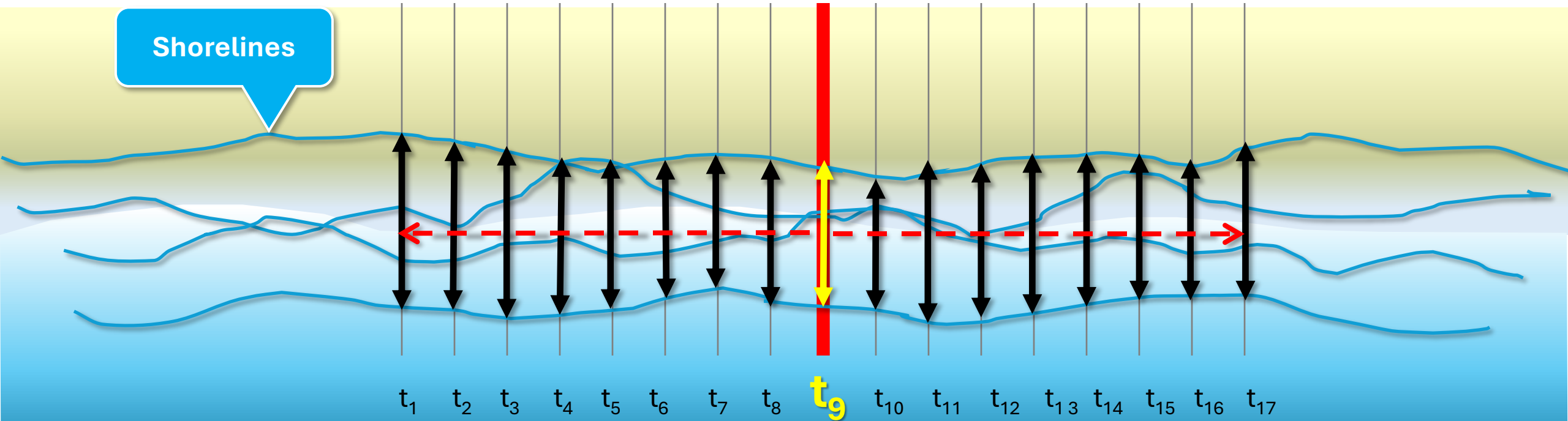
Why Smooth Raw Data?

Statistical smoothing helps filter out the influence of beach cusps, smaller sand waves, and landward-migrating segments of offshore bar systems

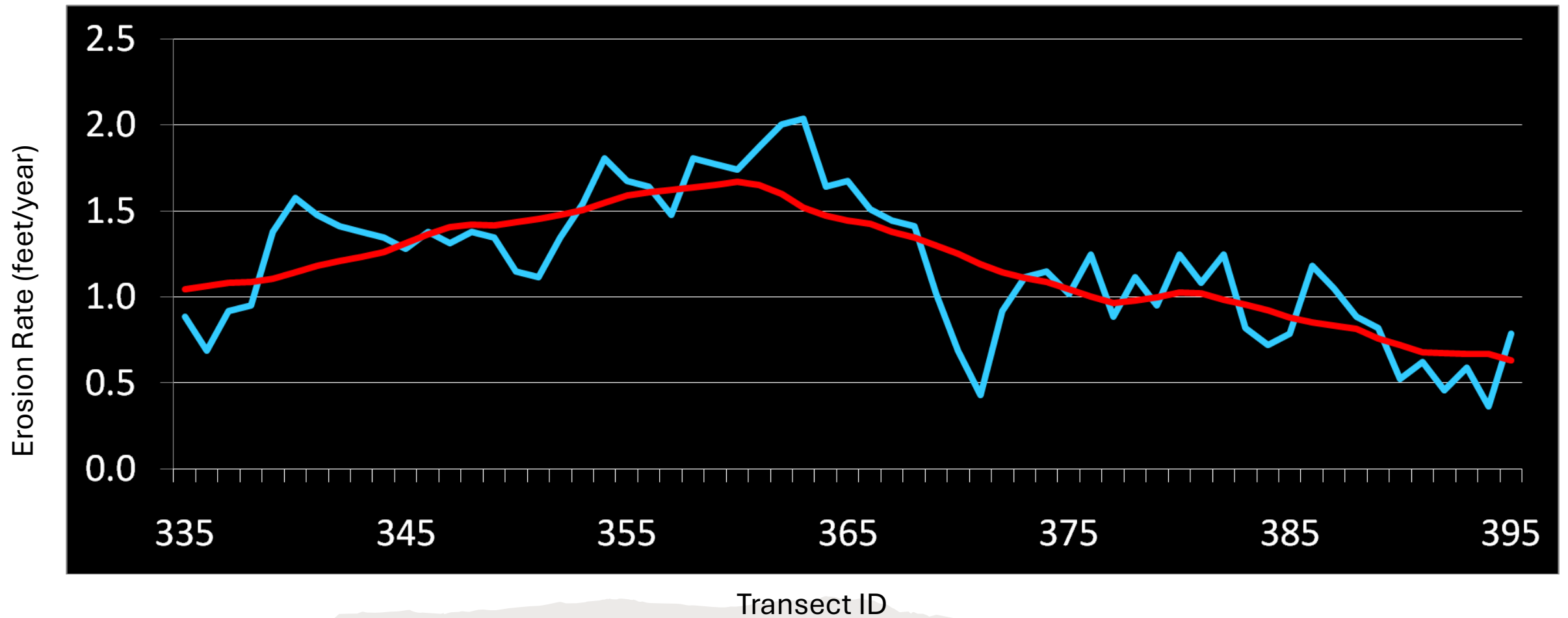


Smoothing Raw Erosion Rate Data

Rate at each transect is averaged with 8 transects on left and right, for a total of 17 points averaged



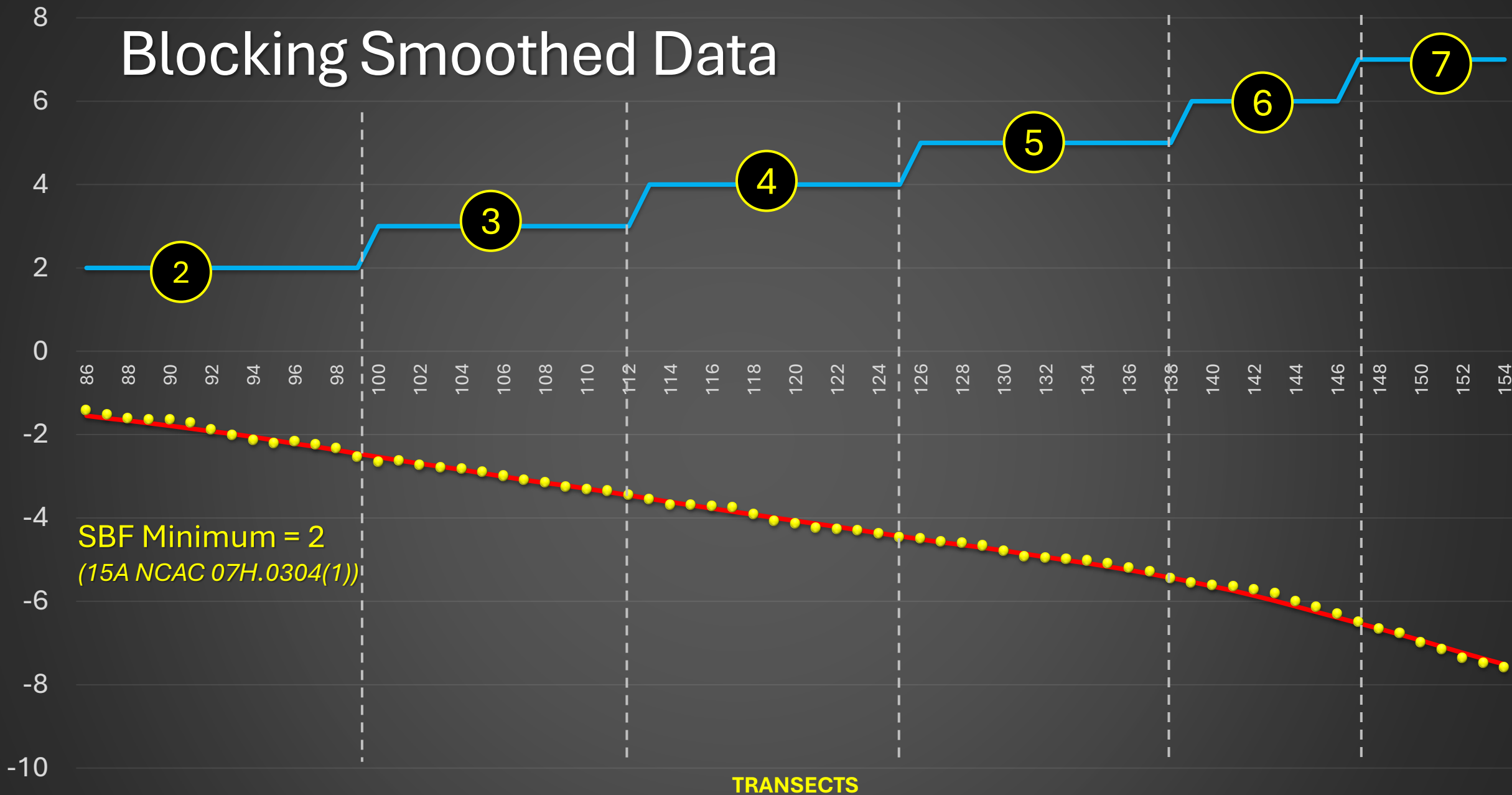
$$t_9 \text{ Rate}_s = 1/n \sum_{i=1}^n t_i = 1/n(t_1 + t_2 + t_3 + \dots + t_n)$$



