NC COASTAL AREA MANAGEMENT ACT
CAMA 50 Years
1974-2024

North Carolina 2025 Inlet Hazard Area (IHA) Erosion Rate & Setback Factors: Update Study

North Carolina Division of Coastal Management - August 10, 2025

NC Division of Coastal Management | Department of Environmental Quality
400 Commerce Avenue, Morehead City, NC 28557 | 252-515-5400 | Ken Richardson

Cover. *Image source - NC Division of Coastal Management; Top-Left: terminal groin installed in 2022 at Ocean Isle Beach; Top-Right: terminal groin installed in 2016 at Bald Head Island; Bottom-Left: Sandbag structure installed at North Topsail Beach adjacent to New River Inlet, and: Bottom-Right: Sandbag structure at Ocean Isle Beach adjacent to Tubbs Inlet.*

Acknowledgements

The shoreline change rates (erosion rates) documented in this report represent the outcome of a coordinated technical analysis conducted by the North Carolina Division of Coastal Management in partnership with the Coastal Resources Commission's (CRC) Science Panel on Coastal Hazards. These rates, derived through rigorous geospatial and statistical methodologies, directly informed the recalibration of inlet-based erosion setback factors and served as a foundational dataset for delineating the revised 2025 Inlet Hazard Areas (IHAs).

Summary

Since 1979, the North Carolina Division of Coastal Management (NC DCM) has utilized long-term erosion data to calculate oceanfront construction setbacks and establish landward boundaries for Ocean Erodible Areas of Environmental Concern. These rates are derived from changes in shoreline position, employing the least squares regression method. This approach reflects historical shoreline change trends rather than modeling or predicting future changes or shoreline locations.

Historically, due to limited data and resources, setback factors for Inlet Hazard Areas (IHAs) have been based on those of adjacent Ocean Erodible Areas, as specified in Rule 15A NCAC 07H.0310. However, shoreline change at inlets can occur more rapidly and dramatically relative to the oceanfront, often over short time periods. As a result, the setback factors may underestimate the true erosion dynamics of these areas.

With advancements in Geographic Information Systems (GIS) technology and the availability of more comprehensive and highly accurate shoreline datasets, NC DCM is transitioning from the end-point method to the least-squares regression method. This updated approach incorporates multiple shoreline positions, providing a more robust analysis of erosion trends.

While some property owners near inlets may see no changes to their erosion rate setback factors, others may experience increases. It is important to note that these updated setback factors are

determined based on inlet-specific erosion rates, rather than those of the adjacent Ocean Erodible Areas.

Contents

1.0 Introduction

Inlet Hazard Areas (IHAs) are one of three Areas of Environmental Concern (AEC) within the broader Ocean Hazard Area system. Since 1979, construction setbacks within IHAs use the setback factor from its adjacent Ocean Erodible AEC (oceanfront) as specified in Rule 15A NCAC 07H.0310, which have been calculated based on oceanfront shoreline long-term change methodology (end-point) and data from two shorelines. However, this method may not accurately reflect erosion hazards within inlet areas.

In 2019, the Coastal Resources Commission's Science Panel on Coastal Hazards, along with the North Carolina Division of Coastal Management (DCM), presented findings from the study titled "*Inlet Hazard Area Boundary, 2019 Update: Science Panel Recommendations to the North Carolina Coastal Resources Commission*." That study aimed to develop methods for analyzing inlet shoreline changes and to provide the CRC with inlet erosion rates and updated IHA boundaries for ten active, developed tidal inlets in North Carolina, including Tubbs, Shallotte, Lockwood Folly, Carolina Beach, Masonboro, Mason, Rich, New Topsail, New River, and Bogue Inlets (**Figure 1**).

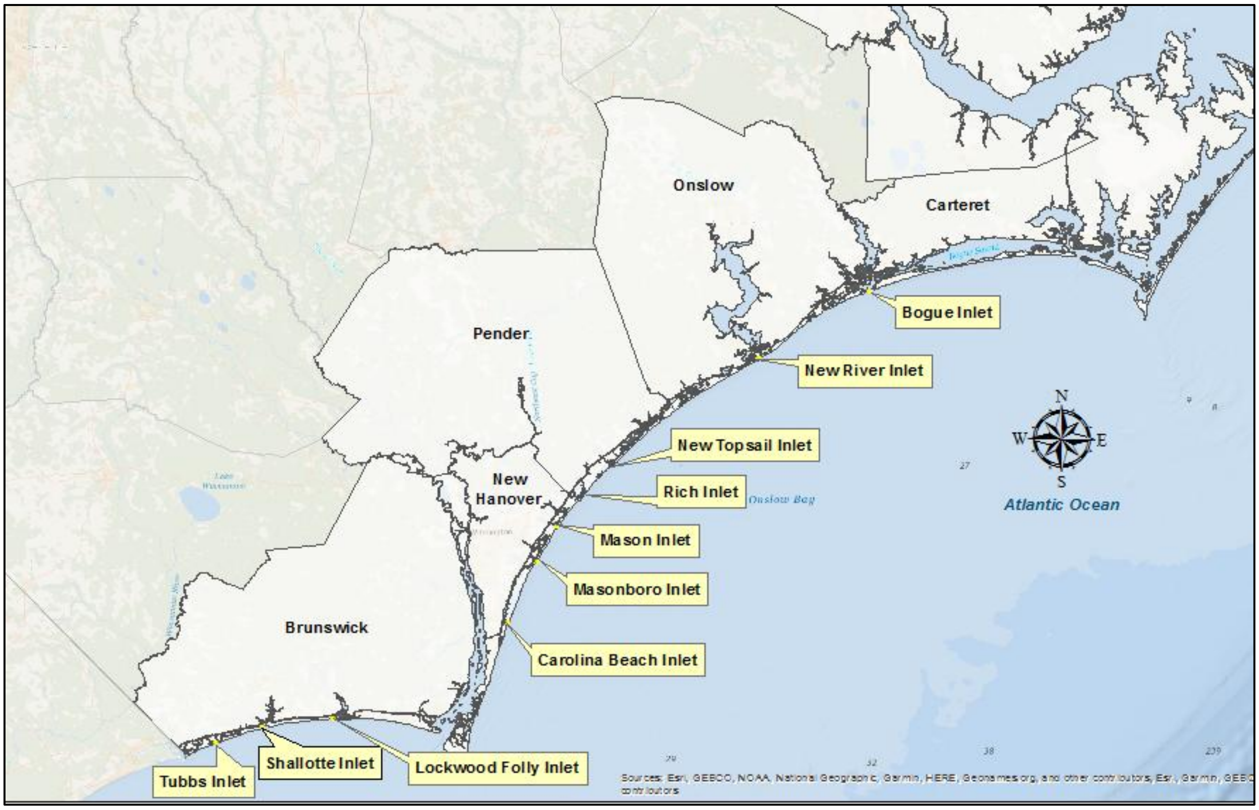


Figure 1. *Study areas include (south to north): Tubbs, Shallotte, Lockwood Folly, Carolina Beach, Masonboro, Mason, Rich, New Topsail, New River, and Bogue Inlets. At least one side of each inlet is developed.*

Although the erosion rates from this study were not implemented, the current update proposal aligns with the oceanfront's long-term average annual erosion rate and introduces newly proposed updates to the Inlet Hazard Area boundaries defined in the CRC's Science Panel on Coastal Hazards 2025 report; "*Inlet Hazard Area Boundary, 2025 Update: Science Panel Recommendations to the North Carolina Coastal Resources Commission*."

NC DCM is proposing inlet setback factors calculated using inlet shoreline change rates for the IHAs.

2.0 Methods

Since 1979, DCM has calculated long-term oceanfront shoreline change (erosion and accretion) using the end-point method. This approach focuses on the change in shoreline position between the earliest and most recent recorded shorelines. While useful for providing an overall picture of long-term shoreline movement, the method does not account for significant short-term fluctuations that may occur between those points in time, which can influence local shoreline behavior and differ from long-term trends. This limitation is particularly evident in inlet shorelines, where constant movement, tidal and storm influences, and sediment transport cause frequent position changes. The dynamic nature of these areas makes the end-point method less effective in accurately capturing the shoreline's behavior or estimating future trends.

To address this complexity in the current study, least squares regression was employed. This statistical technique analyzes multiple shoreline positions over time, offering a more nuanced view of the shoreline's variability and long-term trends (Thieler et al., 2009). By incorporating a broader dataset, least squares regression provides a more reliable and comprehensive analysis of shoreline dynamics, especially in regions affected by the unpredictable behavior of inlets. This approach allows for better understanding of erosion and accretion patterns and offers insights that can inform coastal management strategies.

Shoreline data were analyzed using *ESRI's ArcPro® 3.x and ArcMap® 10.8x* Geographic Information System (GIS) and U.S. Geological Survey's (USGS) Digital Shoreline Analysis System (DSAS) versions 5.1 and 6.0. Geographic Information Systems (GIS) are a sophisticated suite of tools used to capture, store, analyze, manage, and visualize spatial or geographic data. They combine layers of information about a location to help understand patterns, relationships, and trends.

The U.S. Geological Survey's (USGS) *Digital Shoreline Analysis System* (DSAS) is a specialized spatial analysis tool designed to calculate shoreline changes, including erosion and accretion rates. It tracks shoreline movement over time by analyzing both historical and recent data. The following is a general overview of how DSAS is used to calculate shoreline erosion rates:

1. Shoreline Data Input: DSAS requires a series of shoreline positions from different time periods. These shorelines can be digitized from historical maps, aerial imagery, or satellite data.
2. Baseline Creation: A baseline is established landward or seaward of the shorelines. It acts as a reference for the calculation of changes.
3. Transect Generation: Perpendicular transects are automatically generated at regular intervals from the baseline, extending across the shorelines. These transects are the points where shoreline change is measured.
4. Shoreline Change Calculation: For each transect, DSAS computes the distance between different shoreline positions over time, using methods like:
    a. End Point Rate (EPR): Measures the distance between the oldest and most recent shorelines divided by the time span between them.
    b. Linear Regression Rate (LRR): Fits a least-squares regression line through all shoreline points for each transect, estimating the average rate of change.
    c. Weighted Linear Regression (WLR): Like LRR, but weights more recent data more heavily to account for its higher relevance.
5. Output: DSAS generates statistical outputs for each transect, including the rate of shoreline change (in meters per year) and confidence intervals. These results help assess erosion risks, trends, and rates.

In summary, DSAS is used to calculate shoreline erosion rates by analyzing shoreline position changes over time, using automated transects and various statistical methods to provide precise and localized erosion rate data.

2.1 Shoreline Data

DCM's growing database of oceanfront and inlet shorelines facilitated this study by allowing many different approaches to be tried and tested. Most of the shorelines used were mapped using historic orthophotography to digitize the wet-dry line (**Figure 2**), considered a proxy for the

Mean High Water (MHW) line. Three shorelines represented the location of MHW, either derived from lidar (1997 and 2004), or NOS T-Sheets (either from the 1930s or 1940s). Two studies carried out by DCM (Limber et al., 2007a; 2007b) indicated that the lidar-derived MHW line could be used interchangeably with the wet-dry shorelines.

Although shoreline data existed between 1930 and 2022, the temporal focus here is on shorelines between 1970 and 2022 for several reasons:

- The 1930 to 1940 shorelines were excluded at most inlets because of uncertainties on the hydrodynamics at each inlet associated with the construction and maintenance dredging of the Atlantic Intracoastal Waterway (AIWW) and other waterways. This specifically affected the inlets in the southern portion of the State, where one to four shorelines were excluded.
- Shorelines based on photography taken immediately or within one year after major storms or beach nourishment projects were avoided.
- The primary imagery used were NC Department of Transportation (DOT) shoreline images between 1970 and 2000, and post-2000 images acquired from a variety of agencies (USDA NAIP, NOAA, USGS, & NC Emergency Management).

These criteria resulted in the number of shorelines used, ranging between 10 and 24 at each inlet. Oceanfront and inlet shorelines were analyzed along a series of numbered, shore-perpendicular transects spaced at 25-meter (82-foot) intervals using USGS's Digital Shoreline Analysis System (DSAS) with ESRI's ArcGIS. Due to the curvature of inlet shorelines where there is a transition from the oceanfront into the inlet throat, transects were cast from an onshore baseline to create radial transects that retained shore-perpendicular orientation and spacing. Radial transects were used to compute shoreline changes inside the inlet.

Figure 2. *Interpretation of the "wet-dry" shoreline using orthophotography.*

2.2 Transects (25-Meter)

Shoreline positions along oceanfront were assessed using a series of numbered transects that are generally perpendicular to the shore and spaced at 25-meter intervals, and to ensure a consistent shoreline-perpendicular orientation and spacing, transects were extended from an onshore baseline (**Figure 3**). This alignment followed the overall positional trend of shoreline locations, particularly where the inlet shorelines curved from the oceanfront to the inlet throat. This approach was crucial for best capturing the complex geometries and variations in shoreline shape, allowing for accurate analysis of coastal inlet dynamics where the inlet's curvature a spatial disbursement introduced significant variability. At each intersection between shorelines and transects, shoreline change rates, and additional statistical measures were computed. The analysis utilized the US Geological Survey’s (USGS) Digital Shoreline Analysis System (DSAS) (Thieler et al., 2009) in conjunction with ESRI's ArcGIS.

Figure 3. *This map illustrates an example of casting 25-Meter transects (yellow line) from an onshore baseline (red line) that follows the general trend of shoreline positions.*

Future update studies are advised to reassess baselines and transects and recasting them if needed to ensure that any newly added shorelines in subsequent analyses remain seaward of the baseline. This will ensure that transects intersect each shoreline; otherwise, any missed shoreline-transect intersections will be excluded from the analysis.

2.3 Shoreline Change Rates: Linear Regression (Least Squares Regression)

DCM has calculated long-term oceanfront shoreline change (erosion/accretion) rates since 1979 using the end-point method, which is based on the change between the earliest and most recent dates. Any short-term change between those dates, no matter how significant, is not directly captured. Because inlet shorelines are constantly moving and fluctuating in position, the end-point method is less effective in capturing the dynamics of an inlet or for quantifying its long-term trends. Instead, least squares regression, a statistical measure using multiple shorelines, was used for this study (Thieler et al., 2009).

At each transect, there are a series of shoreline-transect intersections that represent the shoreline's position through time (**Figure 4**). Least Squares Regression - Linear regression (LRR) minimizes the distance between the known values (actual shoreline positions) fitting a least-squares regression line through all shoreline points for each transect, estimating the average rate of change (**Figure 5**). The slope of this line is the least squares regression of shoreline change or the local erosion or accretion rate.

Figure 4. *This map illustrates an example of radial transects (green and red lines) and point locations where shorelines intersect transects.*

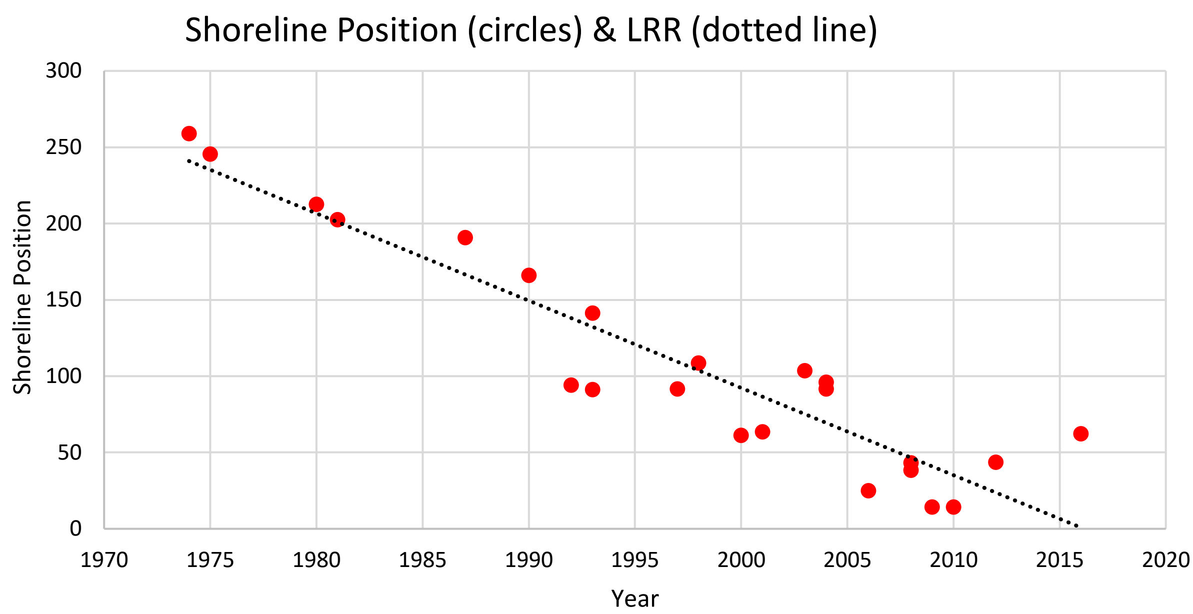


Figure 5. *Relative shoreline position as a function of time (circles). The slope of the best fit, dotted line is the linear regression rate (LRR) of shoreline change (in this case, it is eroding at 19 feet per year).*

The benefits of this method include (Dolan et al., 1991):

- All data can be used, regardless of changes in trend.
- The method is purely computational.
- The calculation is based on accepted statistical concepts.
- The method is easy to employ.

Although the least squares regression method is less sensitive to individual points, it is susceptible to outliers; it assumes that the computed trend is linear, and it tends to underestimate the rate of change relative to other statistics, such as the end-point rate (Dolan et al., 1991; Genz et al., 2007). To exclude outlier data, precautions were taken in this study to avoid shorelines that reflect influences caused by a major storm event or beach nourishment. However, given that the practice of beach nourishment has become a frequently occurring common practice, avoidance of these shorelines is not always possible.

Once computed, the linear regression rate was then smoothed using a 17-transect running-average alongshore. This follows the blocking computation historically used for the oceanfront shoreline rates and further smooths the alongshore variation in the shoreline change rate.

2.4 Shoreline Change Rates: Smoothing

Smoothing raw data has been applied in all oceanfront shoreline position change studies since 1979 and serves as a method of removing high-frequency variations or noise, thereby highlighting the underlying trends and patterns. By doing so, short-term dynamic shoreline phenomena such as beach cusps, smaller sand waves, and the incorporation of landward migrating portions of offshore bar systems are effectively filtered out (**Figure 6**).

Figure 6. *This image shows an example of beach cusps and nearshore sandbars relative to 50-meter transects.*

Shoreline cusps and similar coastal features exhibit a wide range of sizes, from small formations approximately 5 feet in width to much larger structures reaching up to 5,000 feet. Their lifespans also vary considerably, with smaller features lasting only a few days, while larger ones, such as sand waves, can persist for entire seasons or even several years (Dolan and Ferm, 1968; Davis, 1978). This range in both size and duration reflects the dynamic and ever-changing nature of coastal environments, driven by processes like wave action, tidal patterns, and sediment transport.

Sandbars, another prominent coastal feature, typically measure more than 300 feet in length. These structures undergo migration and attachment processes, which unfold over time periods ranging from seasons to years (Davis, 1978). The shifting position of these bars, combined with their ability to attach to different points along the shoreline, underscores the fluidity of coastal landscapes, where no feature remains fixed indefinitely.