Smoothing Raw Erosion Rate Data

Blocking Smoothed Data

EROSION RATE (FEET/YEAR)



• Rate (raw) — Rate (smooth) — Rate (blocked)

Before

SBF = 2

SBF = 3

SBF = 2

SBF = 3

After

SBF = 2

SBF = 3

SBF = 2

SBF = 3

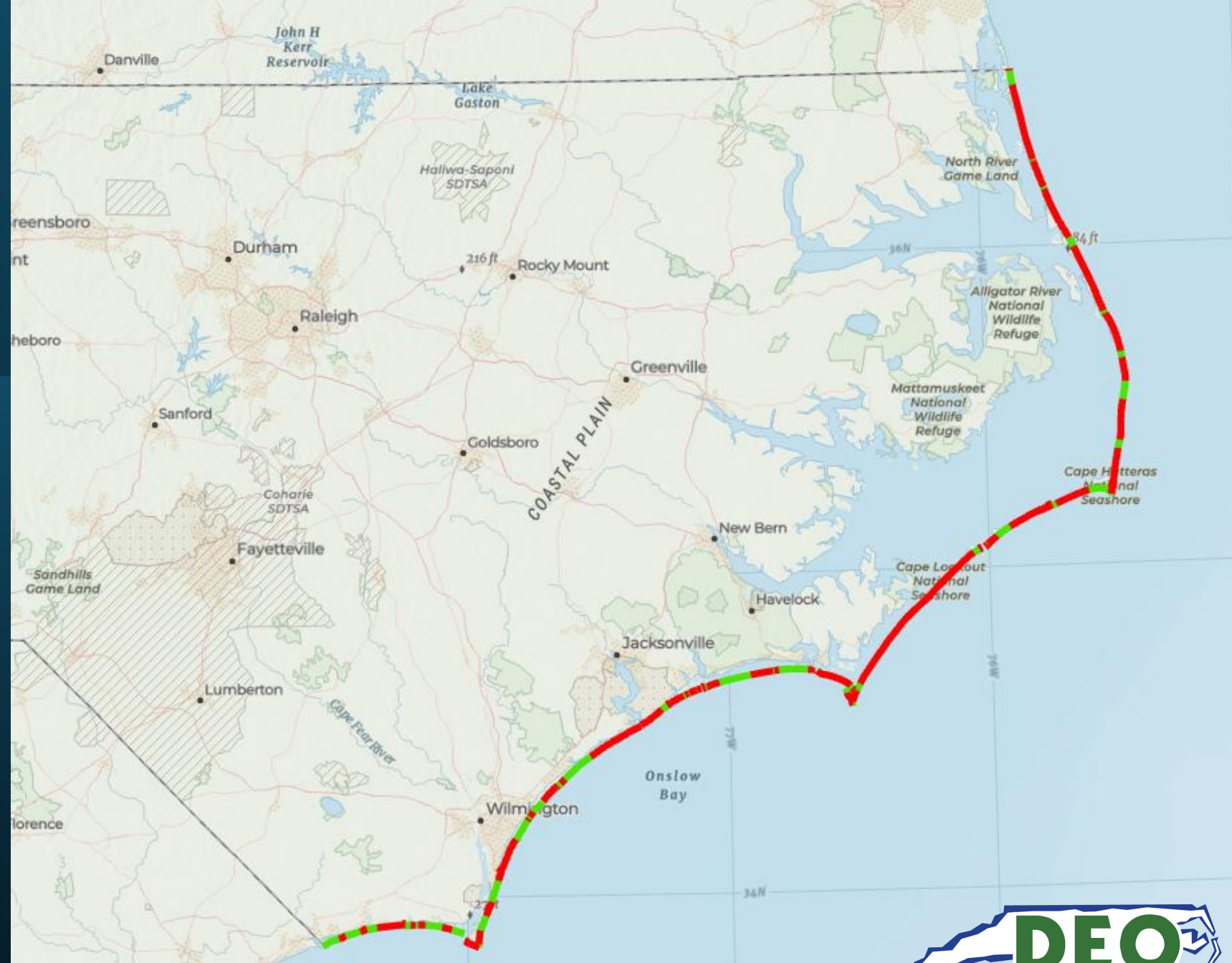
Setback Factor Transition Boundaries

Where two blocked boundaries meet and divide a property or parcel, the lower of the two blocked rates is applied in the direction of the higher rate, giving the property owner the benefit of the lower rate

Results Summary

Ocean Erodible Area (OEA)

- ~ 318 Miles of Oceanfront Shoreline Mapped and Analyzed
- 10,232 Transects (50-Meter)



Ocean Erodible Area (OEA)

Method
Comparison:

End-Point

vs.

Least Squares
Regression

Parameter	Length of Shoreline per Parameter	
	End-Point Method	Least Squares Regression Method
	<i>Miles of Shoreline (%)</i>	<i>Miles of Shoreline (%)</i>
Miles of Shoreline Mapped & Analyzed	317.8	317.8
Measured Accretion	109 (34.3%)	99.2 (31.2%)
Measured Erosion	208.5 (65.6%)	218 (68.6%)
No Change or No Output (no data)	0.3 (<1%)	0.6 (<1%)
SBF = 2.0	196.8 (61.9%)	193.7 (61%)
SBF = 2.5 to 5.0	63.8 (20.1%)	66.5 (20.9%)
SBF = 5.5 to 8.0	34.1 (10.7%)	33.7 (10.6%)
SBF > 8.0	23.1 (7.2%)	23.8 (7.5%)

Ocean Erodible Area (OEA)

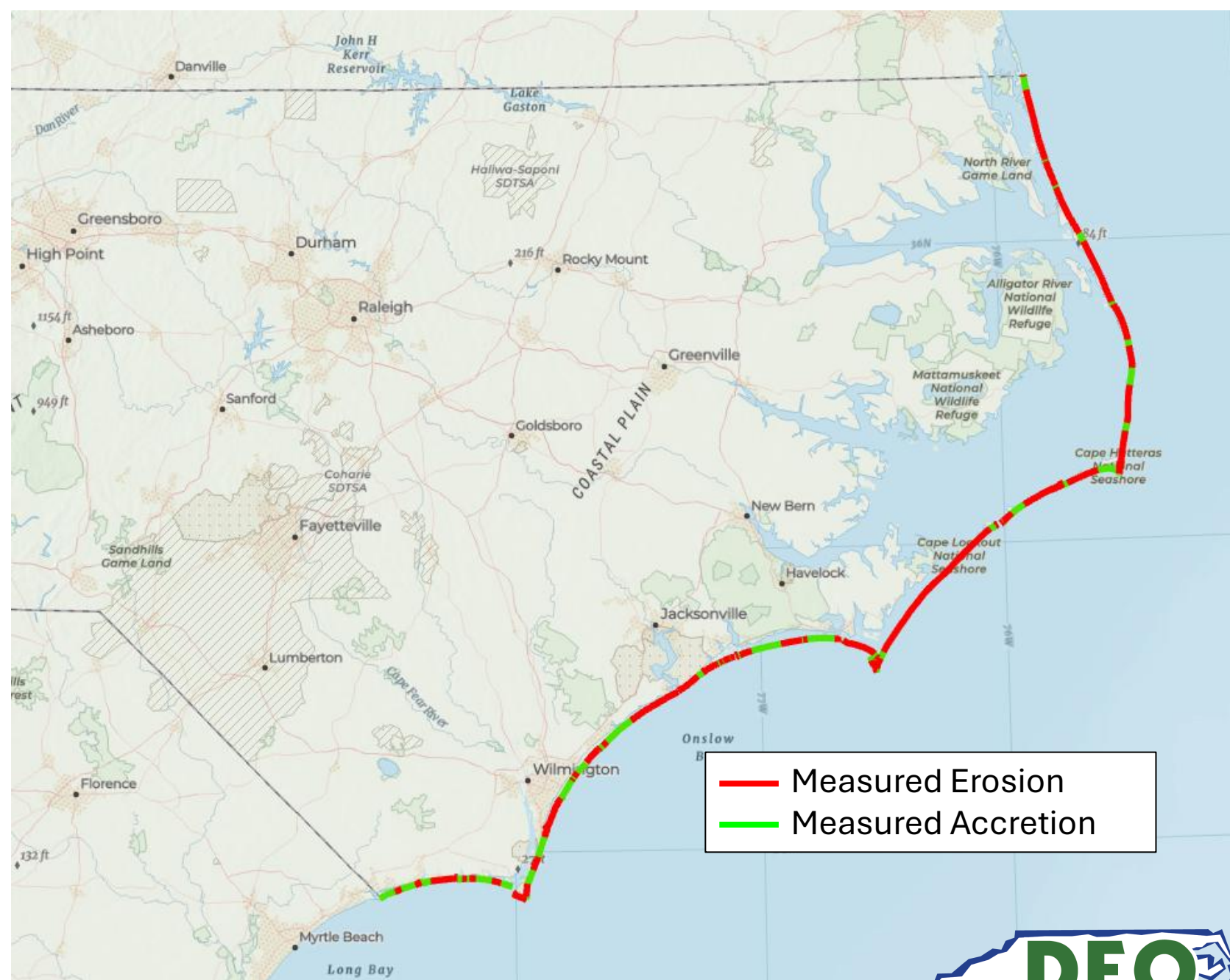
Least Squares Regression Results Compared to Previous Studies

Statewide Summary	2025 Miles %	2020 Miles %	2013 Miles %	2004 Miles %	1997 Miles %	1986 Miles %	1980 Miles %
Miles of Shoreline Mapped/Analyzed	317.8	304.5	307.4	312	300	237*	245*
SBF = 2	193.7 61%	174.6 57.3%	190.2 61.9%	193 62%	165 55%	144 61%	149 61%
SBF = 2.5 to 5.0	66.5 20.9%	67.1 22.1%	62.1 20.2%	64 21%	54 18%	43 18%	52 21%
SBF = 5.5 to 8.0	33.7 10.6%	38.7 12.7%	31.5 10.2%	28 9%	30 10%	20 8%	22 9%
SBF > 8.0	23.8 7.5%	22.7 7.4%	20.8 6.8%	27 8%	32 10.7%	22 9%	22 9%
No Data	0.0	1.4 <0.5%	2.8 <1%	0	19 6%	8 4%	0

Ocean Erodible Area (OEA)

Statewide Erosion Rate Results Summary:

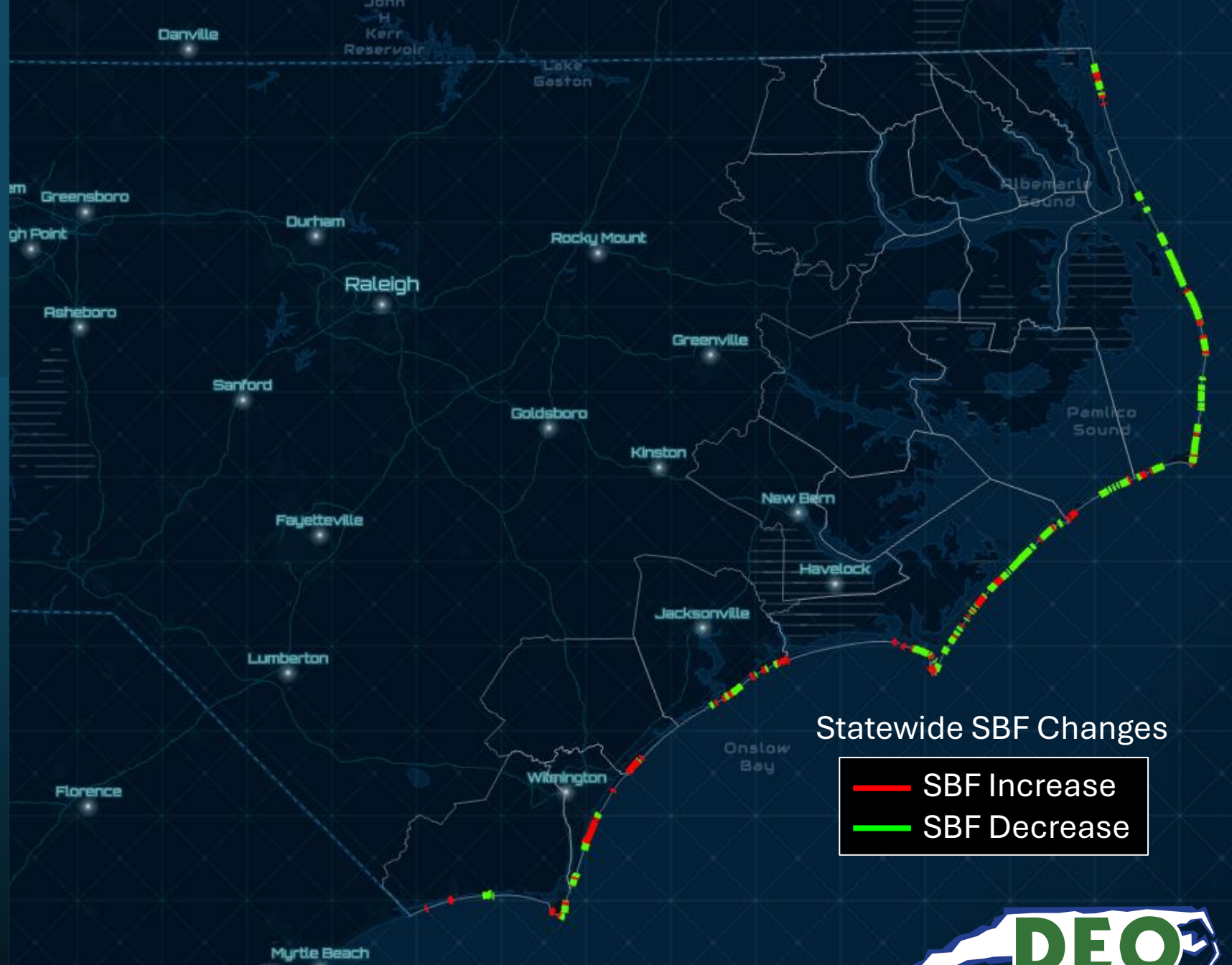
- **Erosion** = 218 miles
 - Avg = -4.2 ft/yr
 - Range = -1 to -234 ft/yr
- **Accretion** = 99 miles
 - Avg. = 3.1 ft/yr
 - Range = +1 to +69 ft/yr
- Statewide Average = -1.9 ft/yr



Ocean Erovable Area (OEA) Erosion Setback Factors (SBF)

Developed Shoreline Only:

- 144.6 Miles (~46% of total)
 - 124.9 miles (86%) = No Change
 - 17.7 miles (12%) = Decreased SBF
 - Range = 0.5 to 3.5
 - 2.0 miles (2%) = Increased SBF
 - Range = 0.5 to 3.5