Unlike smaller, more transient formations, larger and more durable features such as capes are resistant to smoothing processes commonly applied in coastal analysis. These capes remain prominent even after filtering, highlighting their scale and resilience. Despite their size, capes and similar features are not permanently anchored to a single location. They can migrate along the shoreline, shaped by continuous interactions with natural forces like currents, wind, and wave energy. This movement further illustrates the complex and evolving nature of shorelines, where even the largest features remain subject to gradual change.

The procedure for spatially smoothing shoreline change rate data involves a simple moving average or running mean technique, as described by Davis in 1973. Commonly known as the "17-point running average," this method typically includes at least 17 transects, each spaced 25 meters apart, covering approximately 0.25 miles of shoreline. To calculate the smoothed rate, an average is computed for each group of 17 transects, with the calculation centered on the ninth transect (having eight transects on either side).

As the algorithm approaches the inlet at the last 17 transects, the number of transects used to calculate the average is reduced by two, dropping one from each side of the centered transect, until the end is reached. For the last value, a weighted average is calculated using only the final two transects. This approach ensures a smooth transition in areas with fewer available data points near shoreline boundaries or inlets.

$$\mathbf{R_s = (2 \times T_1 + T_2) / 3}$$

$\boldsymbol{R_s}$ *= smoothed rate*

$\boldsymbol{T_1}$ *= erosion rate at last transect adjacent to the inlet*

$\boldsymbol{T_2}$ *= erosion rate at second to last transect adjacent to inlet*

As shown in **Figure 7**, the effects of smoothing are most apparent in areas undergoing accelerated erosion or accretion, such as near inlets. For analyzing erosion rate data, this method is one of the simplest techniques for smoothing time-series data. Its effectiveness in these studies is largely due to the equal spacing between transects, making it well-suited for capturing consistent shoreline change patterns.

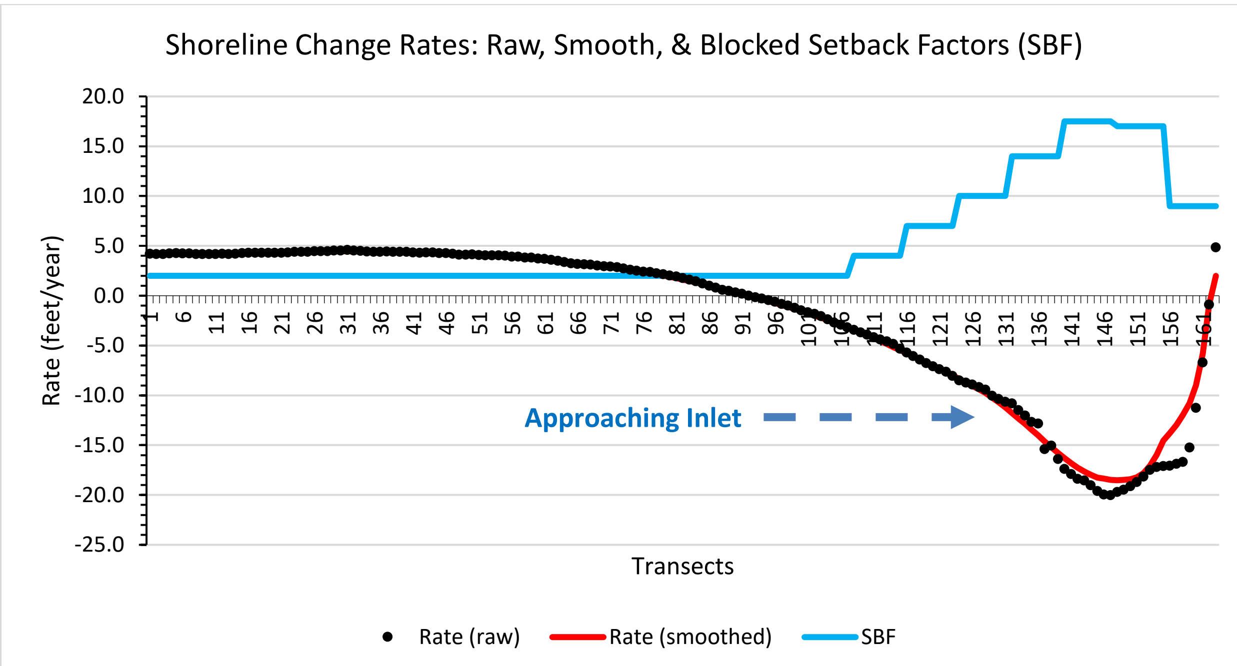


Figure 7. *This example illustrates the raw data (black points), smoothed data (red line), and blocked erosion setback factors (blue line). Note that in areas where erosion rates are less than 2 feet per year, or where accretion occurs, the minimum setback factor defaults to 2. While setback factors are recorded as positive values, they directly correspond to erosion rates, particularly when the values surpass -2 ft/yr.*

2.5 Shoreline Change Rates: Blocking

In late 1978 and early 1979, the North Carolina Coastal Resources Commission undertook an in-depth review and revision of the oceanfront regulations initially adopted in September 1977. One of the most significant updates introduced during this process was the concept of oceanfront development setbacks, which were then partially determined by the average annual long-term erosion rates. These rates, calculated based on transects, helped define how far inland development should be placed to minimize risk from coastal erosion. Where rates are higher, the setbacks are greater to help buffer the risk.

However, because these transects only capture data at specific points along the shoreline, a method was required to establish broader setback areas, or “blocks,” where similar erosion rates could be applied consistently across continuous coastal sections. Following a 1979 study (Tayfun et al., 1979) it was determined that if the blocks or segments were too long, the accuracy of the erosion rates could be compromised, particularly in regions where the rates change rapidly over short distances. Long segments tend to oversimplify the data, failing to reflect these localized variations, which could lead to inappropriate setback distances in areas prone to higher erosion.

It wasn’t until the CRC’s 1986 study that this issue was addressed by decreasing the transect spacing from the original intervals to 50 meters. This closer spacing allowed for a more precise calculation of erosion rates and has been the standard practice in all subsequent studies of oceanfront areas. This refinement enabled a more accurate understanding of how erosion affects different parts of the shoreline, leading to better-informed coastal management and development decisions.

In inlet areas, where shoreline dynamics are far more volatile than on the oceanfront, erosion rates can change dramatically over much shorter distances. While oceanfront rates typically increase or decrease gradually over longer stretches, inlet areas require a much finer level of detail. To capture these rapid variations, a transect spacing of 25 meters is applied in Inlet Hazard Areas (IHAs). This smaller spacing allows for a more detailed and accurate representation of the localized erosion patterns, ensuring that setback lines and management strategies are tailored to the unique and dynamic conditions of inlets.

The technique of "blocking" smoothed rate data creates spatially consistent rate segments along the shoreline. Essentially, blocking groups neighboring transects along the same shoreline segment that exhibit similar smoothed shoreline change rates. This approach enables more uniform and consistant management practices for sections of the shoreline that experience the same or similar rates of change, rather than relying on individual rates at each transect or risking misinterpretations in the areas between transects.

The blocked shoreline change rate data are used as Setback Factors, commonly referred to as "erosion rates," and are applied to determine construction setbacks within Ocean Hazard Areas of Environmental Concern (AECs), which include both Ocean Erodible Areas and Inlet Hazard Areas. This method ensures that setbacks are calculated consistently across similar shoreline segments, improving coastal management and reducing the risk of inappropriate development in high-erosion zones.

Blocking procedures, itemized below, represent refinments and clarifications of procedures established by and used in all previous update studies. These refinements and clarifications are the result of improved accuracy of the data brought about by improvements in the shoreline delineation methodology and quantitative requirements that allow for increased repeatabiltiy of results. In areas experiencing an accelerated change in rates, this refinement resulted in smaller blocked groups. The following list describes the process, or “rules” of blocking:

1. Group “like” erosion rate segments based on rate at transect (*e.g.,* 2.0, 2.2, 2.1, 2.5, 2.6, 2.1, . . . 2.9) and use the mean of each segment as the blocked rate. Transitioning at one-foot intervals are prefered for rate block boundaries. Fractional rates are rounded down to the nearest foot, or half foot interval for segments dominated by a half foot value and do not have values greater than the next highest one foot interval (*e.g.*, a rate segment equal to 5.4 would be rounded to 5.0; and 5.7 would be rounded to 6.0).

2. Blocked shoreline change rate segments must be comprised of at least eight (8) transects. In areas experiencing rapid erosion or accretion (*e.g.,* approaching inlets), it is not always possible achieve a one-foot transition from one blocked rate segment to the next, thus making it necessary to evaluate segments based on its mean so that transitions from one blocked segement to the next was as near to the one-foot interval as feasible.

3. In areas where blocked segments transition from one value to another (*e.g.*, from 3 to 4 feet per year) a determination must be made to select the transect that will serve as a delineation between the change in values. The lower rate would be applied towards the higher blocked segment.

4. 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 in order to give the property owner the benefit of the lower rate.

Based on currentl rules (15A NCAC 07H.0304(1)[1]), segments of the shoreline that result in measured accretion, or where measured erosion rates are less than two (2.0) feet per year, are assigned the default minimum, a blocked rate value (Setback Factor) of two (2) in accordance with the minimum setback of 60 feet, or 30 times the Setback Factor based on blocked shoreline change rates.

[1] NC Administrative Code (NCAC), Title 15A – Environmental Quality, Chapter 7, Sub-Chapter 0304(1)

3.0 Results

The following graphs and maps illustrate proposed inlet setback factors calculated using inlet shoreline change rates associated with 2025 Inlet Hazard Area Boundary update proposal. Where erosion rates are less than 2 feet per year, or where accretion is measured, the minimum setback factor defaults to 2 (Rule NCAC 15A 07H.0304(1)). While setback factors are recorded as positive values, they directly correspond to erosion rates, particularly when the values surpass -2 ft/yr. For example, if a setback factor equals 3, then it corresponds to an area of shoreline that has a long-term average annual erosion rate of approximately -3 feet/year.

It's important to understand that long-term (50+ years) average erosion rates can differ significantly from short-term rates. In 2000, the U.S. Geological Survey (USGS), East Carolina University (ECU), and the N.C. Geological Survey (NCGS) formed the Coastal Geology Research Cooperative to study the coastal geology of North Carolina, from Cape Lookout to Currituck County, and compare short- and long-term shoreline changes. While engineering efforts like dredging, erosion control structures, and beach nourishment can affect short-term erosion, in North Carolina, storm intensity and frequency play a larger role in shaping short-term changes. For example, beach nourishment can artificially lower erosion rates, while storm event frequency and intensity can cause higher short-term erosion rates that don't necessarily reflect long-term trends.

Based North Carolina's 2019 oceanfront erosion rate study, the statewide average erosion rate along the coast is -2.1 feet per year, with a median rate of -1.6 feet per year (NC DCM, 2019). This provides a general view of erosion across the state's oceanfront, but localized conditions can vary significantly, especially near inlets. When considering all NC inlets and not just those analyzed for this study, erosion rates are much higher, with an average rate of -8.4 feet per year and a median rate of -9.7 feet per year.

However, it's equally important to recognize that inlets can also experience significant accretion, where sand is deposited rather than eroded. Where shoreline accretion was measured, the average rate is 5.8 feet per year, and the median is 4.9 feet per year. This substantial buildup of sediment, particularly at oscillating and migrating inlets, highlights the dual nature of these coastal zones—while erosion can be 4 to 5 times higher at inlets compared to other areas, accretion can also be far more pronounced. These rapid and sometimes dramatic changes in shoreline position underscore the highly dynamic and unpredictable nature of inlets, where sediment can shift quickly, creating both erosion and accretion with significant potential to reverse trends.

Although all oceanfront and inlet areas were analyzed, these findings focus only on the regions within the 2025 updated Inlet Hazard Areas. The following sections summarize erosion and accretion for each side of each inlet.

3.1 Tubbs Inlet: Sunset Beach

Likely due to several factors, including the relocation of Tubbs Inlet to the northeast in 1970, the construction of a dual jetty system at Little River Inlet to the south in 1980, and the closure of Mad Inlet in 1997, Sunset Beach has benefited from a more abundant sediment supply. More sediment in the system has resulted in natural accretion along the shoreline, and thus far, eliminating the need for beach nourishment.

In the 2025 updated Inlet Hazard Area, covering approximately one-third of a mile (1,805 feet) from transect 213 to Tubbs Inlet, the analysis included sixteen shorelines from 1981 to 2020 (**Figure 8**). The spit adjacent to the inlet channel is continuously shifting and has more recently extended further landward toward the northeast and contributing to significant shoaling in Jinks Creek (**Figure 11**). According to the measurements from this study, the average shoreline change rate within the IHA is 6.5 feet per year (accretion), with a median of 3.5 feet per year (**Figure 10**). As a result, the erosion setback factor defaults to 2 (**Figure 12**).

Figure 8. *This map illustrates shorelines and erosion rates measured at each transect for the area approaching Tubbs Inlet from the 2025 updated IHA alongshore boundary (yellow transect).*

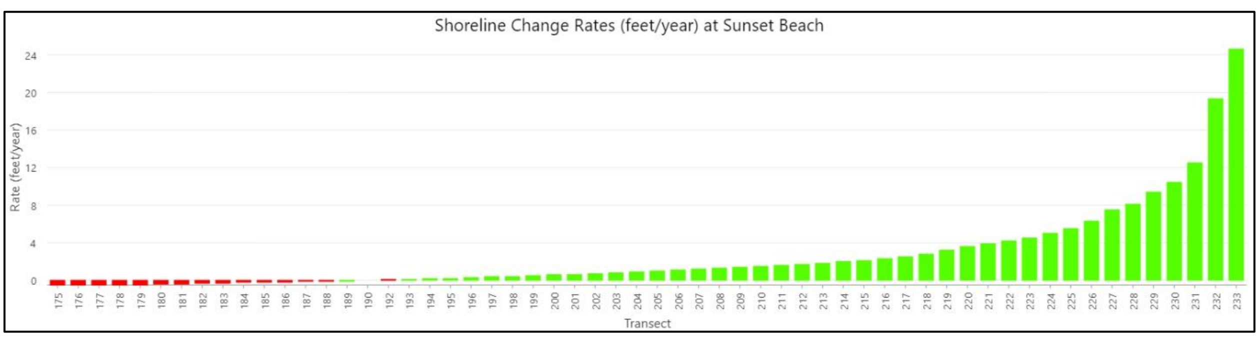


Figure 9. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

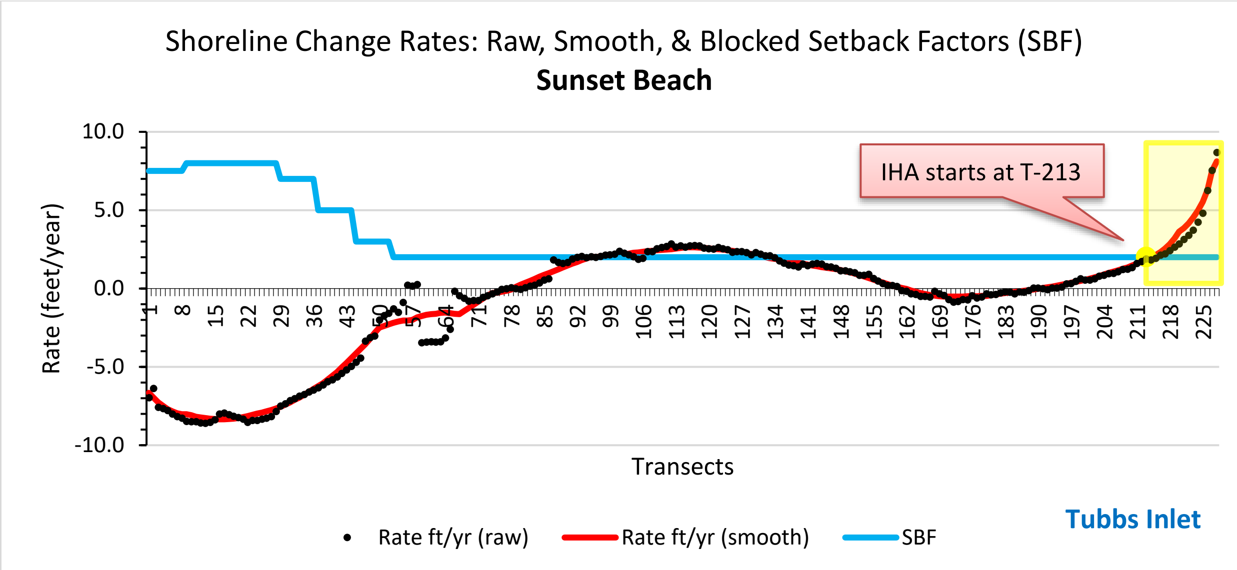


Figure 10. *This graph displays shoreline change rates represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs. The yellow box represents IHA's spatial extent along the shoreline.*

Figure 11. *This image shows the spit at Sunset Beach extending into the inlet in a northeast direction, and the shoaling within Jinks Creek. Photo source: Sunset Beach Environmental Resource Committee, 2024.*

Figure 12. *This map image illustrates 2025 inlet erosion rate setback factors in relation to the 2025 updated IHA boundary.*

For the same area inside the 2025 updated IHA, **Table 1** compares resulting erosion setback factors to those measured and calculated in previous oceanfront erosion rate and setback factor update studies. Here, the application of existing Rule 15A NCAC 07H.310 requiring the use of the adjacent OEA has not influenced setbacks. Given the general trend of accretion since 1981, setbacks have remained consistent with those calculated in previous studies.

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

Table 1. This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.

3.2 Tubbs Inlet: Ocean Isle

The Ocean Isle side of Tubbs Inlet has experienced varying rates of erosion. However, the historical use of sandbag structures along the inlet's shoreline has likely reduced these rates by temporarily stabilizing the shoreline and preventing further erosion. While not within the updated IHA, the oceanfront shoreline has been nourished to varying degrees since 1974. The first large-scale (>300,000 cubic yards) beach nourishment occurred in 2001 as part of the Federal Coastal Storm Damage Reduction (CSDR) project; subsequently followed by routine maintenance in 2006, 2009, 2014, 2018, 2021 and 2022.

In the 2025 updated Inlet Hazard Area, covering approximately one-half mile (2,500 feet) from transect 27 to Tubbs Inlet, the analysis included twenty-five shorelines from 1970 to 2022 (**Figure 13**). According to the measurements from this study, the average shoreline change rate within the IHA is -1.8 feet per year (erosion), while rates within the inlet exceed -20 feet per year (**Figure 14**). As a result, the erosion setback factor nearest the inlet is 10 and quickly transitions to 2 at transect 9 (**Figure 16**).

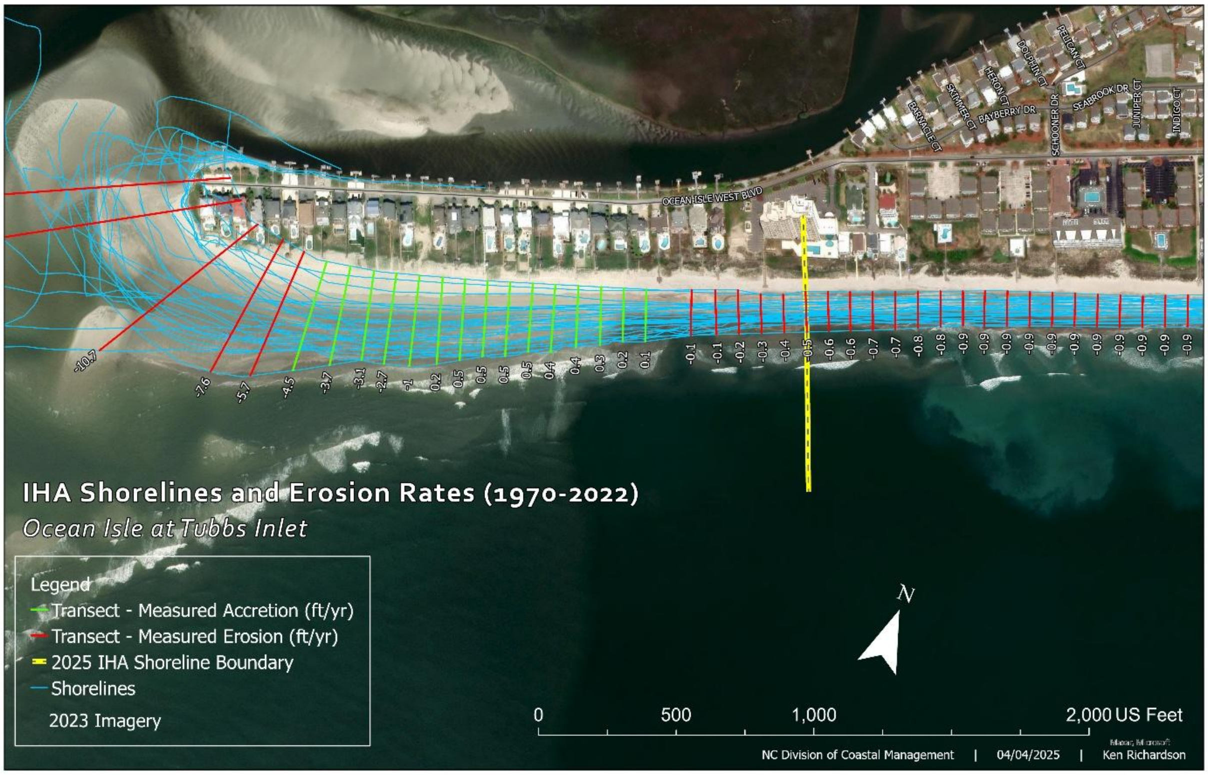


Figure 13. *This map illustrates shorelines and erosion rates measured at each transect for the area approaching Tubbs Inlet from the 2025 updated IHA alongshore boundary (yellow transect).*

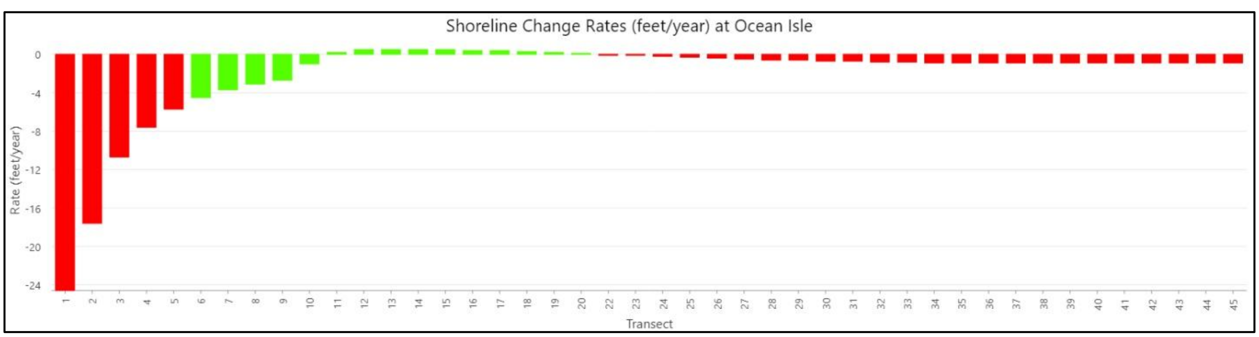


Figure 14. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

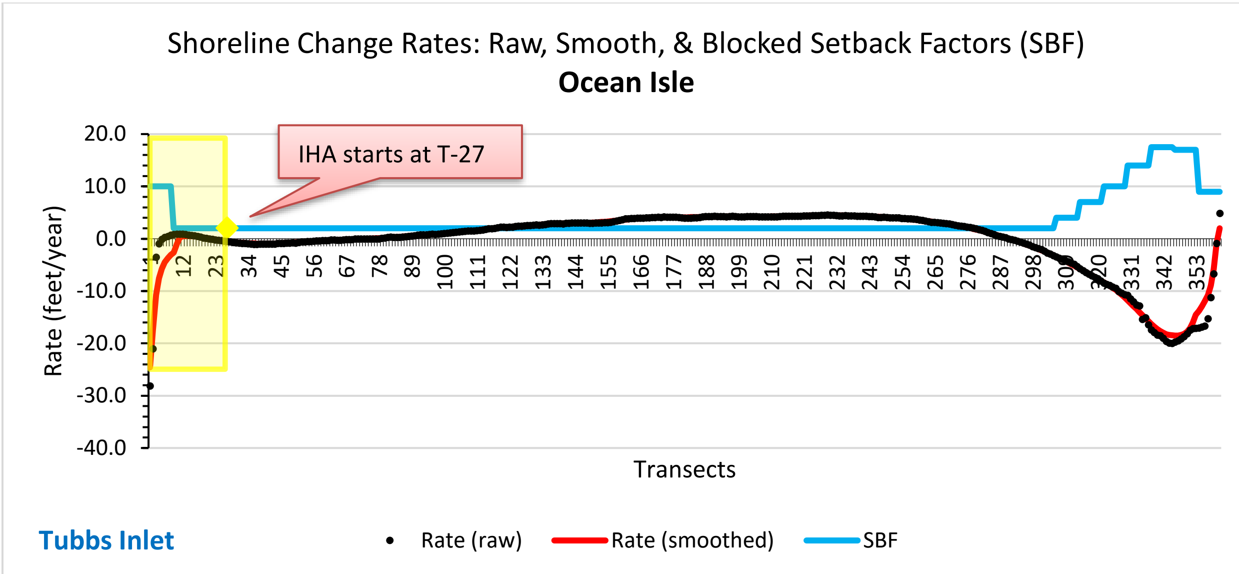


Figure 15. *This graph displays shoreline change rates represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs. The yellow box represents IHA's spatial extent along the shoreline.*

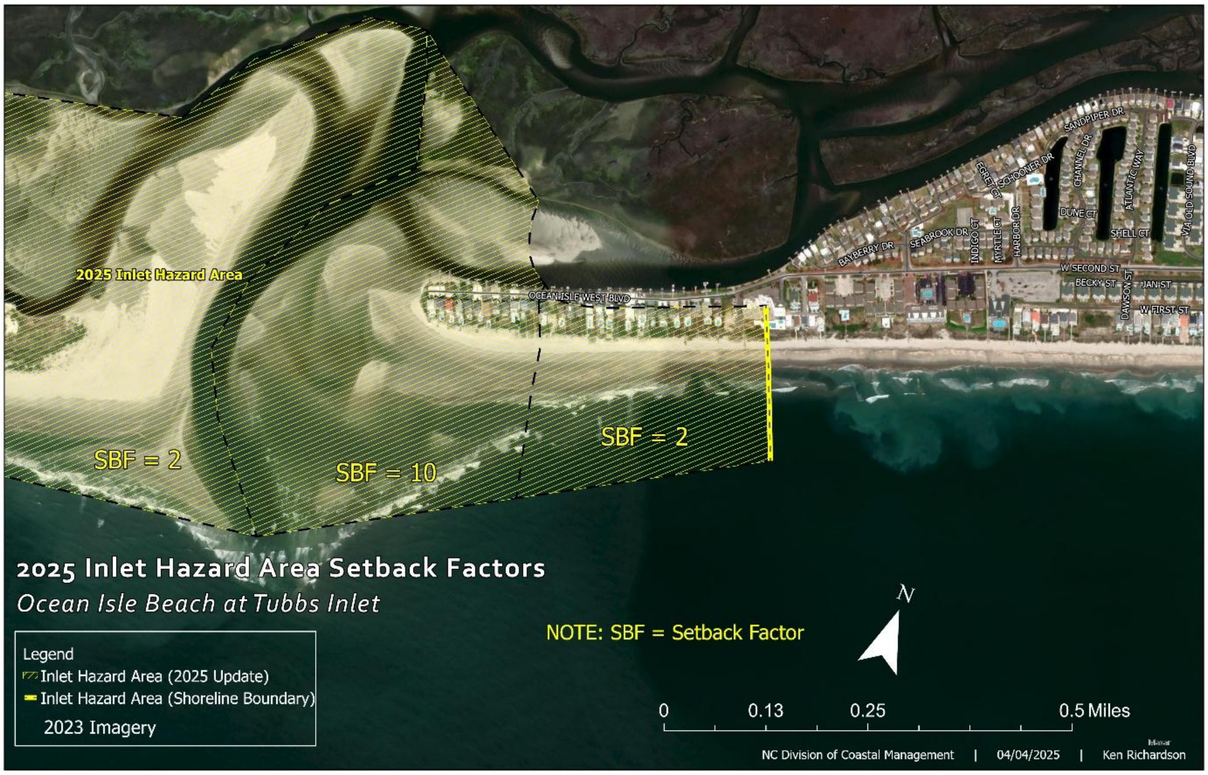


Figure 16. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

For the same area within the 2025 updated IHA, **Table 2** compares the resulting erosion setback factors with those from previous oceanfront erosion rates and setback factors studies. Although earlier studies have measured various degrees of erosion near the inlet, the use of ocean-perpendicular transects ending at the inlet, combined with the application of existing Rule 15A NCAC 07H.310, which requires using the adjacent Ocean Erodible Area (OEA), has affected the resulting setbacks. Historically, for the area where the setback factor is ten (SBF=10) (**Figure 16**), applying the setback factor from the adjacent OEA has consistently reduced the setback factor to two. While the setback factor is higher, it is reflective of inlet erosion rates, and without the use of sandbags it is expected that the erosion would have a greater impact on structures along this section of shoreline.

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

Table 2. *This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.*

3.3 Shallotte Inlet: Ocean Isle

The Ocean Isle side of Shallotte Inlet has faced persistent erosion, leading to the loss of property, homes, and infrastructure. Before the completion of the terminal groin in 2022, sandbag structures and beach nourishment efforts helped slow erosion at and near the island's east end, though they couldn't fully stop it. If the groin performs as intended, it is expected to significantly reduce erosion rates on its west side. However, continued erosion is anticipated to persist along the east side, near the inlet. More time and data area needed to measure long-term performance.

The first large-scale beach nourishment, involving over 300,000 cubic yards of sand, took place in 2001 as part of the Federal Coastal Storm Damage Reduction (CSDR) project, and has been followed by routine maintenance efforts in 2006, 2009, 2014, 2018, 2021, and 2022. While portions of sediment from some of these projects have been allocated to the shoreline within the west side of the Inlet Hazard Area (IHA), the area closest to the inlet itself has not received direct sediment replenishment.

In the 2025 updated Inlet Hazard Area, covering approximately 1 mile (5,578 feet) from transect-296 to Shallotte Inlet, the analysis included twenty-five shorelines from 1970 to 2022 (**Figure 17**). According to the measurements from this study, the average shoreline change rate within the IHA is -9.9 feet per year (erosion), ranging between -2 and -20 feet per year (**Figures 18 & 19**). As a result, erosion setback factors range from 2 starting at transect 296 and gradually increasing to 17.5 approaching the inlet (**Figure 20**).

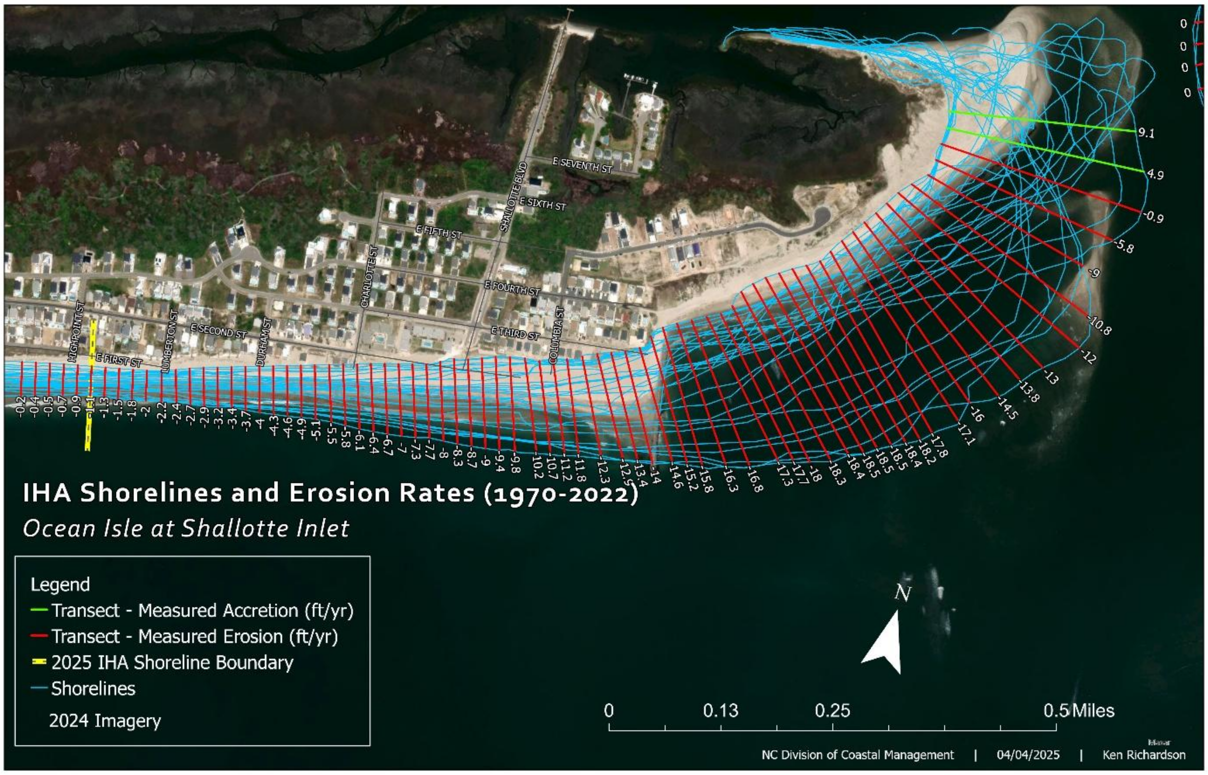


Figure 17. *This map illustrates shorelines and erosion rates measured at each transect for the area approaching Shallotte Inlet from the 2025 updated IHA alongshore boundary (yellow transect)*.

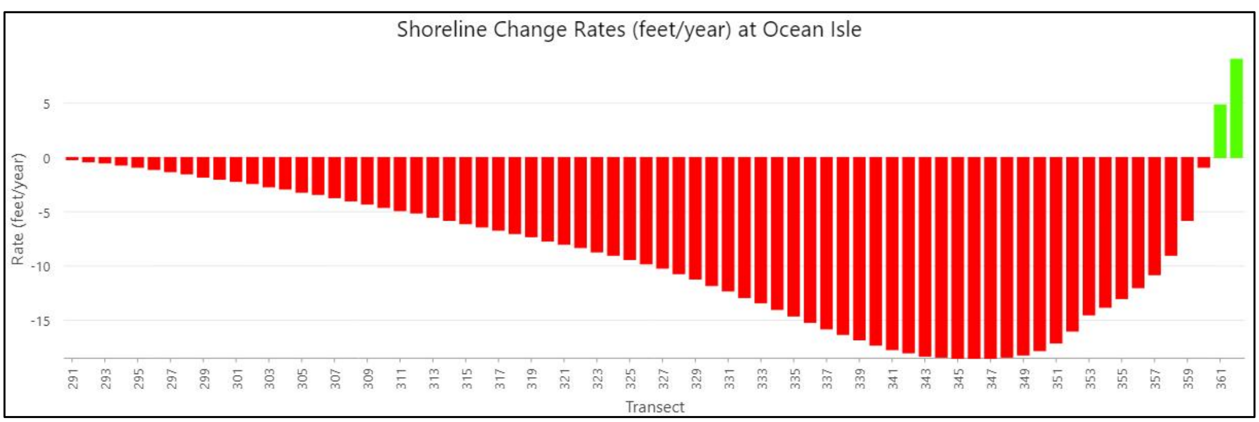


Figure 18. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

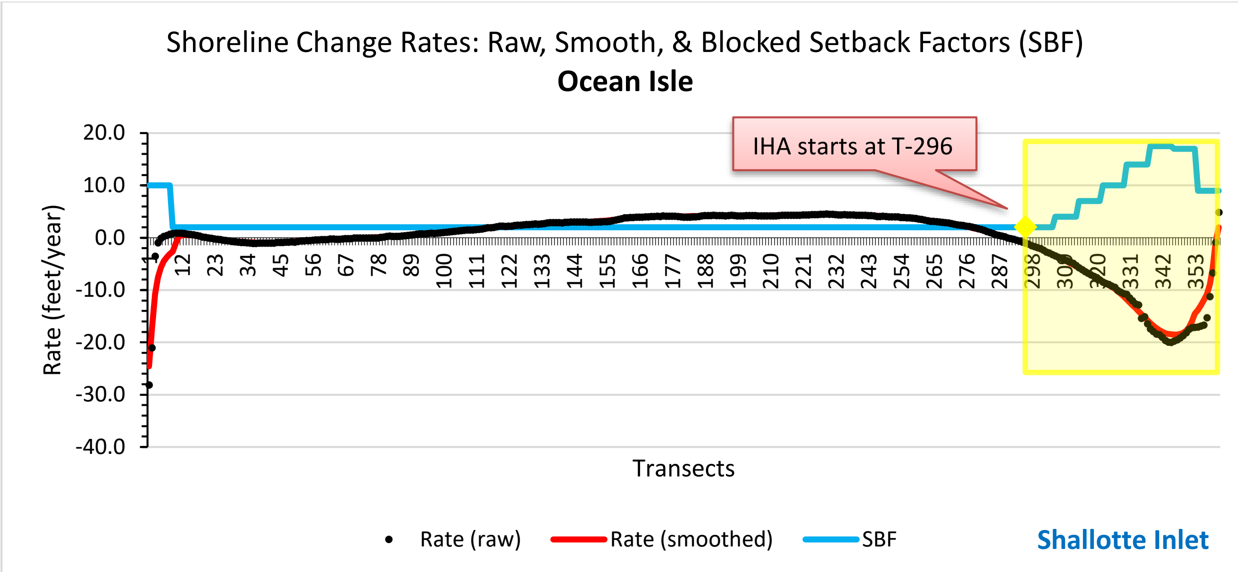


Figure 19. *This graph displays shoreline change rates represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs. The yellow box represents IHA's spatial extent along the shoreline.*