Statewide SBF Changes

- SBF Increase
- SBF Decrease

Erosion Rate Setback Factors: Increases

Developed Shoreline Areas

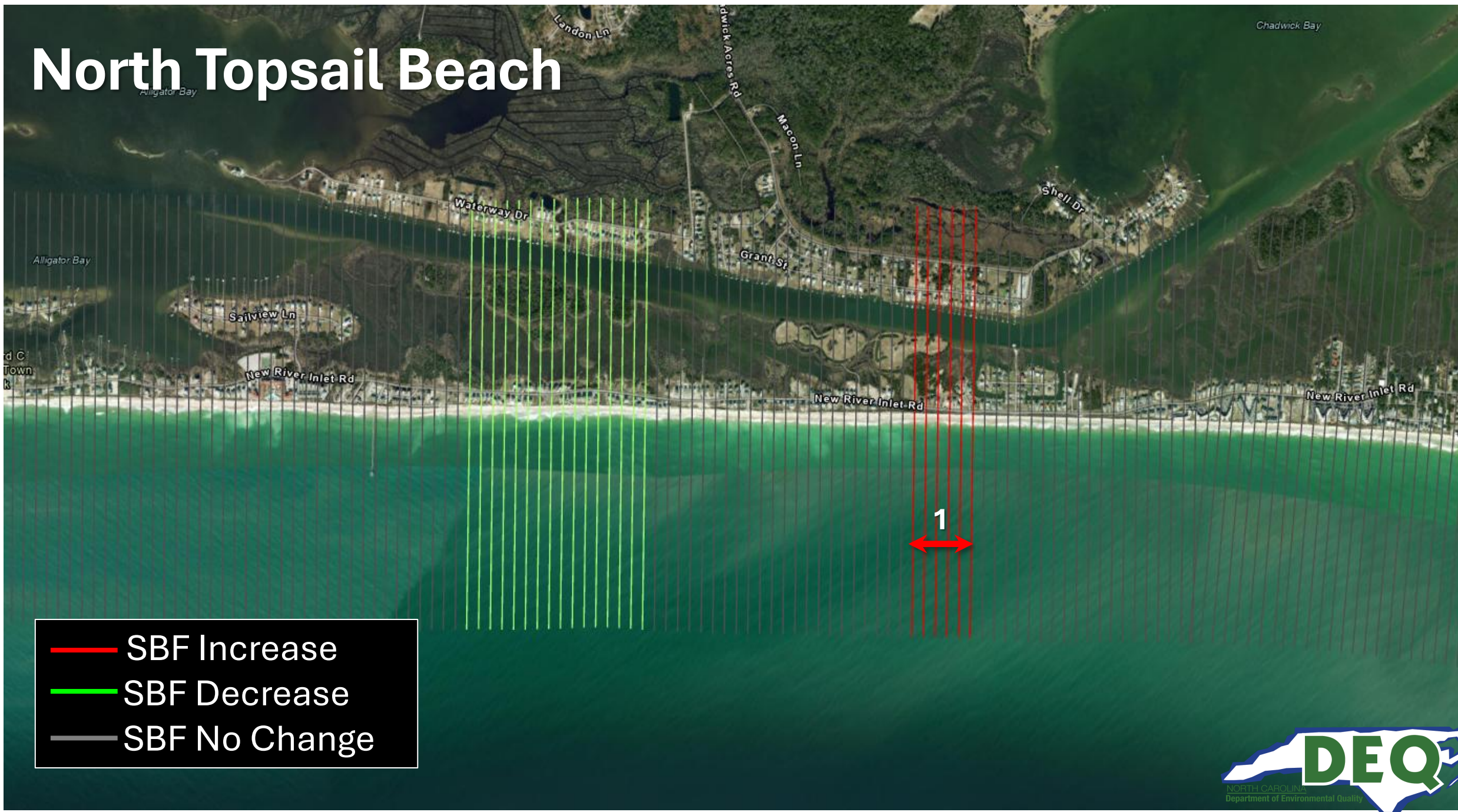
Location	Setback Factor Increase
Bald Head Island (south-beach)	0.5 to 3.5
North Topsail Beach	1
Buxton	0.5
Waves-Rodanthe	1 to 1.5
Corolla	1
Currituck County (N. of Corolla)	1