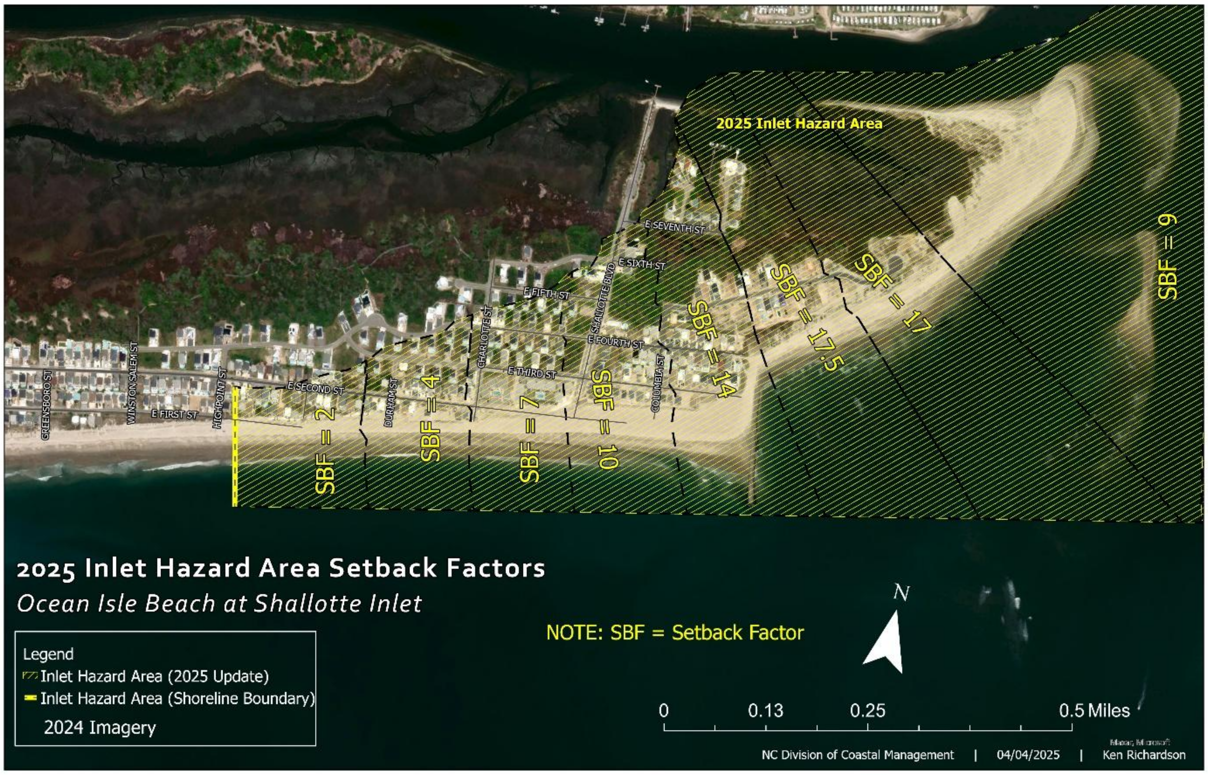


Figure 20. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

For the same area within the 2025 updated IHA, **Table 3** compares the resulting erosion setback factors with those from previous oceanfront erosion rates and setback factors studies. While earlier studies have measured various degrees of erosion near the inlet, the use of ocean-perpendicular transects ending at the inlet, combined with the application of existing Rule 15A NCAC 07H.310, which requires using the adjacent Ocean Erodible Area (OEA), has affected resulting setbacks by lowering them. Historically, for the area where the setback factor is ten (SBF=10) (**Figure 20**), it is approximately where the OEA meets the existing IHA, and the OEA's setback factor is applied throughout the IHA; which can be seen in the table. While setback factors are higher at the inlet, they are reflective of inlet erosion rates for the period of study. As mentioned, it is anticipated that in time, the terminal groin will likely reduce rates on its west side where setbacks range between 2 and 14; however, the pattern of erosion is expected to continue at the structure's east side facing the inlet.

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

Table 3. *This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.*

3.4 Shallotte Inlet: Holden Beach

While several small-scale beach nourishment projects occurred between 1971 and 1998, the first large-scale beach nourishment, involving the placement of over 300,000 cubic yards of sand, was completed in 2002 as part of the Federal Coastal Storm Damage Reduction (CSDR) project, and has been followed by routine maintenance efforts in 2003, 2004, 2006, 2008, 2009, 2011, 2014, 2015, 2017, 2019, 2020 and 2022[2].

Although Shallotte Inlet is classified as an oscillating inlet, its erosion-accretion cycle is among the longest of North Carolina's inlets. Since the 1970s, this cycle has trended towards accretion, eliminating the need for nourishment along the west end of Holden Beach and within the area covered by the 2025 IHA. However, it’s essential to understand that this extended period of accretion, while beneficial to current oceanfront structures, is unlikely to be permanent. Broader

[2] American Shore and Beach Preservation Association’s Beach Nourishment Database, 2024; Elko, N., Briggs, T.R., Benedet, L., Robertson, W., Thomson, G., Webb, B.M., Garvey, K., 2021. A Century of U.S. Beach Nourishment. Ocean & Coastal Management, 199(2021) 105406, ISSN 0964-5691.

erosion trends will eventually affect the shoreline position across much of the area inside the 2025 IHA.

In the 2025 updated Inlet Hazard Area, covering approximately 2.3 miles (11,894 feet) from transect-144 to Shallotte Inlet, the analysis included seventeen shorelines from 1970 to 2022 (**Figure 21**). According to the measurements from this study, the average shoreline change rate within the IHA is 5.6 feet per year (accretion); however, the analysis did show erosion rates approaching -20 feet per year adjacent to the inlet (**Figures 22 & 23**). As a result, erosion setback factors range from 2 starting at transect 144, then rapidly increasing to 9.5 between transects 9 and 17, and 16 between transects 1 and 9 adjacent to the inlet (**Figure 24**).

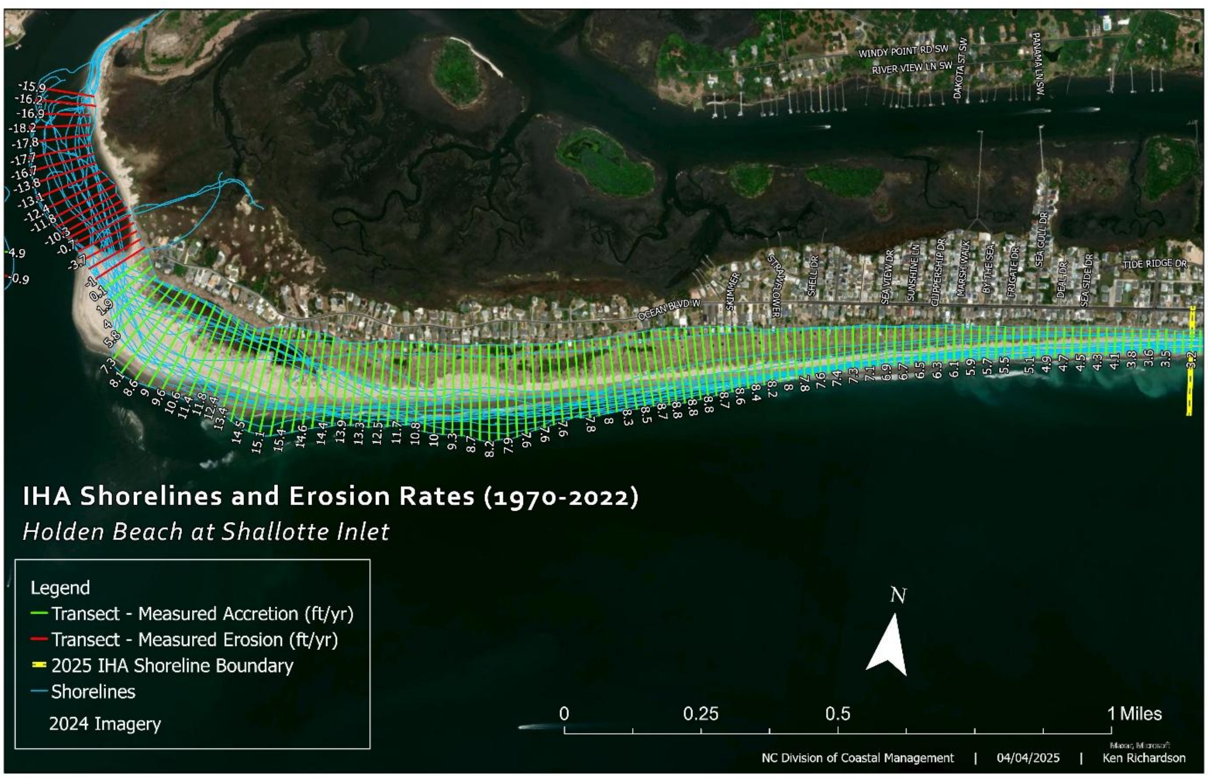


Figure 21. *This map illustrates shorelines and erosion rates measured at each transect for the area approaching Shallotte Inlet from the 2025 updated IHA alongshore boundary (yellow transect).*

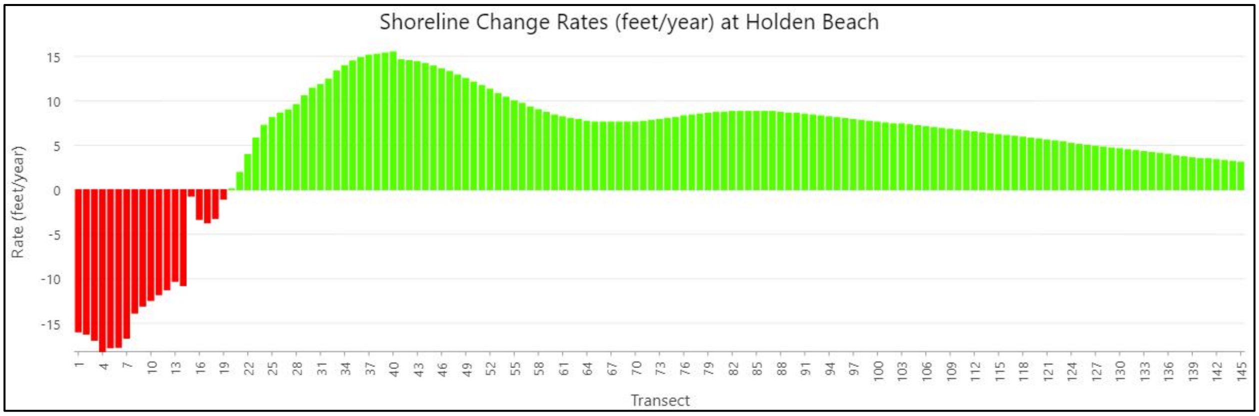


Figure 22. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

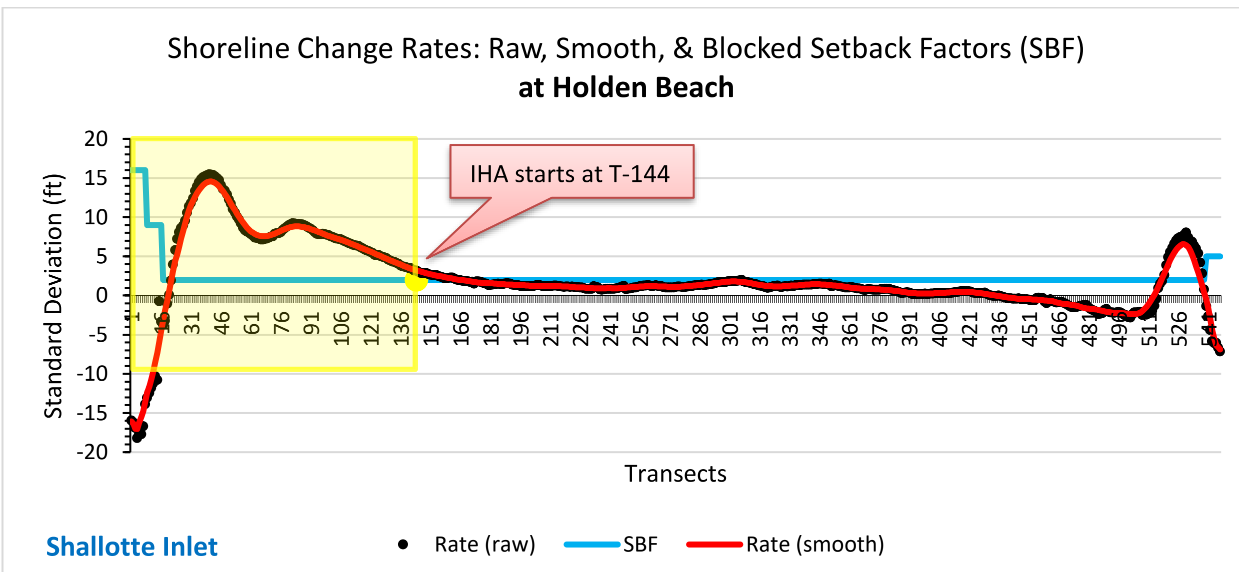


Figure 23. *This graph displays shoreline change rates represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs. The yellow box represents IHA's spatial extent along the shoreline.*

Figure 24. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

For the same area within the 2025 updated IHA, **Table 4** compares the resulting erosion setback factors with those from previous oceanfront erosion rates and setback factors studies. Because earlier studies used ocean-perpendicular transects which stopped short of the inlet, the areas where high erosion rates were measured between transects 1 and 19 were not included in previous oceanfront updates. Nevertheless, this area would have assumed its adjacent OEA's erosion setback factor which has been two based on erosion rate measurements and standards specified in current Rule 15A NCAC 07H.310. While setback factors are higher at the inlet, they are reflective of inlet erosion rates for the period of study.

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

Table 4. *This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.*

3.5 Lockwood Folly Inlet: Holden Beach

As mentioned in the previous section, several small-scale beach nourishment projects occurred along the ocean shoreline between 1971 and 1998, but the first large-scale beach nourishment, involving the placement of over 300,000 cubic yards of sand, was completed in 2002 as part of the Federal Coastal Storm Damage Reduction (CSDR) project, and has been followed by routine maintenance efforts in 2003, 2004, 2006, 2008, 2009, 2011, 2014, 2015, 2017, 2019, 2020 and 2022. However, the initial project did not extend throughout the 2025 IHA; however, it did taper off near the alongshore IHA boundary approximately between transects 478 and 487.

In the updated 2025 Hazard Area (IHA), which spans approximately 1.2 miles (6,239 feet) from transect 478 to Lockwood Folly Inlet, the analysis examined eighteen shorelines from 1970 to 2021 (**Figure 25**). The study found an average shoreline change rate of less than -2 feet per year across the IHA. However, localized erosion rates were observed, approaching -3 feet per year along the ocean side IHA boundary and as much as -7 feet per year within the inlet. A transitional area of accretion between the oceanfront and the inlet helped reduce the overall average rate of change (**Figure 26**). As a result, erosion setback factors range from 2 throughout most of the IHA until increasing to 5 along the shoreline adjacent to the inlet channel between transect 540 and the Intracoastal Waterway (**Figure 27**).

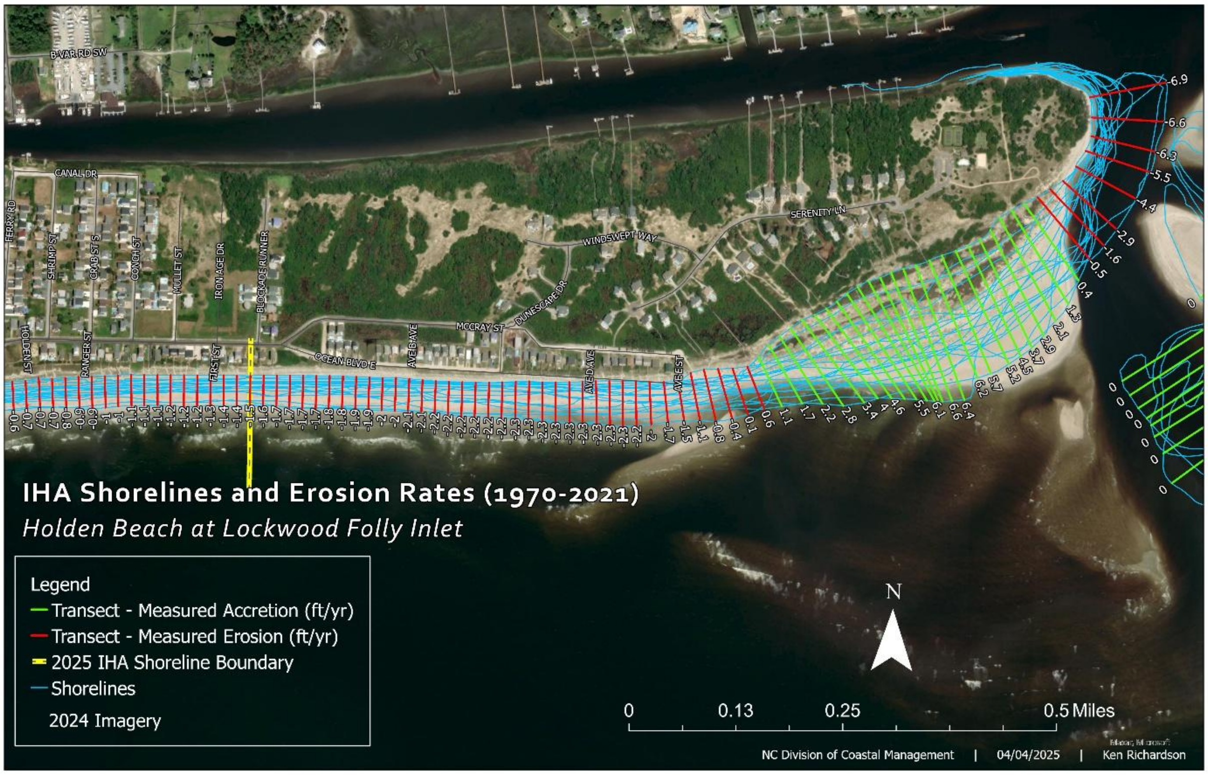


Figure 25. *This map illustrates shorelines and erosion rates measured at each transect for the area approaching Lockwood Folly Inlet from the 2025 updated IHA alongshore boundary (yellow transect).*

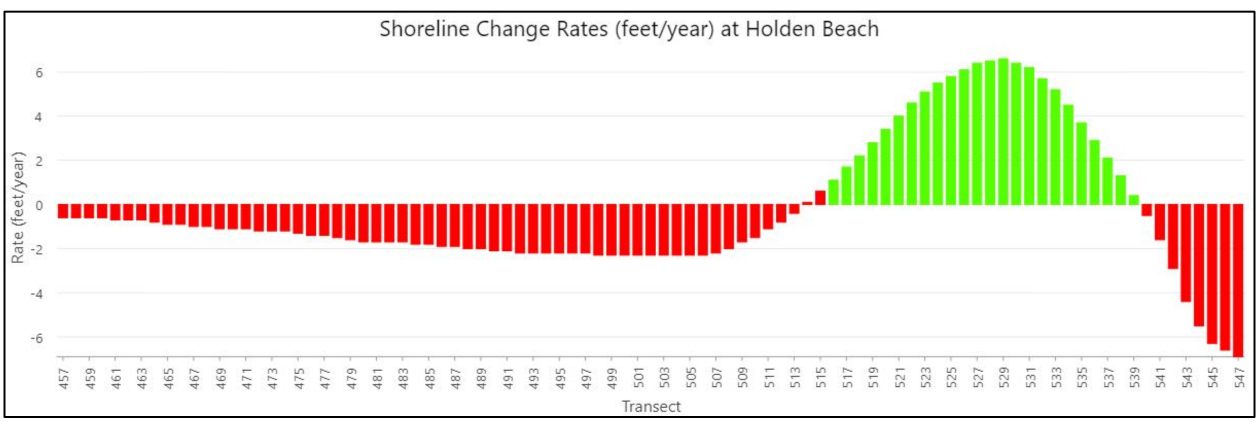


Figure 26. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

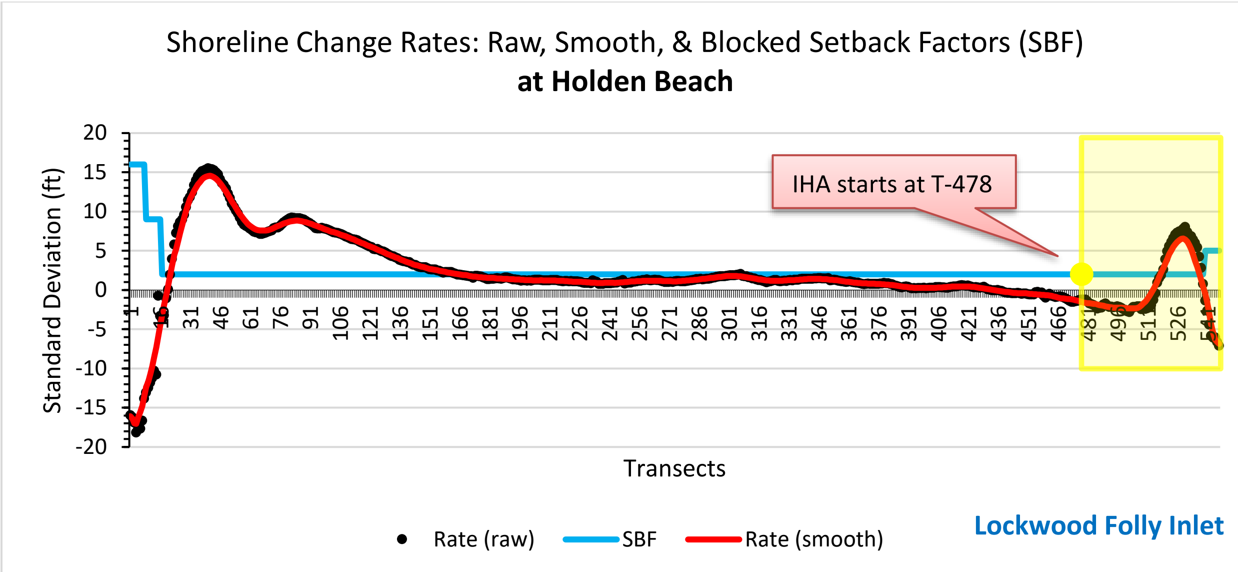


Figure 27. *This graph displays shoreline change rates represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs. The yellow box represents IHA's spatial extent along the shoreline.*

Figure 28. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

In the same area within the 2025 updated Inlet Hazard Area (IHA), **Table 5** compares the erosion setback factors derived from this analysis with those from previous oceanfront erosion rate and setback factor studies. Earlier studies, which used ocean-perpendicular transects that terminated before reaching the inlet, excluded areas with high erosion rates measured between transect 540 and the Intracoastal Waterway. Additionally, those earlier studies analyzed a longer period and applied the end-point method, resulting in higher erosion rate estimates between 1983 and 2020. This methodological difference complicates direct comparisons with the current analysis. However, this area would have adopted the erosion setback factor of its adjacent Ocean Erodible Area (OEA), based on standards outlined in current Rule 15A NCAC 07H.310.

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

Table 5. *This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.*

3.6 Lockwood Folly: Oak Island

Oak Island installed its first large-scale beach nourishment project in 2001 where the western end of the project tapered off in the area inside the 2025 IHA boundary approximately between transects 61 and 81. In 2019 and 2022, beneficial use of dredged material from the inlet, AIWW crossing and eastern channel was completed by the USACE's navigation initiatives resulting in material being placed along the western end of Oak Island stopping short of the inlet at approximately transect-20.

In the updated 2025 Hazard Area (IHA), which spans approximately 1.4 miles (7,500 feet) from transect 81 to Lockwood Folly Inlet, the analysis examined twenty-seven shorelines from 1970 to 2021 (**Figure 29**). The study found an average shoreline change rate equal to 3.5 feet per year (accretion) across the IHA (**Figure 30**). However, localized erosion rates less than -2 feet per year were observed between transects 34 and 55 (**Figures 30 & 31**). As a result, the erosion setback factor is 2 throughout the IHA (**Figure 32**).

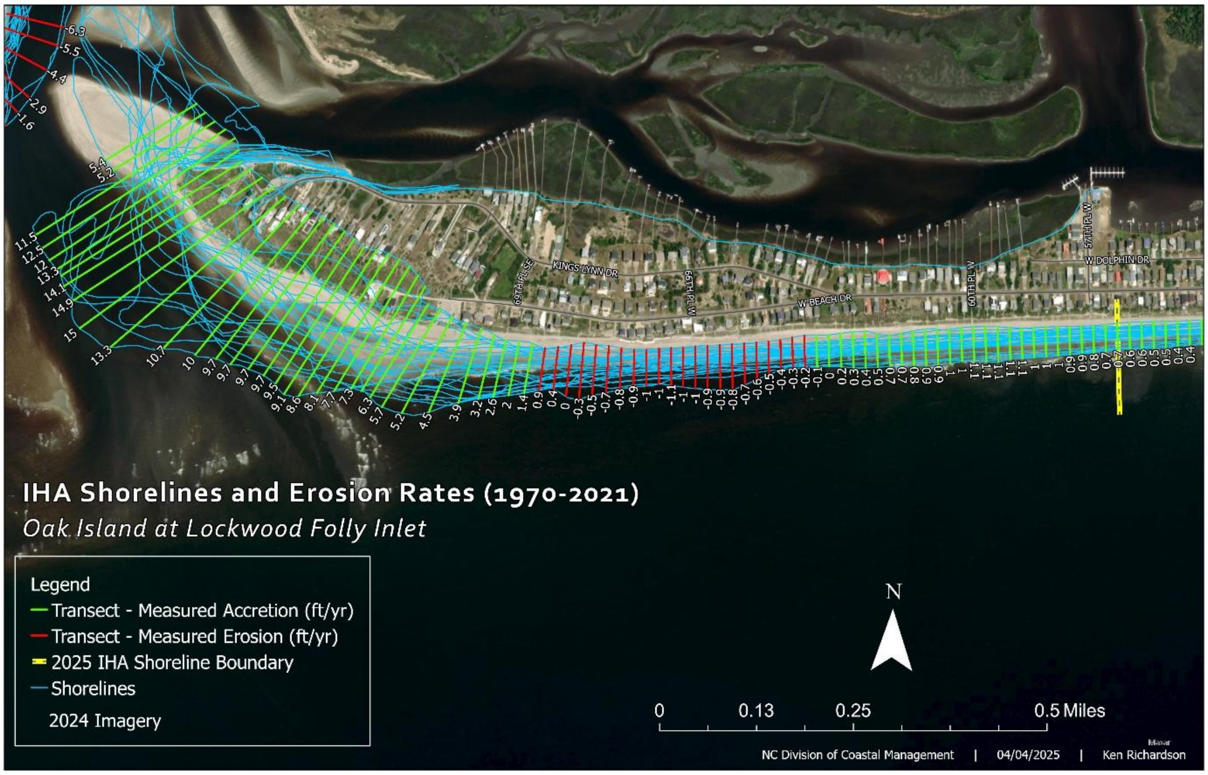


Figure 29. *This map illustrates shorelines and erosion rates measured at each transect for the area approaching Lockwood Folly Inlet from the 2025 updated IHA alongshore boundary (yellow transect).*

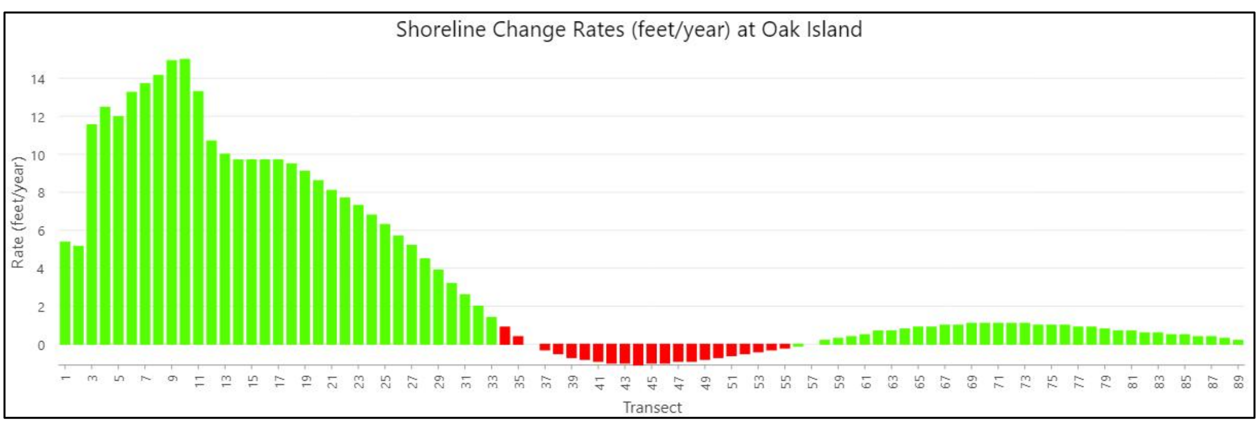


Figure 30. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

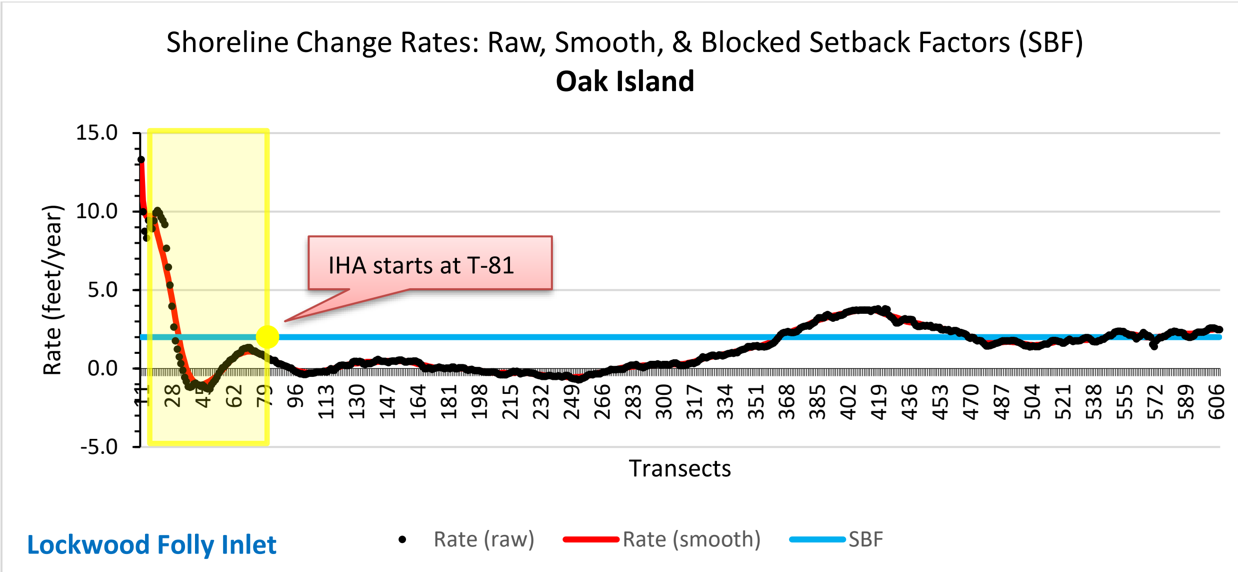


***Figure 31**. This graph displays shoreline change rates represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs. The yellow box represents IHA's spatial extent along the shoreline.*

Figure 32. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

In the same area within the 2025 updated Inlet Hazard Area (IHA), **Table 6** compares the erosion setback factors derived from this analysis with those from previous oceanfront erosion rate and setback factor studies. While methodologies and periods of study differ, the erosion setback factors have generally remained consistent for the area inside the 2025 IHA boundary.

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

Table 6. *This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.*

3.7 Carolina Beach Inlet: Carolina Beach

Carolina Beach Inlet, opened in 1952 to serve private interests, has undergone numerous beach fill projects over the years. Between 1955 and 1998, these projects were relatively small in scale and associated with navigational channel maintenance. However, in 2001, the U.S. Army Corps of Engineers (USACE) completed the Town's first large-scale project under the Coastal Storm Damage Reduction (CSDR) program, now referred to as Coastal Storm Risk Management (CSRM). Since then, additional large-scale projects were completed in 2006-2007, 2009-2010, 2014, 2018, and 2022. Following the inlet's opening, chronic erosion affected both the Carolina Beach side and the Masonboro Island side. To address this, the U.S. Army Corps of Engineers (USACE) constructed an initial 1,100-foot rock revetment in 1970, followed by an additional 950-foot section in 1973, bringing the total length to 2,050 feet.

In the updated 2025 Hazard Area (IHA), which spans approximately 1.6 miles (8,500 feet) from transect 2119 to Carolina Beach Inlet, the analysis examined twenty shorelines from 1971 to 2021 (**Figure 33**). The study found an average shoreline change rate equal to 4.1 feet per year (accretion) across the IHA. However, localized erosion rates approaching -5 feet per year were observed within the inlet between transects 2210 and 2225 (**Figures 34 & 35**). As a result, the erosion setback factor is 2 throughout the IHA (**Figure 36**).

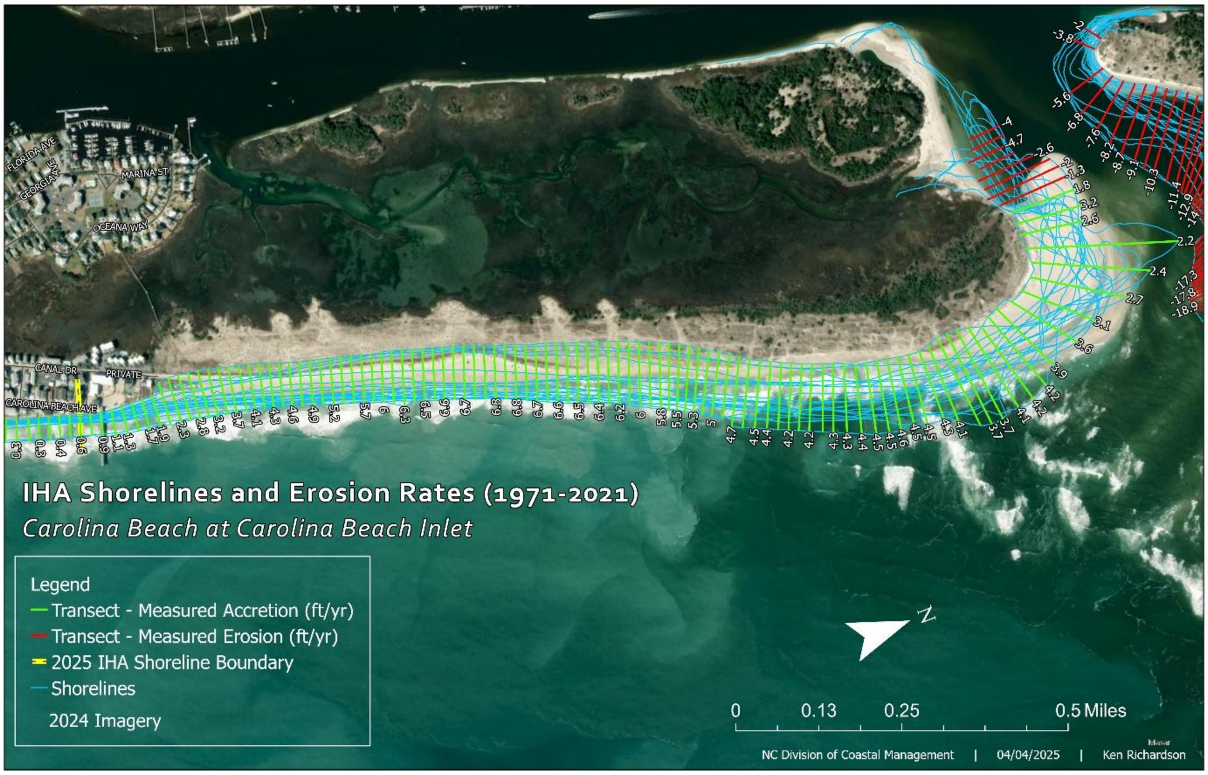


Figure 33. *This map illustrates shorelines and erosion rates measured at each transect for the area approaching Carolina Beach Inlet from the 2025 updated IHA alongshore boundary (yellow transect).*

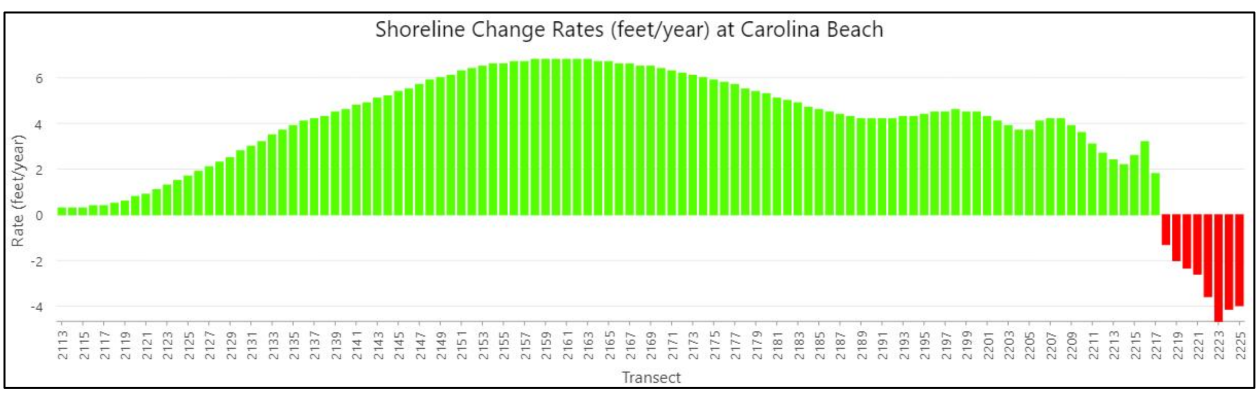


Figure 34. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

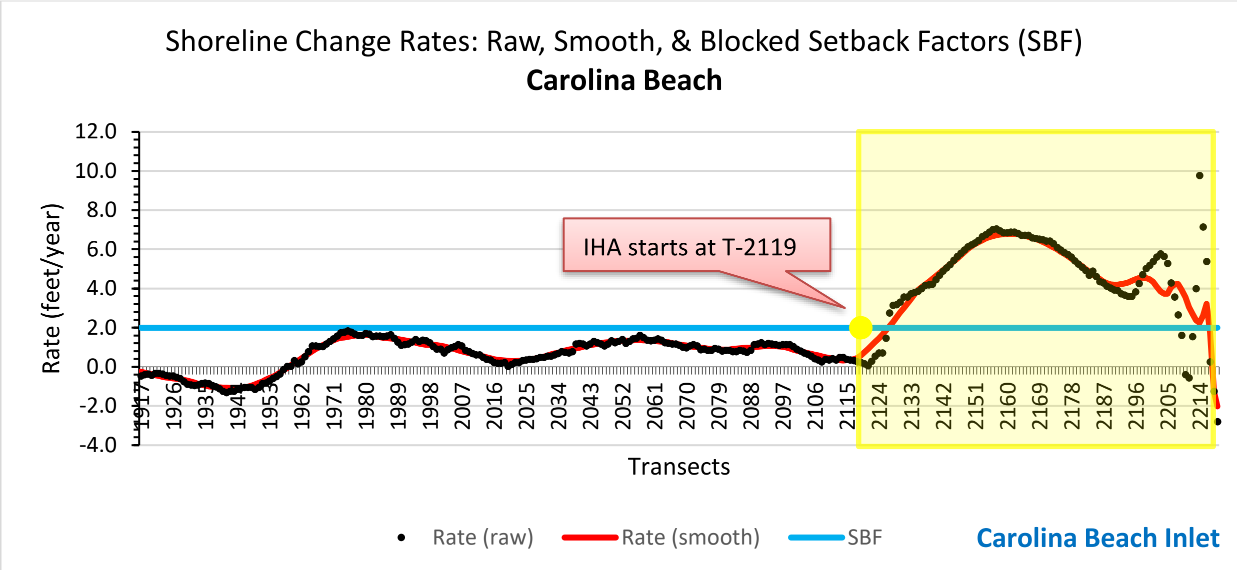


Figure 35. *This graph displays shoreline change rates represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs. The yellow box represents IHA's spatial extent along the shoreline.*

Figure 36. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

In the same area within the 2025 updated Inlet Hazard Area (IHA), **Table 7** compares the erosion setback factors derived from this analysis with those from previous oceanfront erosion rate and setback factor studies. It's important to note that at this location, the differences can be explained by the differences associated with calculation methodologies, periods of study, and pre-inlet conditions considered in earlier studies.