Bald Head Island



North Topsail Beach

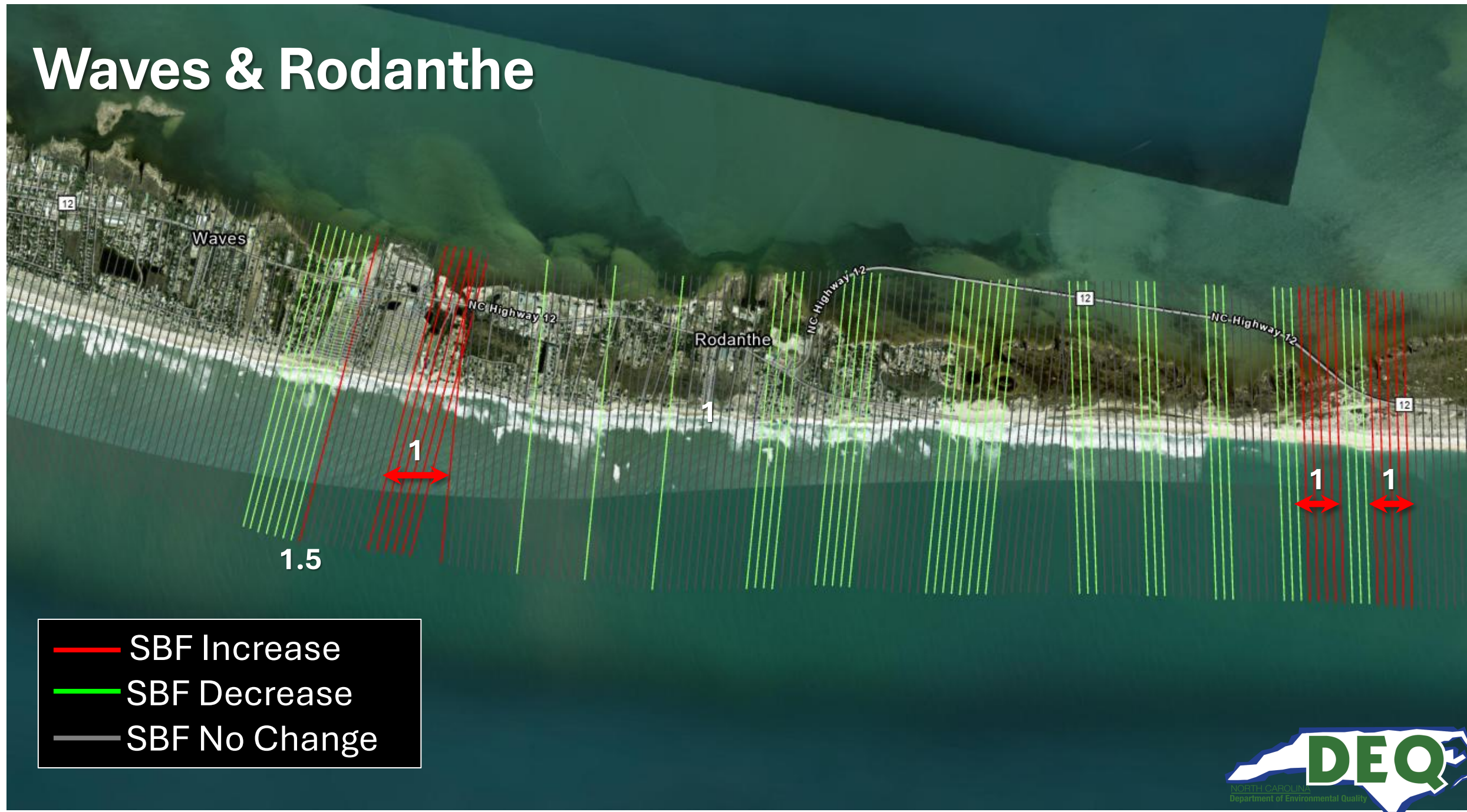


Buxton & National Seashore

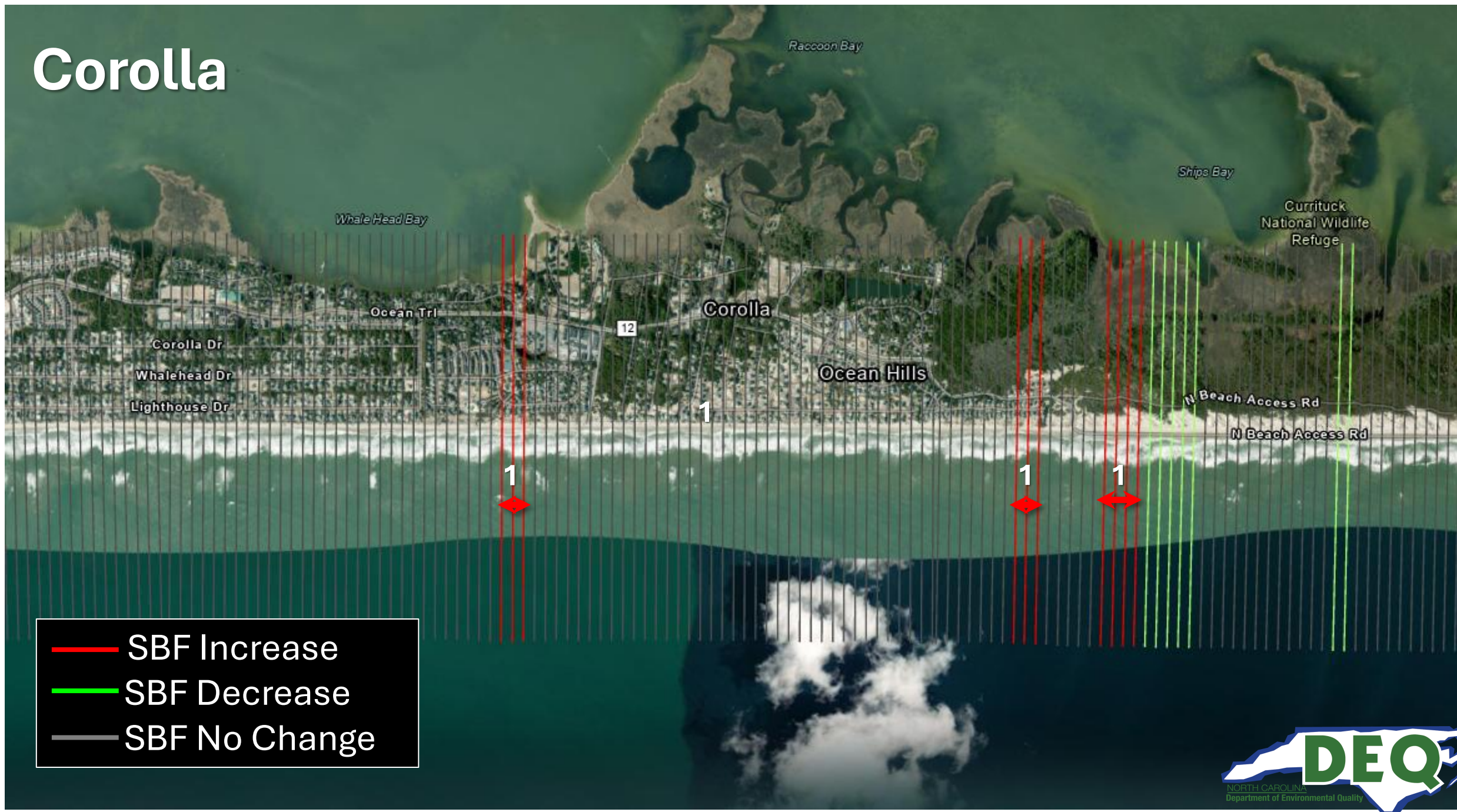


- SBF Increase
- SBF Decrease
- SBF No Change

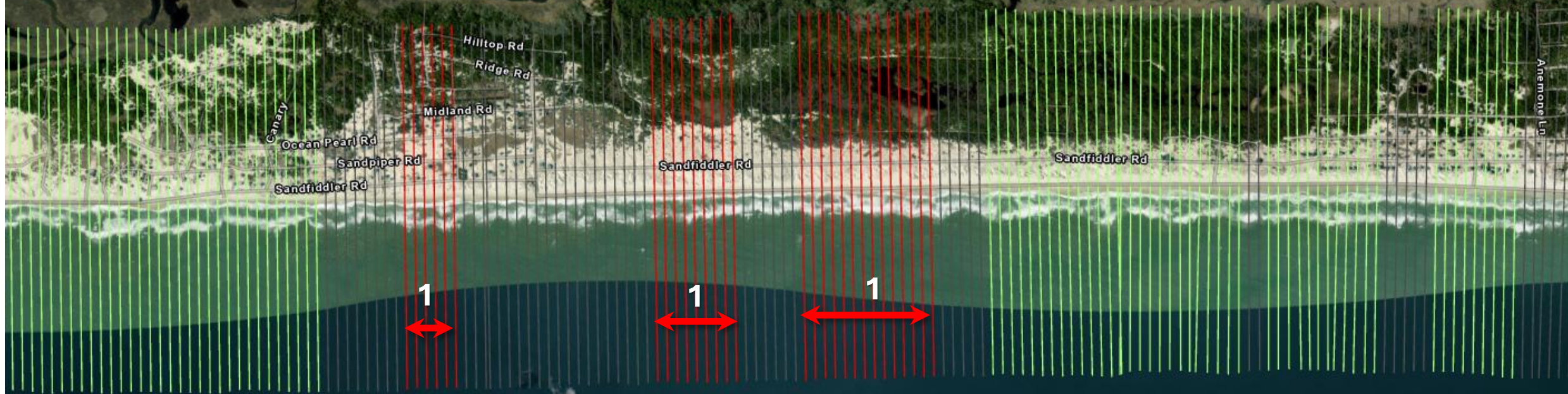
Waves & Rodanthe



Corolla



Currituck County (Carova)



- SBF Increase
- SBF Decrease
- SBF No Change

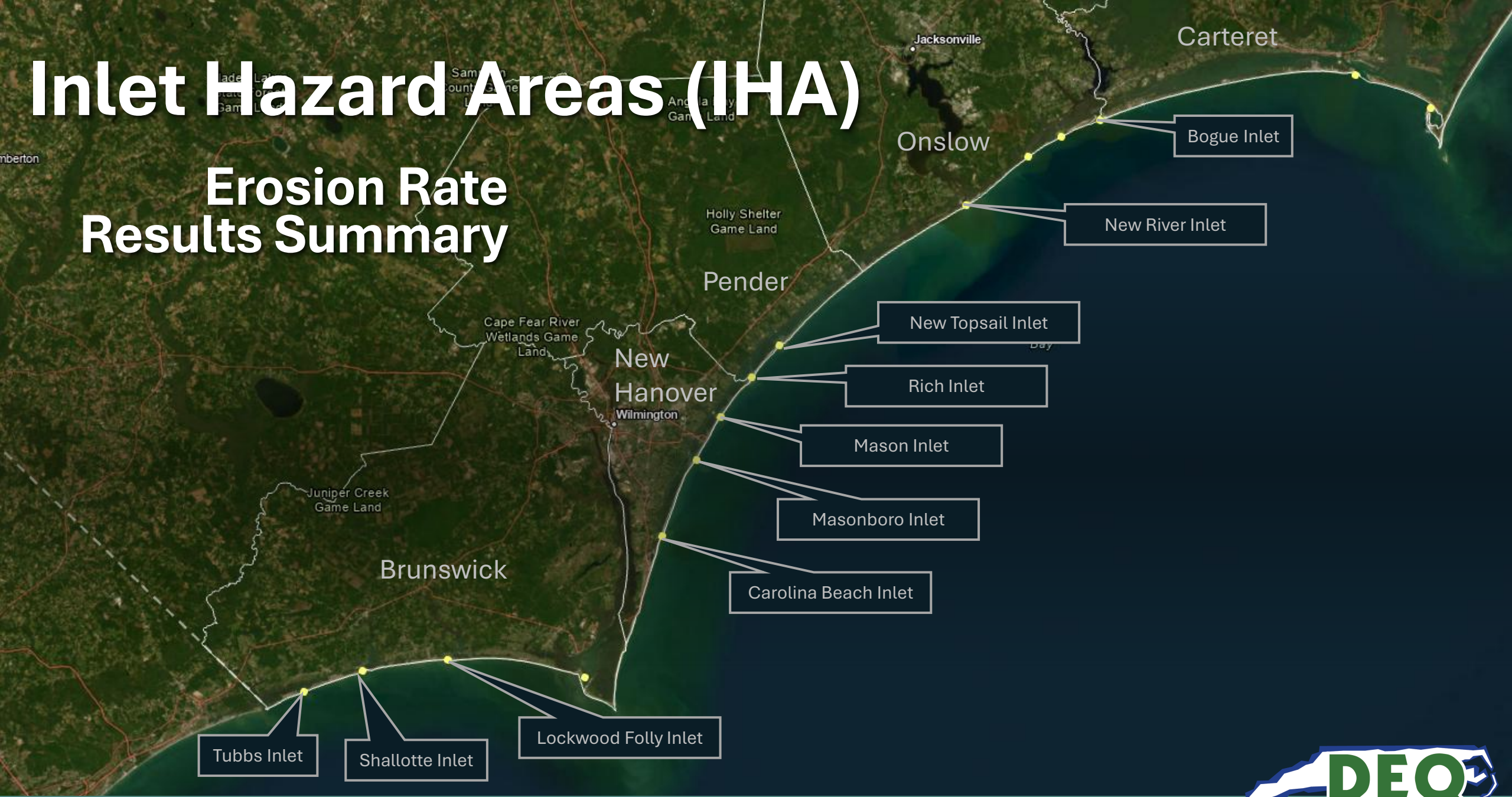
Ocean Erodible Area (OEA)

Transitioning from
one study to the
next: How they
compare

Transition to New Setback Factors	No Change miles %	SBF Increase miles %	SBF Decrease miles %
2020 to 2025	124.9 86%	2 1.4%	17.7 12%
2013 to 2020	120.5 86%	20.3 14%	3.8 2.6%
2004 to 2013	118.3 82%	10.3 7%	16 11%
1997 to 2004	111.6 77%	10.4 7%	22.6 16%

Inlet Hazard Areas (IHA)

Erosion Rate Results Summary



Tubbs Inlet – Sunset Beach



Area Inside 2025 IHA	2020	2013	2004	1997	1986	1983	1980
SBF = 2	2	2	2	2	2	2	2

2025 Inlet Hazard Area Setback Factors *Sunset Beach at Tubbs Inlet*

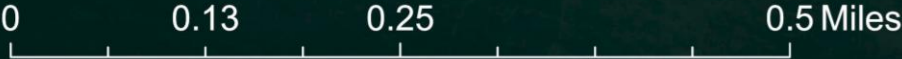
Legend

 Inlet Hazard Area (2025 Update)

 Inlet Hazard Area (Shoreline Boundary)

2023 Imagery

NOTE: SBF = Setback Factor



Tubbs Inlet – Ocean Isle



2025 Inlet Hazard Area Setback Factors
Ocean Isle Beach at Tubbs Inlet

Legend

 Inlet Hazard Area (2025 Update)

 Inlet Hazard Area (Shoreline Boundary)