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

Table 7. *This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.*

3.8 Carolina Beach & Masonboro Inlets: Masonboro Island

The updated 2025 Hazard Area (IHA) spans the entirety of Masonboro Island (8 miles) given the influences of Carolina Beach Inlet and navigational jetties at Masonboro Inlet on the island's north end. The study found an average shoreline change rate equal to -6.8 feet per year (erosion) across the IHA. However, localized results varied significantly ranging between 13.5 (accretion) and -22.5 (erosion) feet per year (**Figure 45**). Measured accretion adjacent to the Masonboro Inlet south-jetty is a result of construction of the south jetty in 1980 trapping sand on the northern oceanfront of Masonboro Island, reversing the rapid erosion that followed construction of the north jetty. Within the next decade, the fillet created south of the new jetty accreted over 420 feet and eventually stabilized. The fillet has stabilized at least 3000 feet of Masonboro Island shoreline immediately south of the jetty. Erosion setback factors range from 2 on the island's north end and increase moving south up to 18 at Carolina Beach Inlet (**Figure 46** to **Figure 49**).

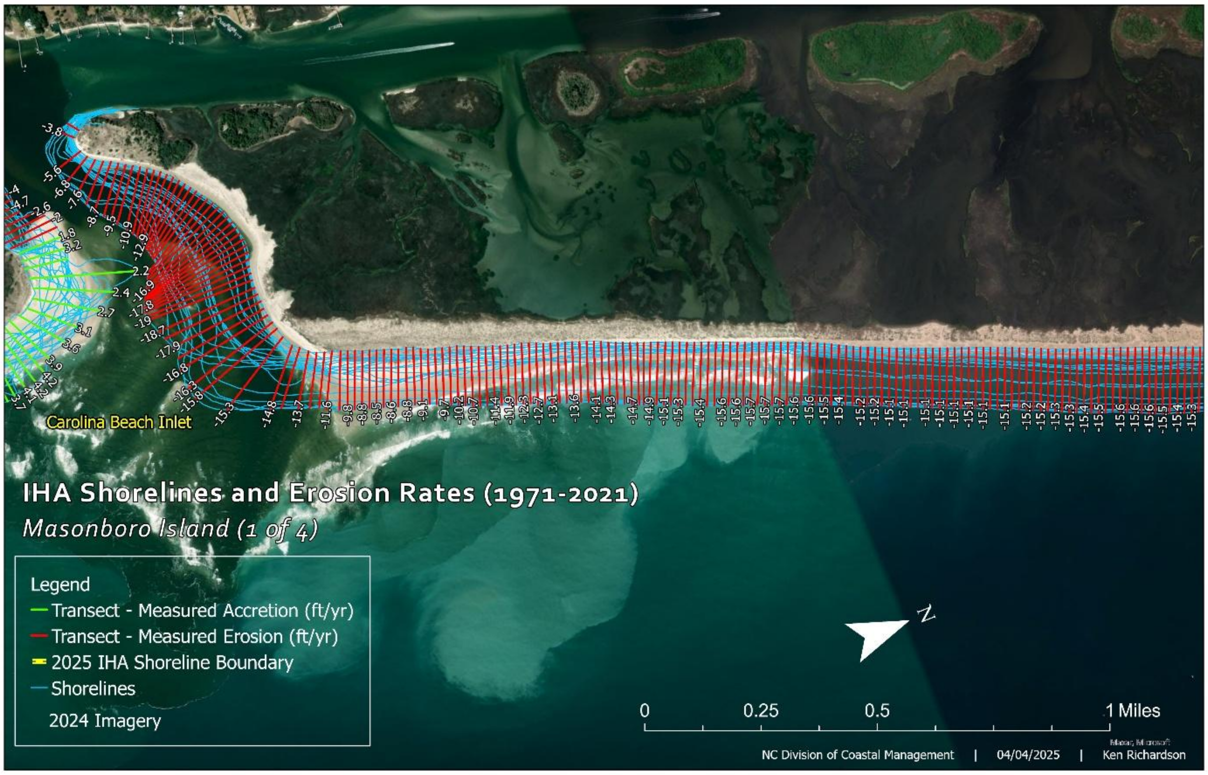


Figure 37. *This map illustrates shorelines and erosion rates measured at each transect.*

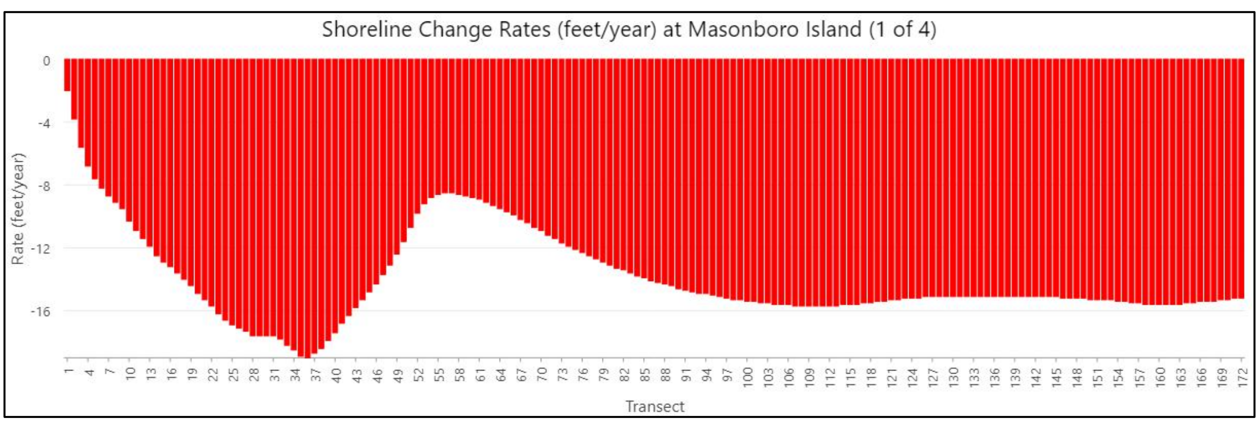


Figure 38. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

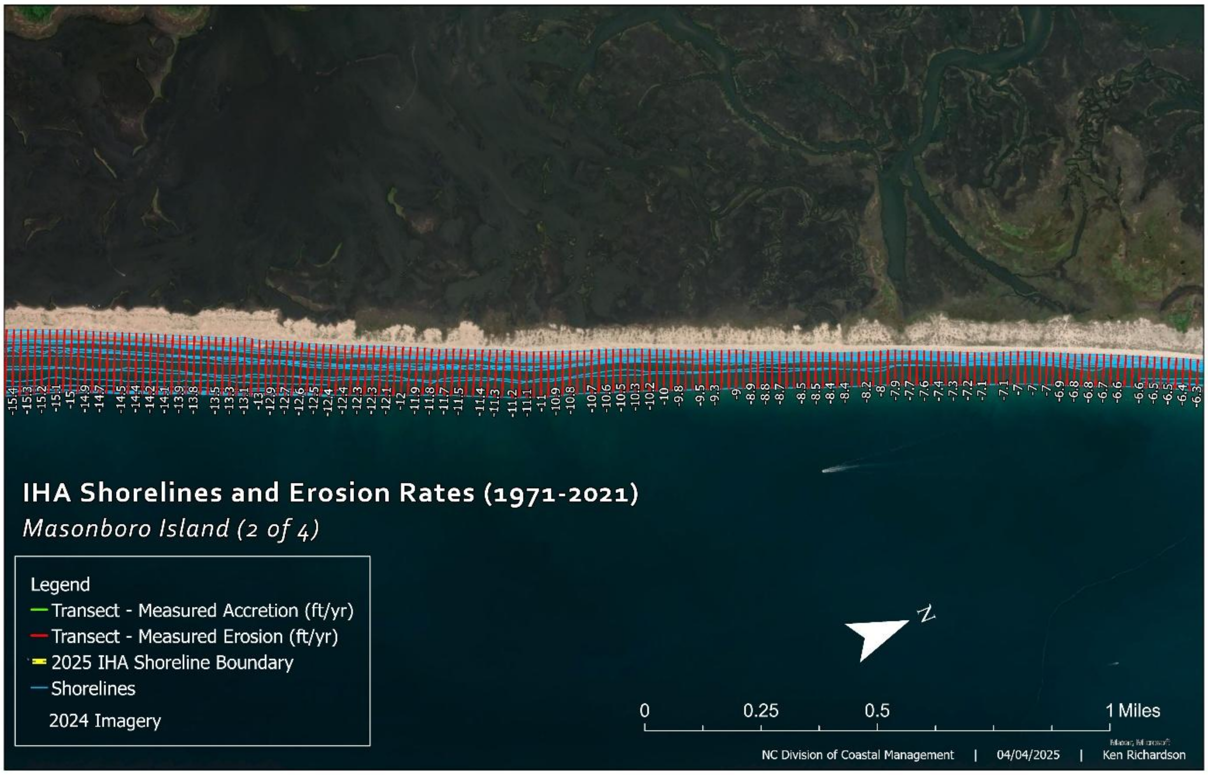


Figure 39. *This map illustrates shorelines and erosion rates measured at each transect.*

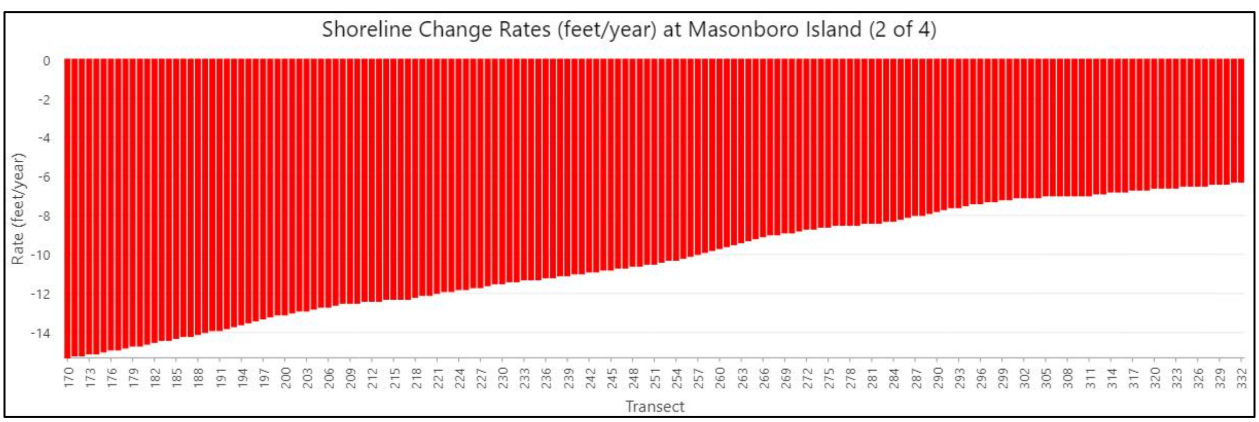


Figure 40. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

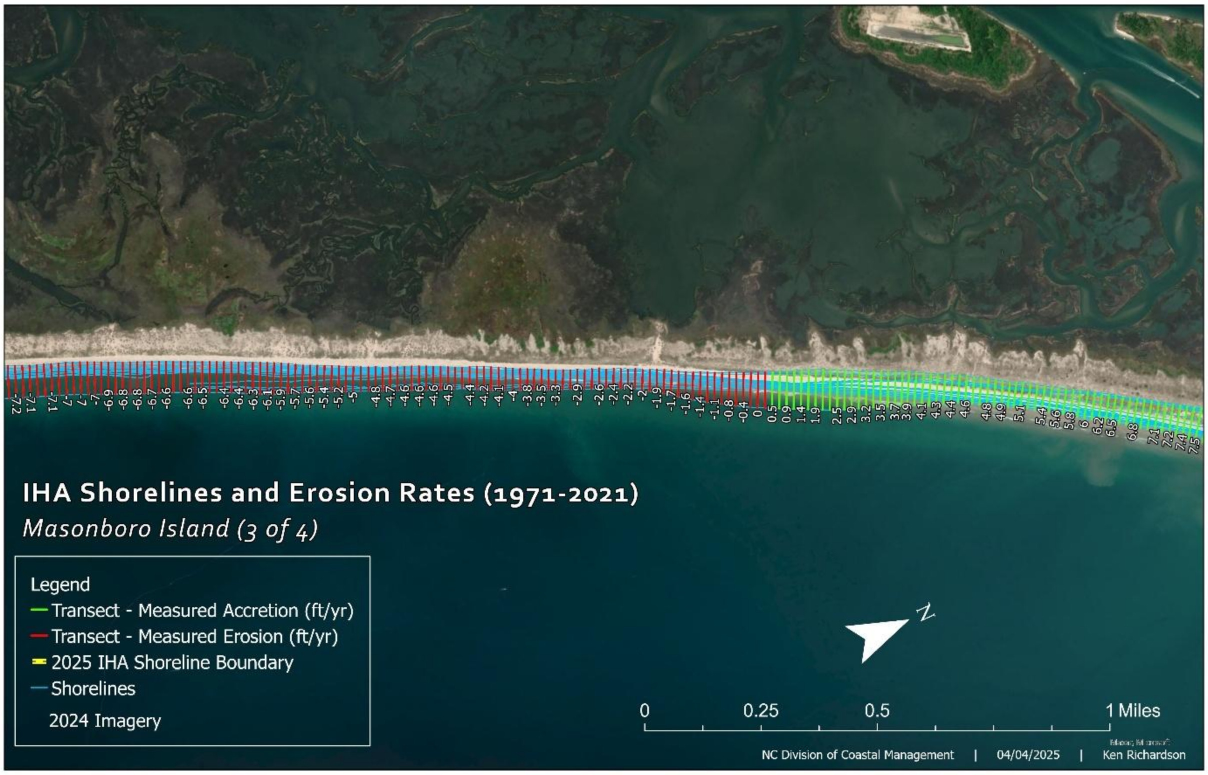


Figure 41. *This map illustrates shorelines and erosion rates measured at each transect.*

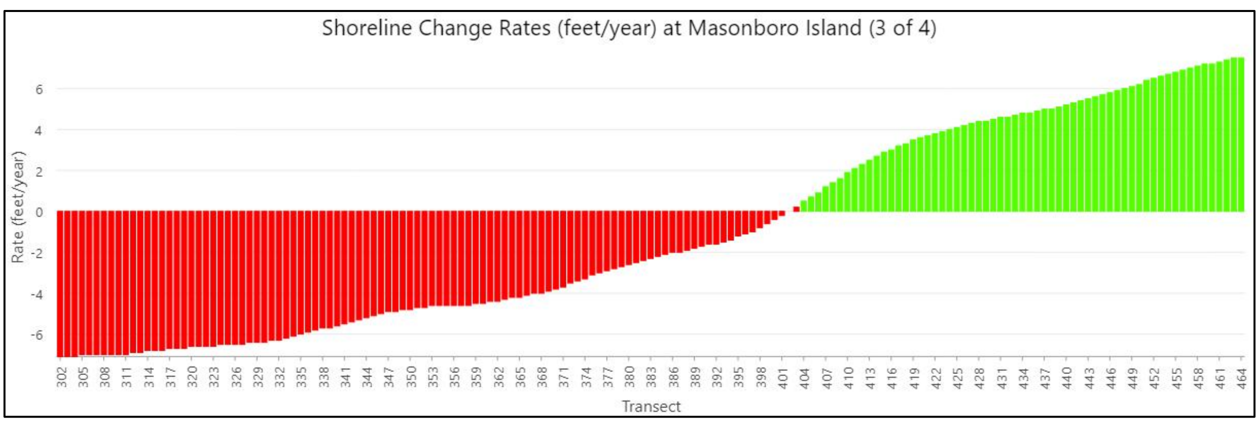


Figure 42. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

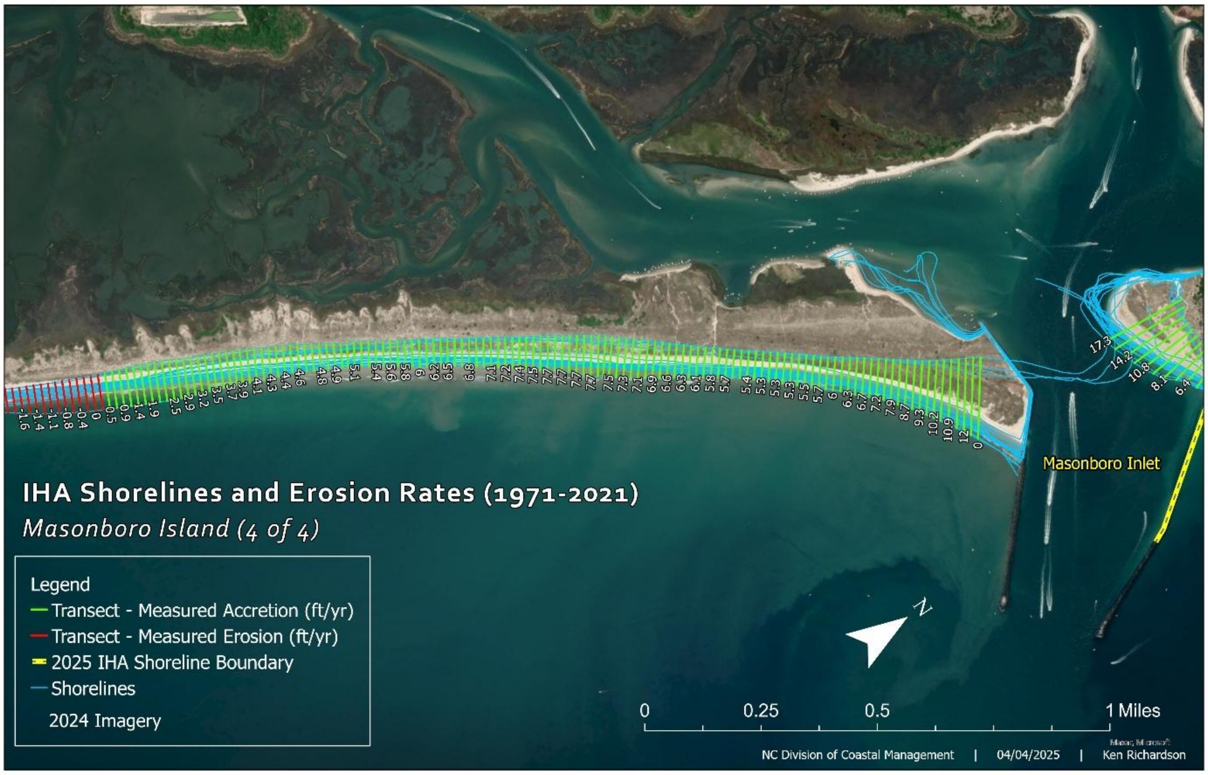


Figure 43. This map illustrates shorelines and erosion rates measured at each transect.