2023 Imagery

Area Inside 2025 IHA	2020	2013	2004	1997	1986	1983	1980
SBF = 10	2	2	2	2	2	2	2
SBF = 2	2	2	2	2	2	2	2



Shallotte Inlet – Ocean Isle



2025 Inlet Hazard Area Setback Factors

Ocean Isle Beach at Shallotte Inlet

Legend

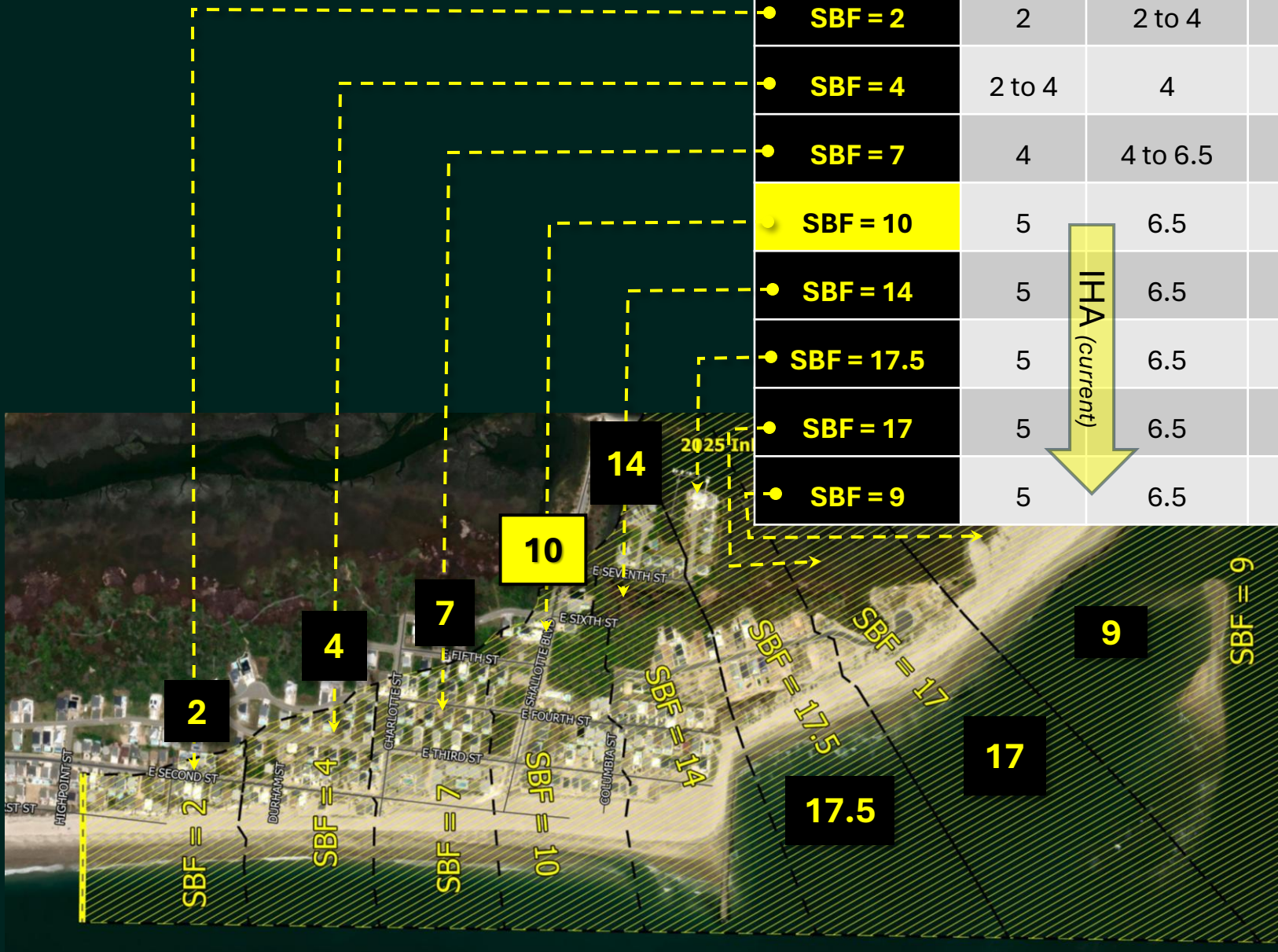
- Inlet Hazard Area (2025 Update)
- Inlet Hazard Area (Shoreline Boundary)

2024 Imagery

NOTE: SBF = Setback Factor



Shallotte Inlet – Ocean Isle



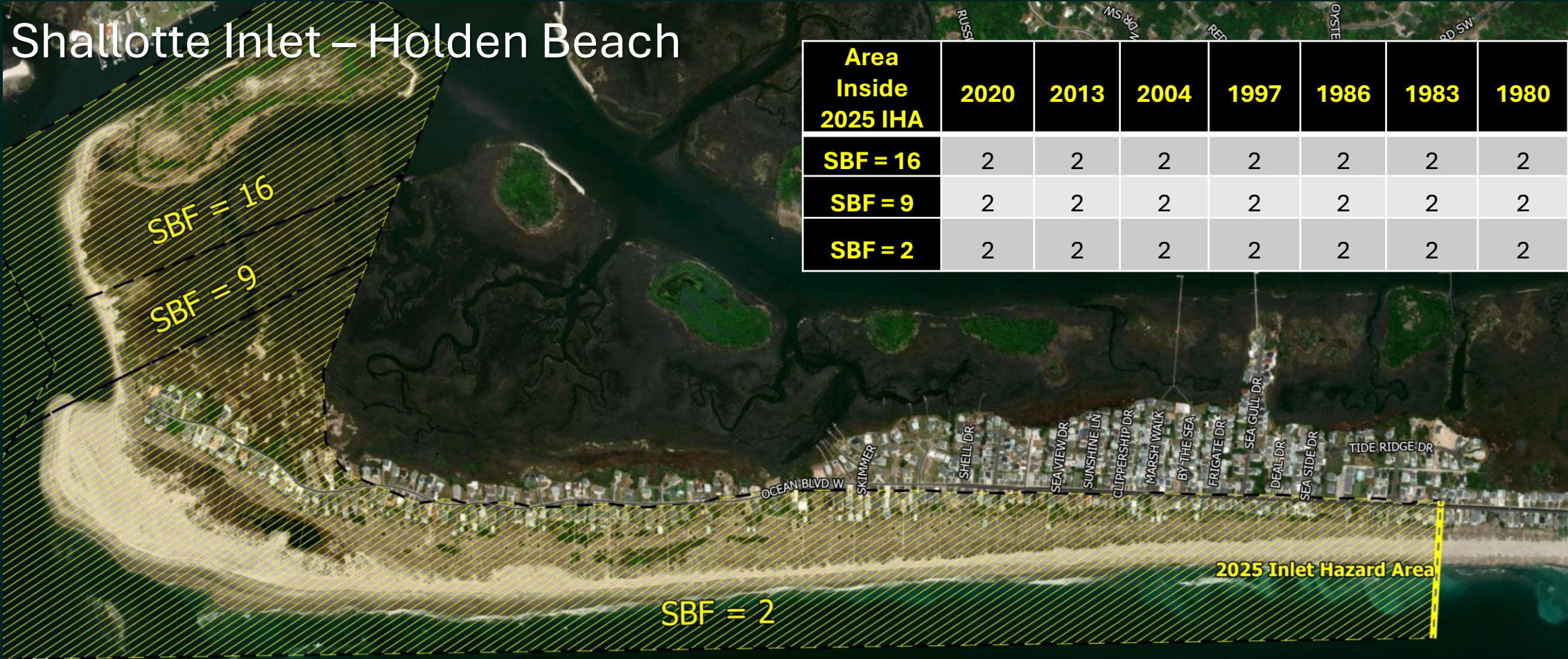
Area Inside 2025 IHA	2020	2013	2004	1997	1986	1983	1980
● SBF = 2	2	2 to 4	2	2	2	2 to 3	2
● SBF = 4	2 to 4	4	2	2	2	3	2
● SBF = 7	4	4 to 6.5	2 to 4.5	2	2	3	2
● SBF = 10	5	6.5	4.5	2	2	3	2
● SBF = 14	5	6.5	4.5	2	2	3	2
● SBF = 17.5	5	6.5	4.5	2	2	3	2
● SBF = 17	5	6.5	4.5	2	2	3	2
● SBF = 9	5	6.5	4.5	2	2	3	2

IHA (current)

Current Rule 15A NCAC 07H.0310(a)(1)
“...setback required in the adjacent Ocean Hazard Area.”

Shallotte Inlet – Holden Beach

Area Inside 2025 IHA	2020	2013	2004	1997	1986	1983	1980
SBF = 16	2	2	2	2	2	2	2
SBF = 9	2	2	2	2	2	2	2
SBF = 2	2	2	2	2	2	2	2



2025 Inlet Hazard Area Setback Factors

Holden Beach at Shallotte Inlet

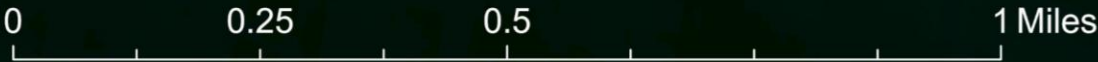
Legend

Inlet Hazard Area (2025 Update)

Inlet Hazard Area (Shoreline Boundary)

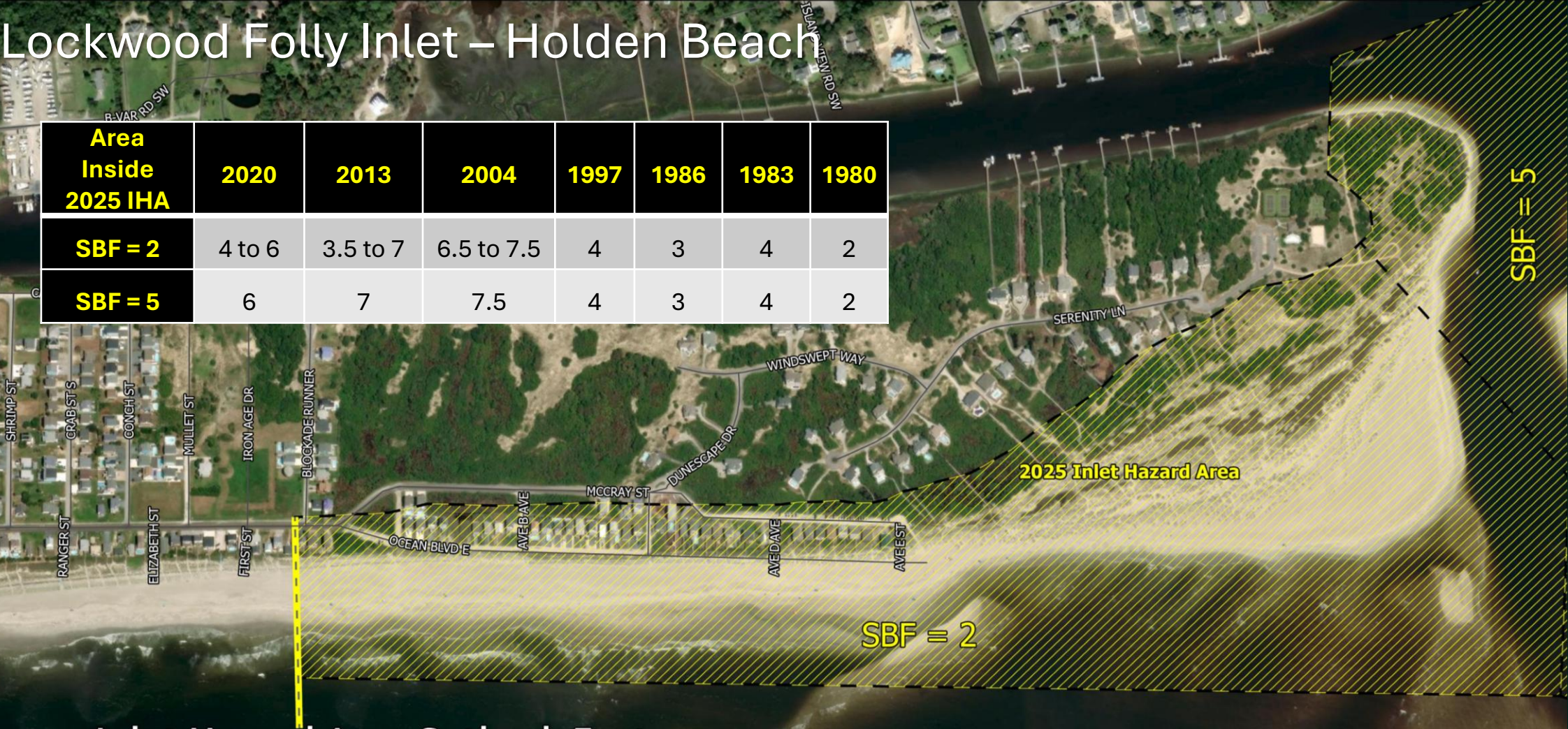
2024 Imagery

NOTE: SBF = Setback Factor



Lockwood Folly Inlet – Holden Beach

Area Inside 2025 IHA	2020	2013	2004	1997	1986	1983	1980
SBF = 2	4 to 6	3.5 to 7	6.5 to 7.5	4	3	4	2
SBF = 5	6	7	7.5	4	3	4	2



2025 Inlet Hazard Area Setback Factors *Holden Beach at Lockwood Folly Inlet*

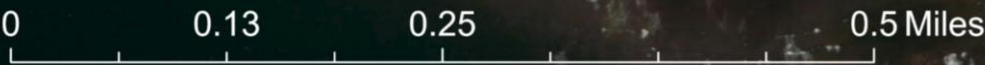
Legend

 Inlet Hazard Area (2025 Update)

 Inlet Hazard Area (Shoreline Boundary)

2024 Imagery

NOTE: SBF = Setback Factor



Lockwood Folly Inlet – Oak Island

Area Inside 2025 IHA	2020	2013	2004	1997	1986	1983	1980
SBF = 2	2	2	2	2	2	2 to 4	2

2025 Inlet Hazard Area Setback Factors

Oak Island at Lockwood Folly Inlet

Legend

Inlet Hazard Area (2025 Update)

Inlet Hazard Area (Shoreline Boundary)

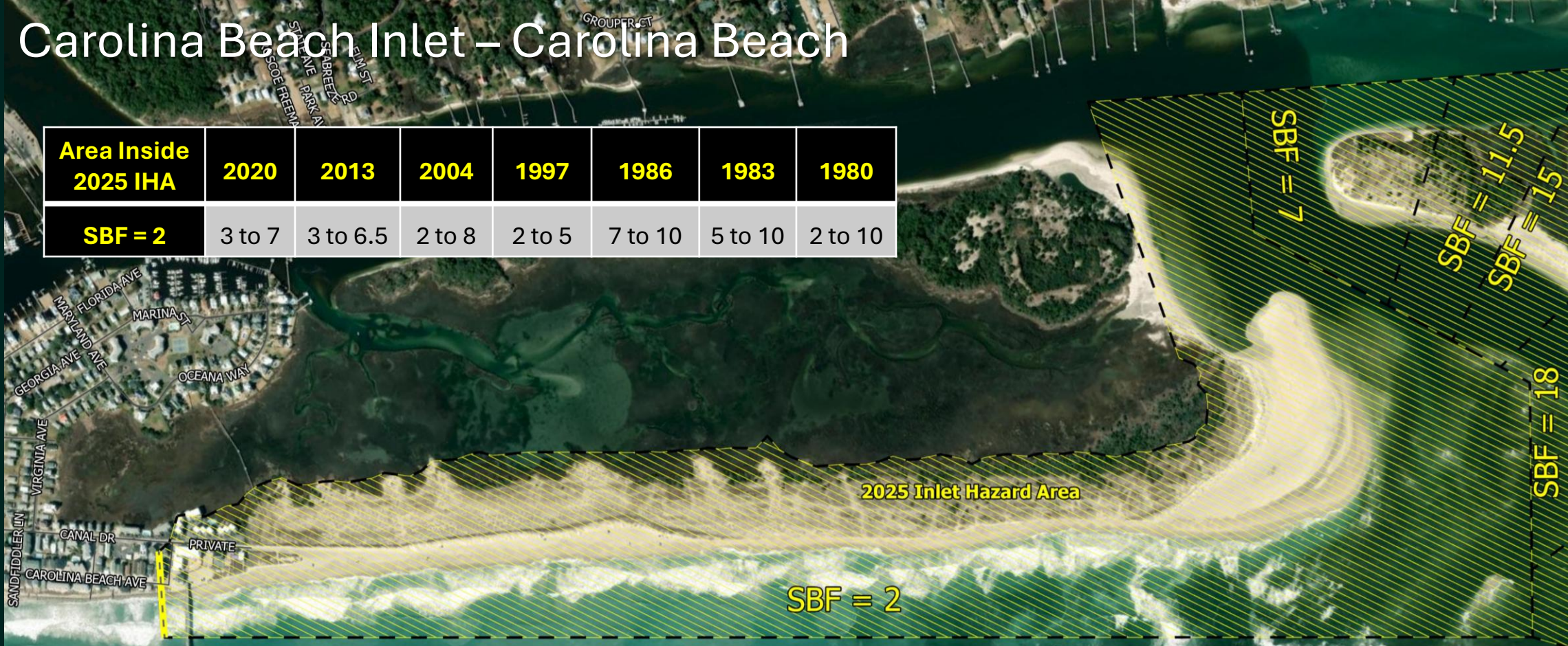
2024 Imagery

NOTE: SBF = Setback Factor



Carolina Beach Inlet – Carolina Beach

Area Inside 2025 IHA	2020	2013	2004	1997	1986	1983	1980
SBF = 2	3 to 7	3 to 6.5	2 to 8	2 to 5	7 to 10	5 to 10	2 to 10