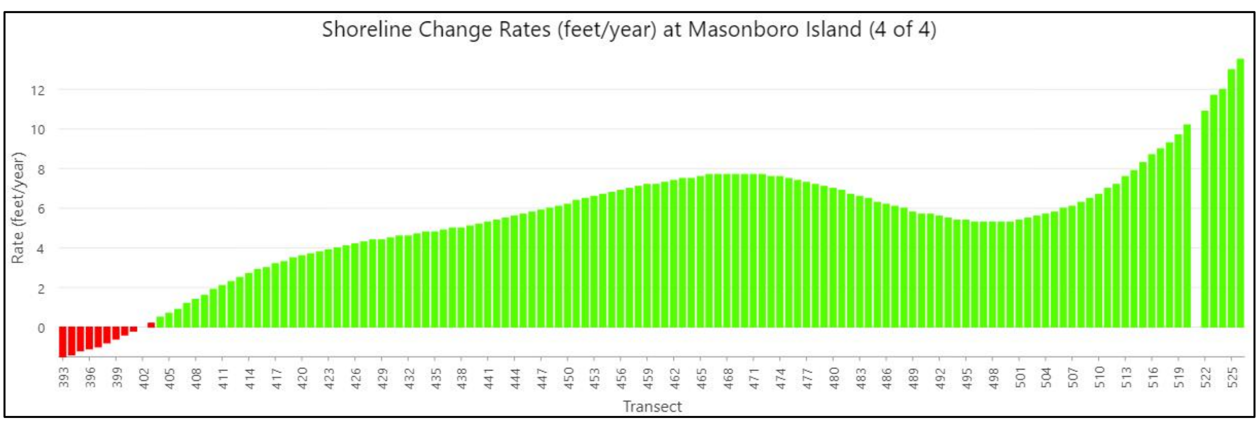


Figure 44. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

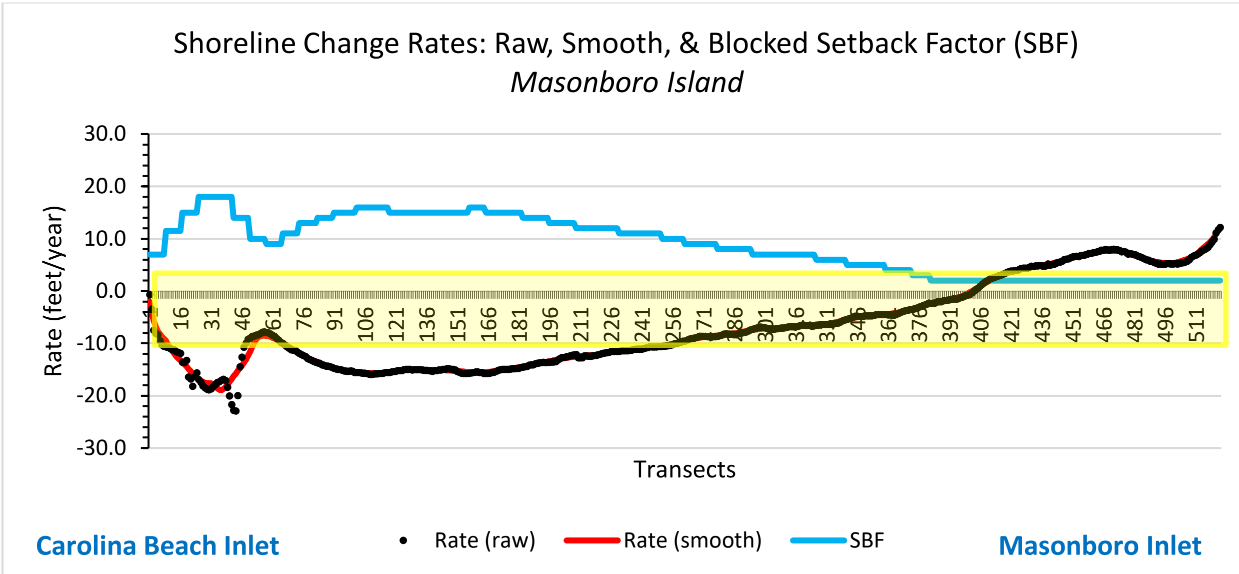


Figure 45. *This graph displays shoreline change rates represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs. The yellow box represents IHA's spatial extent along the shoreline.*

Figure 46. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

Figure 47. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

Figure 48. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

Figure 49. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

Within the 2025 updated Inlet Hazard Area (IHA), **Table 8** compares erosion setback factors from this analysis to those from earlier oceanfront erosion rate and setback factor studies. Prior to the 2004 oceanfront study, the results were predominately influenced by the newly constructed south jetty at Masonboro Island, which shifted the area's dynamics from high erosion to accretion. Since 2004, studies have consistently shown accretion near the jetty, transitioning to erosion further south. Despite differing calculation methods and study periods, the findings in this study remain generally consistent with post-2004 studies.

Area Inside IHA	**2025**	**2020**	**2013**	**2004**	**1997**	**1986**	**1983**	**1980**
SBF = 2	2 to 18	2 to 29	2 to 12.5	2 to 12	4 to 7	5 to 7	4 to 12.5	2.4

Table 8. *This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.*

3.9 Masonboro Inlet: Wrightsville Beach

Wrightsville Beach holds NCs record for the most completed projects over the longest period. Small-scale efforts associated with navigational channel maintenance began as early as 1939. However, larger projects were not installed until 1965-1966, following Congressional authorization in 1962, and coinciding with the completion of the north jetty in 1966. However, NC considers the first large-scale project at Wrightsville Beach occurred in 1980-1981, and has been followed by routine maintenance since then, culminating in the most recent project completed in 2024. Collectively, the installation of the jetty and routine beach fill practices has been effective at stabilizing the inlet and resulting measured accretion.

In the updated 2025 Inlet Hazard Area (IHA), the boundary ends at the north jetty between transects 11 and 12. An analysis of nineteen shorelines from 1973 to 2020 (**Figure 50**) revealed an average shoreline change rate of 9.3 feet per year (accretion) across the IHA (**Figures 51 & 52**). Consequently, the erosion setback factor is set at 2 throughout the area (**Figure 53**).

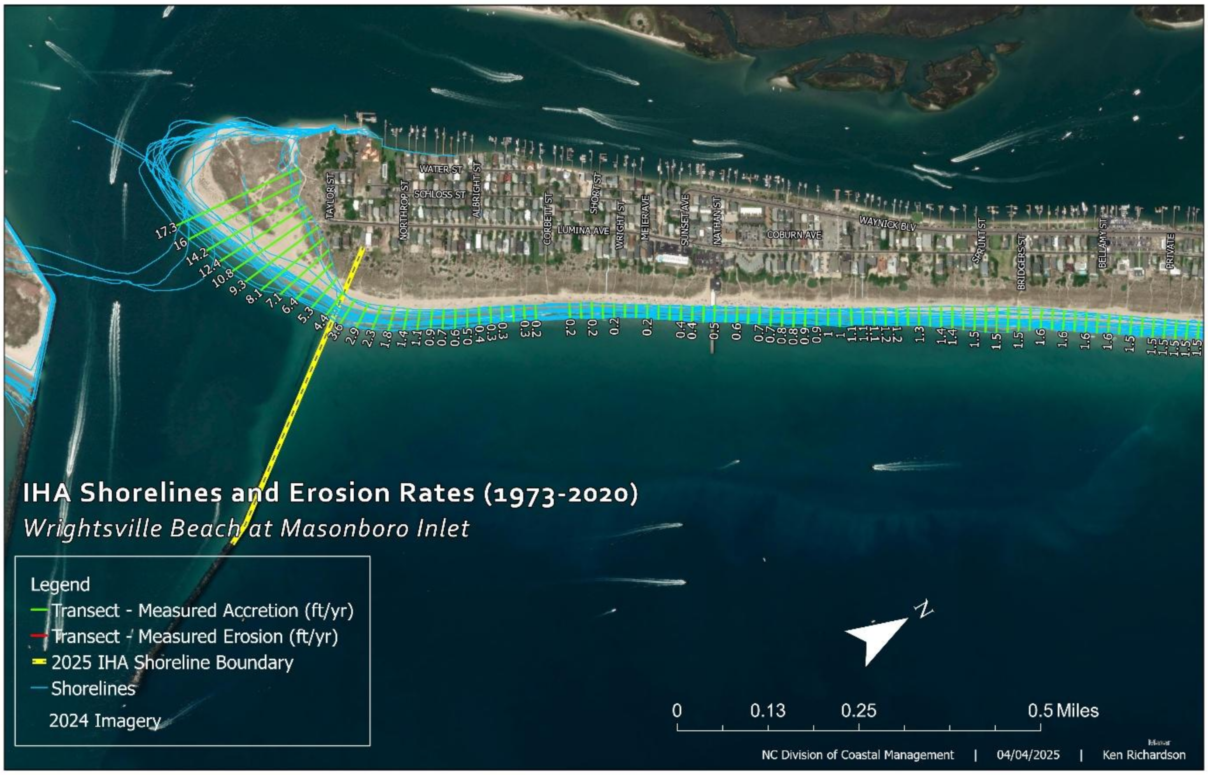


Figure 50. *This map illustrates shorelines and erosion rates measured at each transect for the area approaching Masonboro Inlet from the 2025 updated IHA alongshore boundary (yellow transect).*

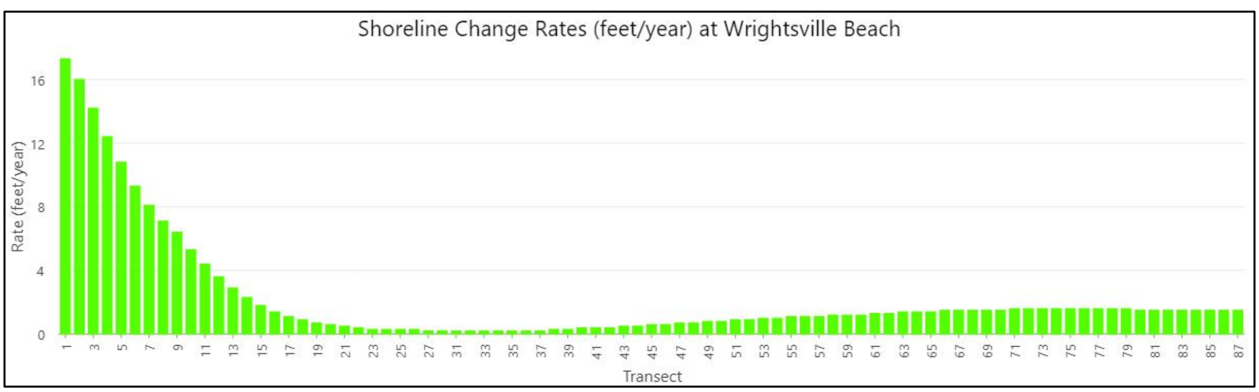


Figure 51. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

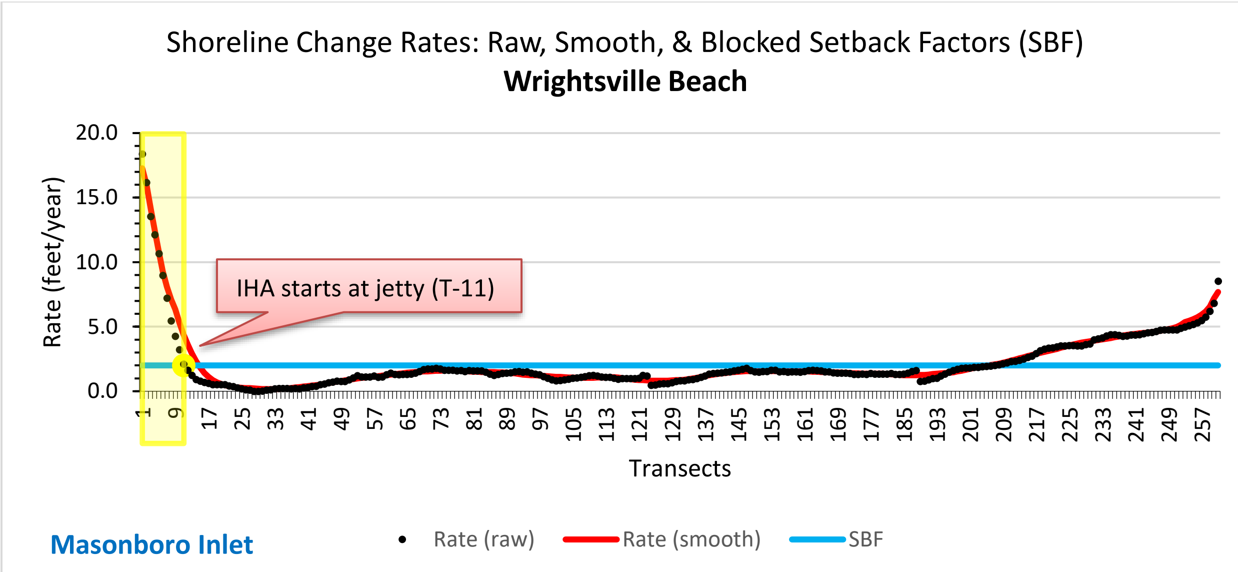


Figure 52. *This graph displays shoreline change rates represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs. The yellow box represents IHA's spatial extent along the shoreline.*

Figure 53. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

Within the 2025 updated Inlet Hazard Area (IHA), **Table 9** compares erosion setback factors from this analysis to those from earlier oceanfront erosion rate and setback factor studies. Despite differing calculation methods and study periods, the findings in this study remain generally consistent with earlier studies.

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

Table 9. *This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.*

3.10 Mason Inlet: Wrightsville Beach

Mason Inlet is a small migrating system that opened in the early 1880s 1.8 miles northeast of its current location. For the period between 1971 and 2020, and while the inlet shoreline consistently migrated toward Wrightsville Beach, the oceanfront shoreline near Shell Island Resort (last structure closest to the inlet) remained generally stable and accretional due to pre-relocation inlet influences **Figure 54**. However, the post-2002 analysis highlights significant erosion as the oceanfront shoreline adjusted to the relocated inlet's stabilized position **Figure 56**. While post-2002 data were utilized to delineate the alongshore IHA boundary at transect 249, 1971 to 2020 data more accurately reflect long-term erosion rates **Figure 57**. This trend is expected to continue with the routine beach nourishment and maintenance dredging activities at Mason Inlet to limit its migration.

As mentioned in Section 3.9, Wrightsville Beach has an extensive history of managing its oceanfront shoreline with beach nourishment. However, the area within the 2025 IHA at Mason Inlet was not included in the Town's initial large-scale project. Within the updated 2025 Inlet Hazard Area (IHA), the analysis included seventeen shorelines from 1971 to 2020 (**Figure 54**) revealed an average shoreline change rate of 5.2 feet per year (accretion) across the IHA (**Figure 55**). Consequently, the erosion setback factor is set at 2 throughout the area (**Figure 59**).

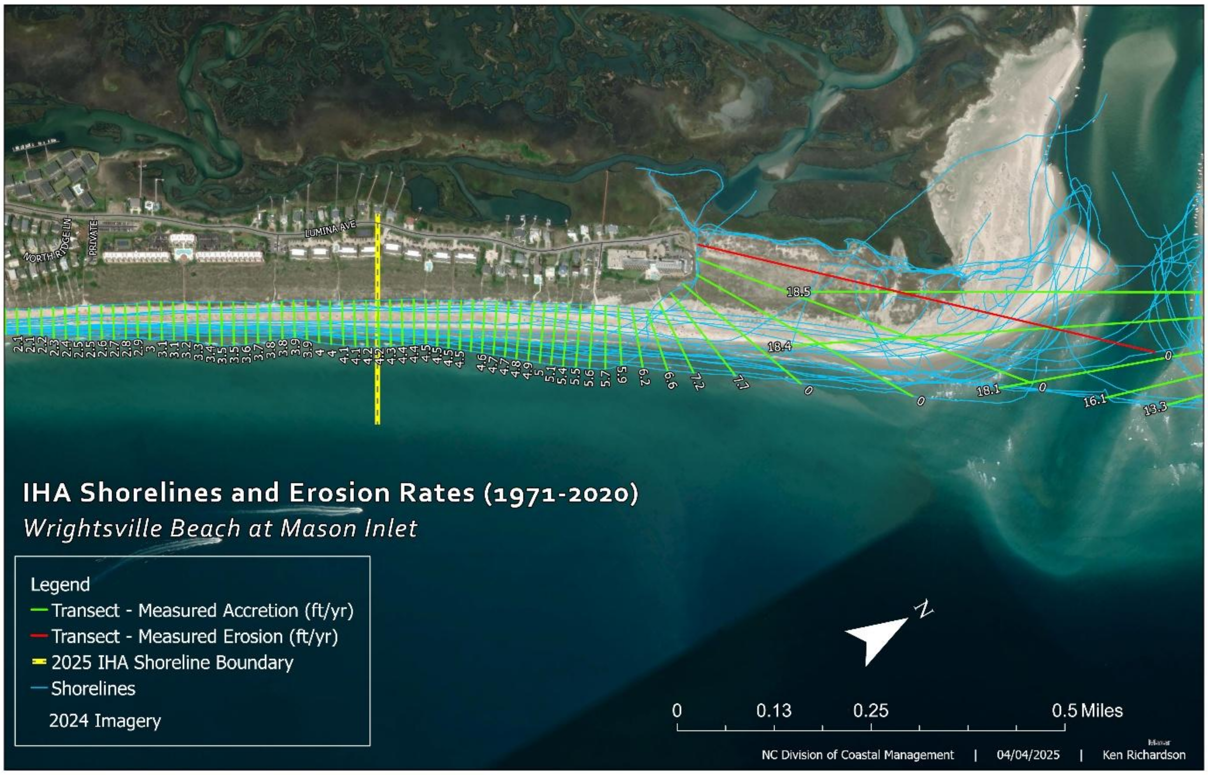


Figure 54. *This map illustrates shorelines and erosion rates measured at each transect for the area approaching Mason Inlet from the 2025 updated IHA alongshore boundary (yellow transect).*