2025 Inlet Hazard Area Setback Factors *Carolina Beach at Carolina Beach Inlet*

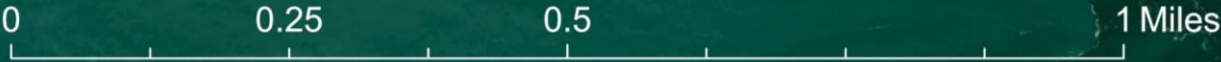
Legend

Inlet Hazard Area (2025 Update)

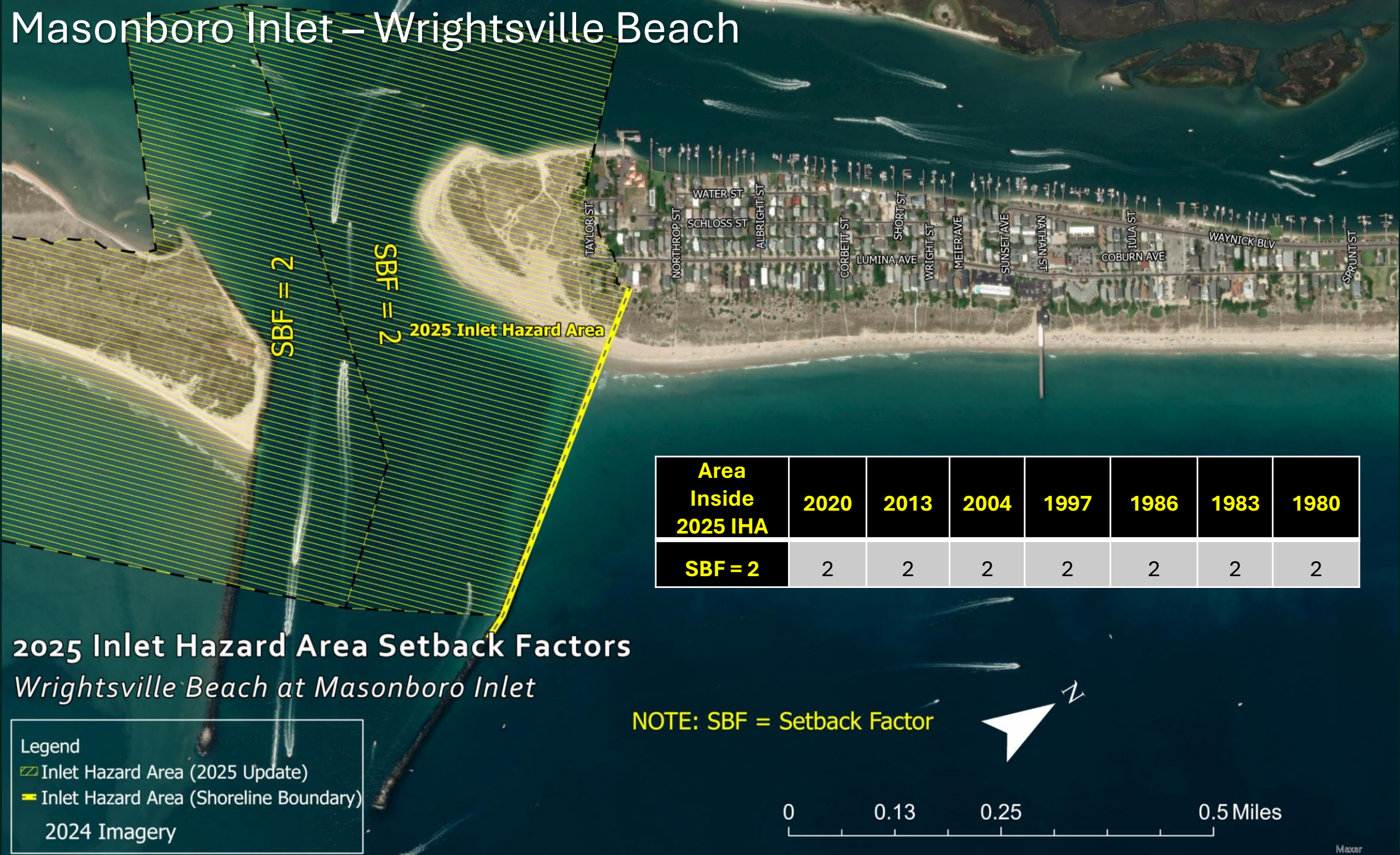
Inlet Hazard Area (Shoreline Boundary)

2024 Imagery

NOTE: SBF = Setback Factor



Masonboro Inlet – Wrightsville Beach



Mason Inlet – Wrightsville Beach

Area Inside 2025 IHA	2020	2013	2004	1997	1986	1983	1980
SBF = 2	2	2	2	2	2	2	2



2025 Inlet Hazard Area Setback Factors
Wrightsville Beach at Mason Inlet

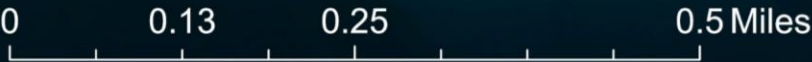
Legend

 Inlet Hazard Area (2025 Update)

 Inlet Hazard Area (Shoreline Boundary)

2024 Imagery

NOTE: SBF = Setback Factor



Mason Inlet – Figure Eight Island

Area Inside 2025 IHA	2020	2013	2004	1997	1986	1983	1980
SBF = 2	2	2	2	2	2	5	2.3



2025 Inlet Hazard Area Setback Factors

Figure Eight Island at Mason Inlet

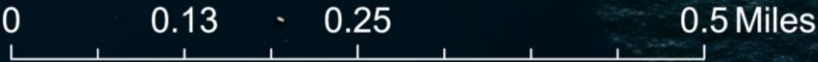
Legend

Inlet Hazard Area (2025 Update)

Inlet Hazard Area (Shoreline Boundary)

2024 Imagery

NOTE: SBF = Setback Factor



Rich Inlet – Figure Eight Island

Area Inside 2025 IHA	2020	2013	2004	1997	1986	1983	1980
SBF = 2	2	2	2	2	2	2	2.3
SBF = 3.5	2	2	2	2	2	2	2.3
SBF = 5	2	2	2	2	2	2	2.3
SBF = 2	2	2	2	2	2	2	2.3



2025 Inlet Hazard Area Setback Factors

Figure Eight Island at Rich Inlet

Legend

Inlet Hazard Area (2025 Update)

Inlet Hazard Area (Shoreline Boundary)

2024 Imagery

NOTE: SBF = Setback Factor



New Topsail Inlet – Topsail Beach

Area Inside 2025 IHA	2020	2013	2004	1997	1986	1983	1980
SBF = 2	2	2	2	2	2	2	2



2025 Inlet Hazard Area Setback Factors *Topsail Beach at New Topsail Inlet*

Legend

Inlet Hazard Area (2025 Update)

Inlet Hazard Area (Shoreline Boundary)

2024 Imagery

NOTE: SBF = Setback Factor



New River Inlet – North Topsail Beach

Area Inside 2025 IHA	2020	2013	2004	1997	1986	1983	1980
SBF = 2	2	2	2	2	2	2	2.5
SBF = 2.5	2	2	2	2	2	2	2.5
SBF = 5	2	2	2	2	2	2	2.5
SBF = 7	2	2	2	2	2	2	2.5
SBF = 6	2	2	2	2	2	2	2.5
SBF = 10	2	2	2	2	2	2	2.5



2025 Inlet Hazard Area Setback Factors

North Topsail Beach at New River Inlet

Legend

- ▨ Inlet Hazard Area (2025 Update)
 - ▨ Inlet Hazard Area (Shoreline Boundary)
- 2024 Imagery

NOTE: SBF = Setback Factor



0 0.13 0.25 0.5 Miles

Bogue Inlet – Emerald Isle

2025 Inlet Hazard Area

SBF = 2

Area Inside 2025 IHA	2020	2013	2004	1997	1986	1983	1980
SBF = 2	2	2	2	3	5	3	NA

2025 Inlet Hazard Area Setback Factors *Emerald Isle at Bogue Inlet*

Legend

 Inlet Hazard Area (2025 Update)

 Inlet Hazard Area (Shoreline Boundary)

2024 Imagery

NOTE: SBF = Setback Factor



Rule-Making Process Timeline

Consider Approval of:

1. Ocean Erovable Areas (OEA):

- 2025 Erosion Rate Setback Factors

2. Inlet Hazard Areas (IHA)

- 2025 Science Panel's IHA Boundary Update Recommendations
- 2025 IHA Erosion Rate Setback Factors