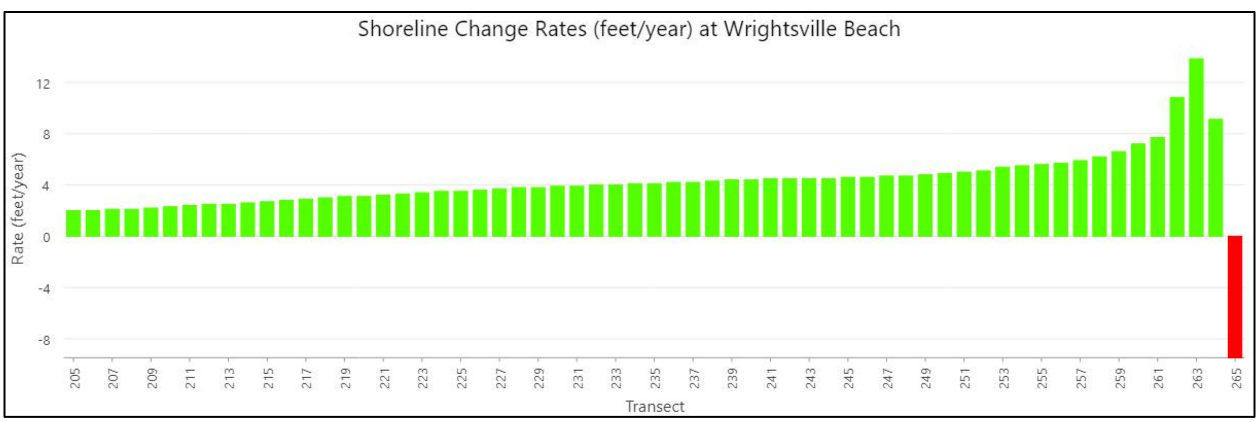


Figure 55. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

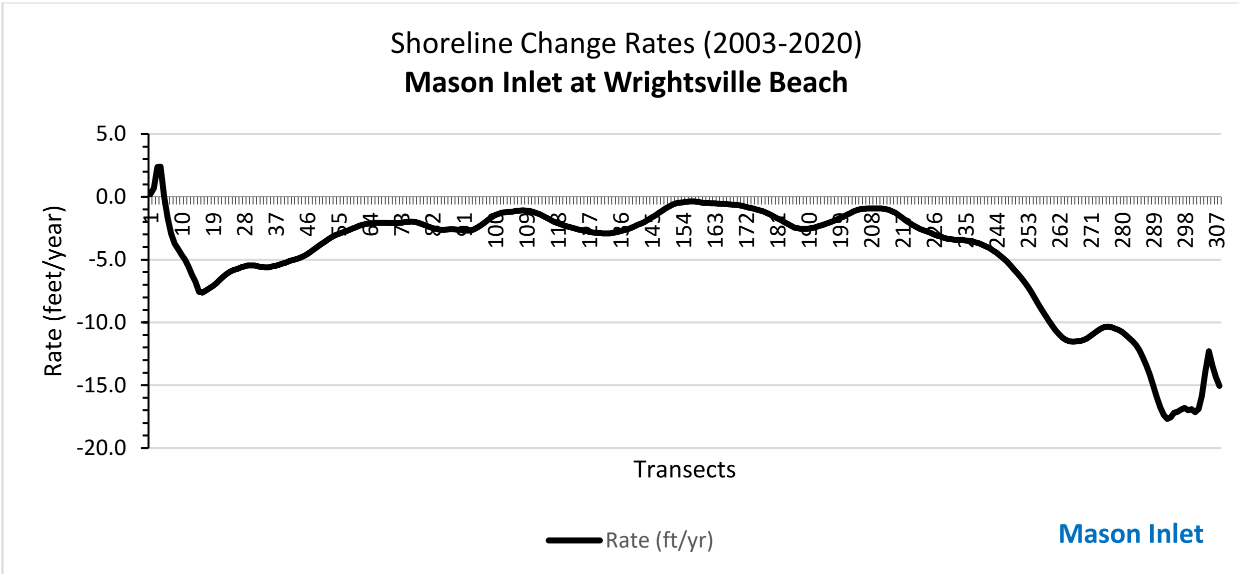


Figure 56. *This graph shows post-2002 shoreline change rates. Notice measured erosion significantly increases between transects 208 and 307 approaching Mason Inlet following the inlets relocation.*

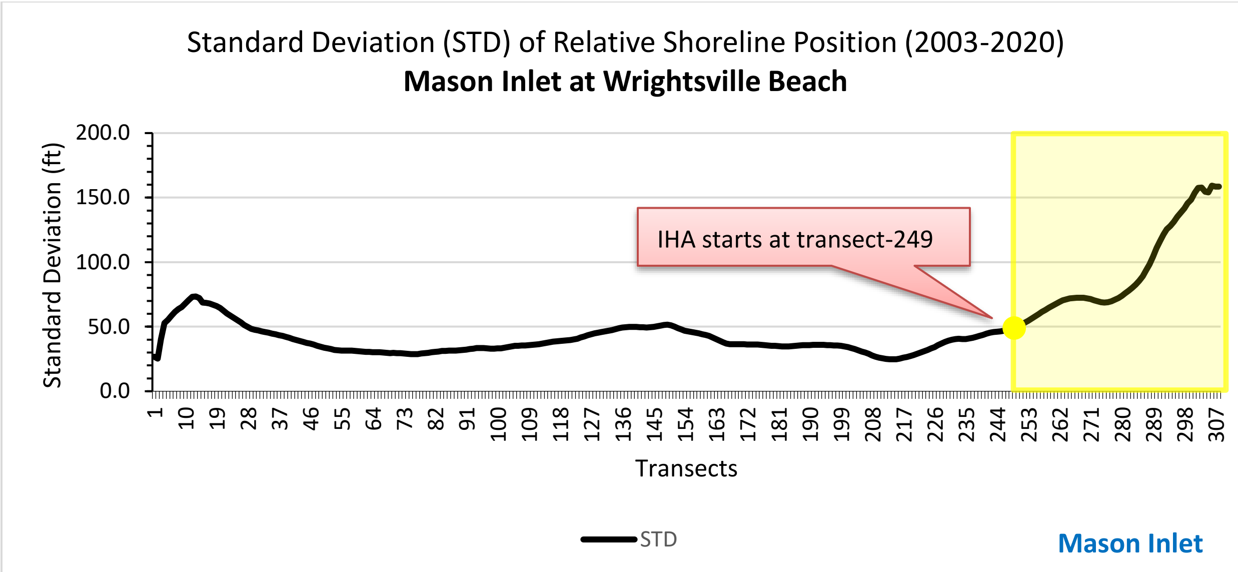


Figure 57. *This graph shows the standard deviation of relative shoreline position using post-2002 data. The IHA alongshore boundary is defined at transect 249.*

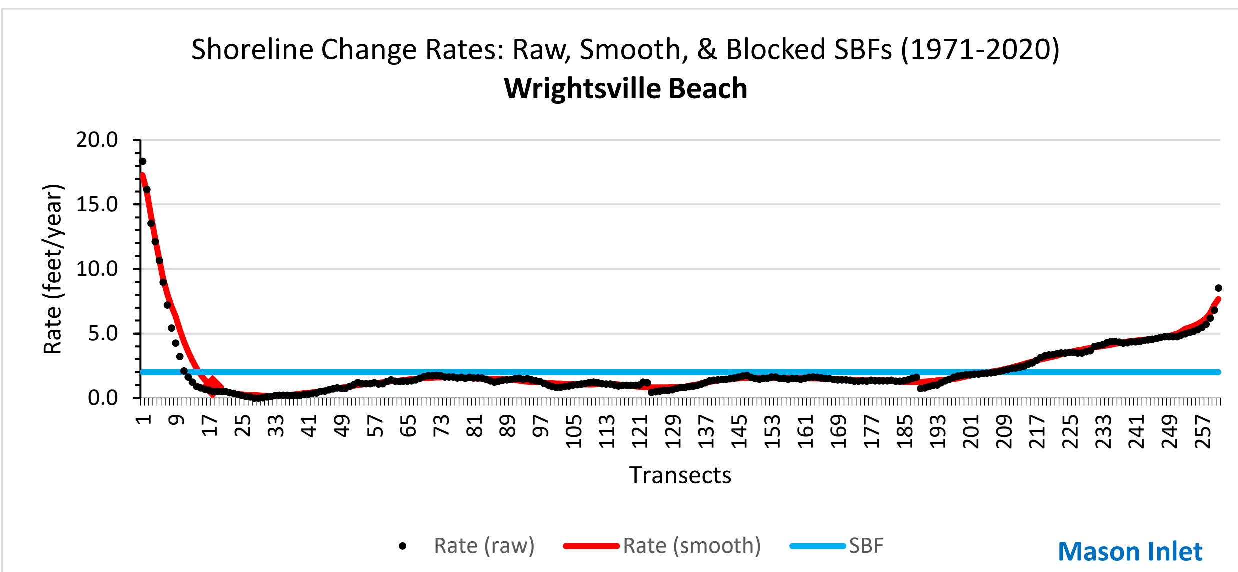


Figure 58. *This graph displays shoreline change rates for the period between 1971 and 2020 represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs.*

Figure 59. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

Within the 2025 updated Inlet Hazard Area (IHA), **Table 10** compares erosion setback factors from this analysis to those from earlier oceanfront erosion rate and setback factor studies. Despite differing calculation methods and study periods, the findings in this study remain generally consistent with earlier studies.

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

Table 10. *This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.*

3.11 Mason Inlet: Figure Eight Island

Within the 2025 updated Inlet Hazard Area (IHA), spanning less than one mile (4,429 feet) from transect 42 to Mason Inlet, the analysis considered seventeen shorelines from 1971 to 2020 (**Figure 60**). Like the Wrightsville Beach side of Mason Inlet and considering long-term engineering measures to stabilize the inlet's location, post-2002 data were used to define the alongshore IHA boundary at transect 42 (**Figure 62**). However, the full 1971–2020 dataset better captures the long-term erosion rate trends (**Figure 64**). These trends are anticipated to persist, supported by ongoing beach nourishment and maintenance dredging at Mason Inlet to offset it natural migration.

The analysis measured an average shoreline change rate of 18.5 feet per year, indicating accretion. This high average is primarily influenced by significant accretion rates along the inlet channel shoreline, while erosion near the alongshore boundary had a minimal impact on reducing the overall average. As a result, the erosion setback factor for the area is uniformly set at 2 (**Figure 65**).

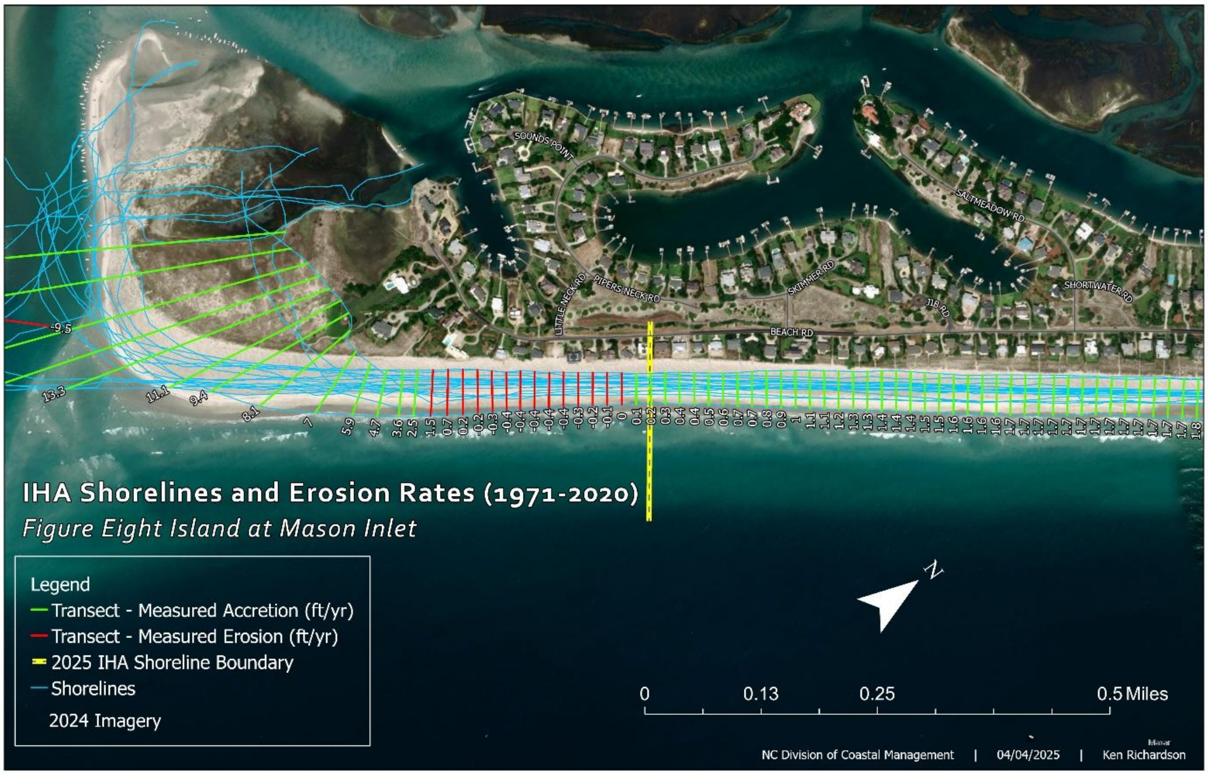


Figure 60. *This map illustrates shorelines and erosion rates measured at each transect for the area approaching Mason Inlet from the 2025 updated IHA alongshore boundary (yellow transect).*

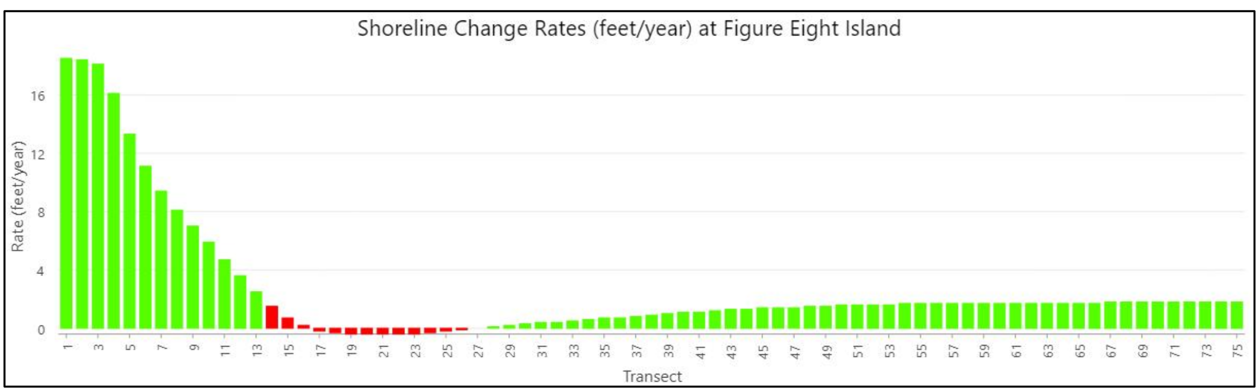


Figure 61. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

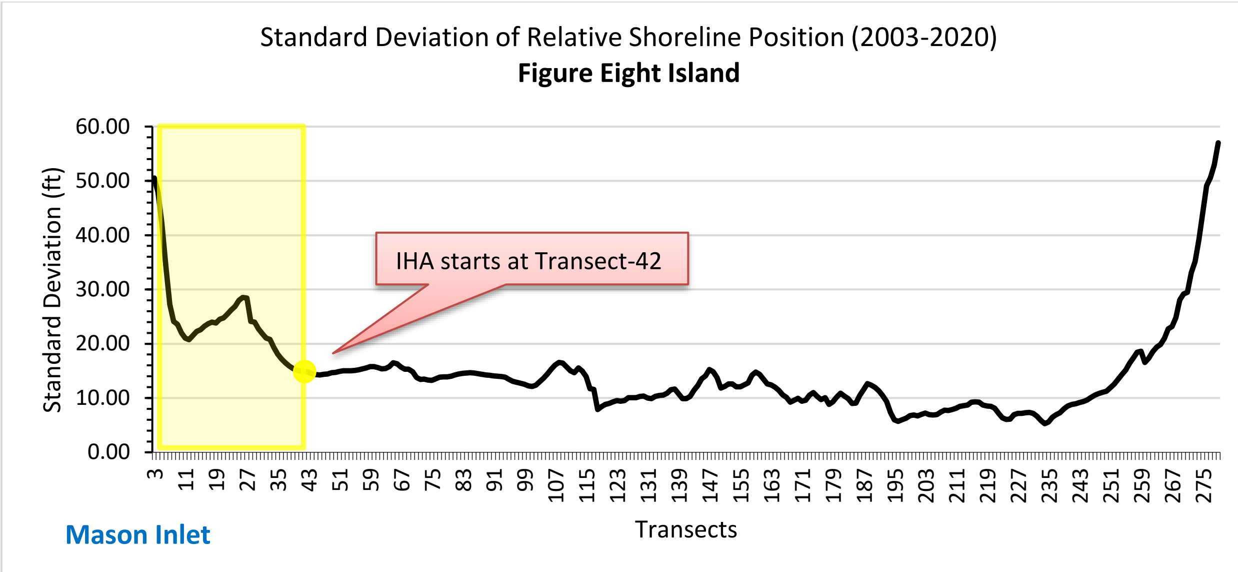


Figure 62. *This graph shows the standard deviation of relative shoreline position using post-2002 data. The IHA alongshore boundary is defined at transect 42.*

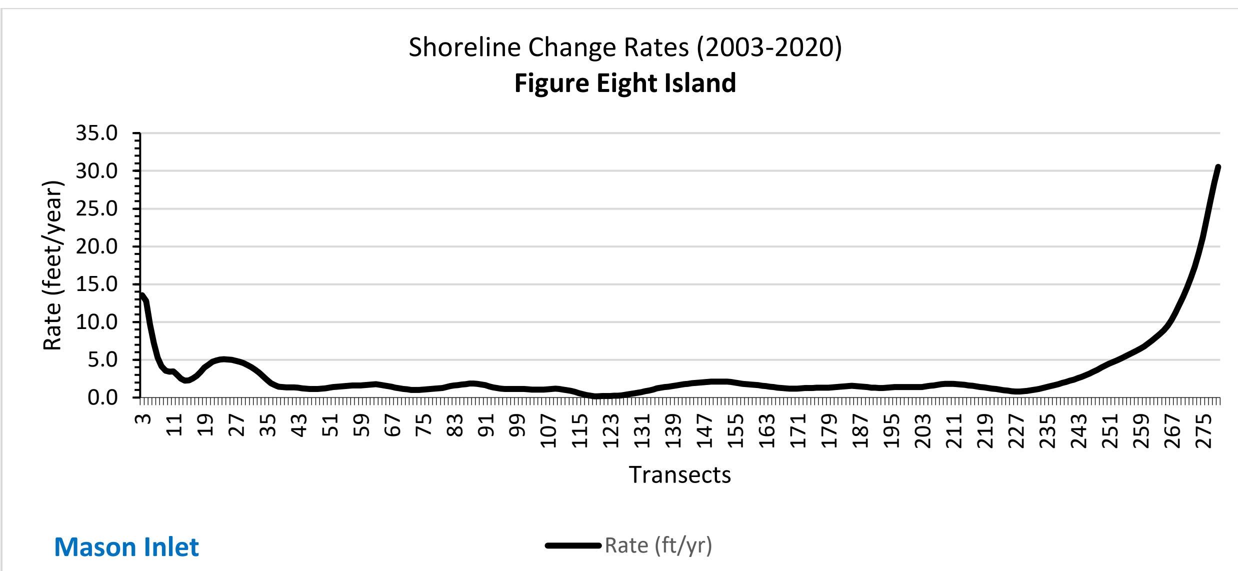


Figure 63*. This graph shows post-2002 shoreline change rates.*

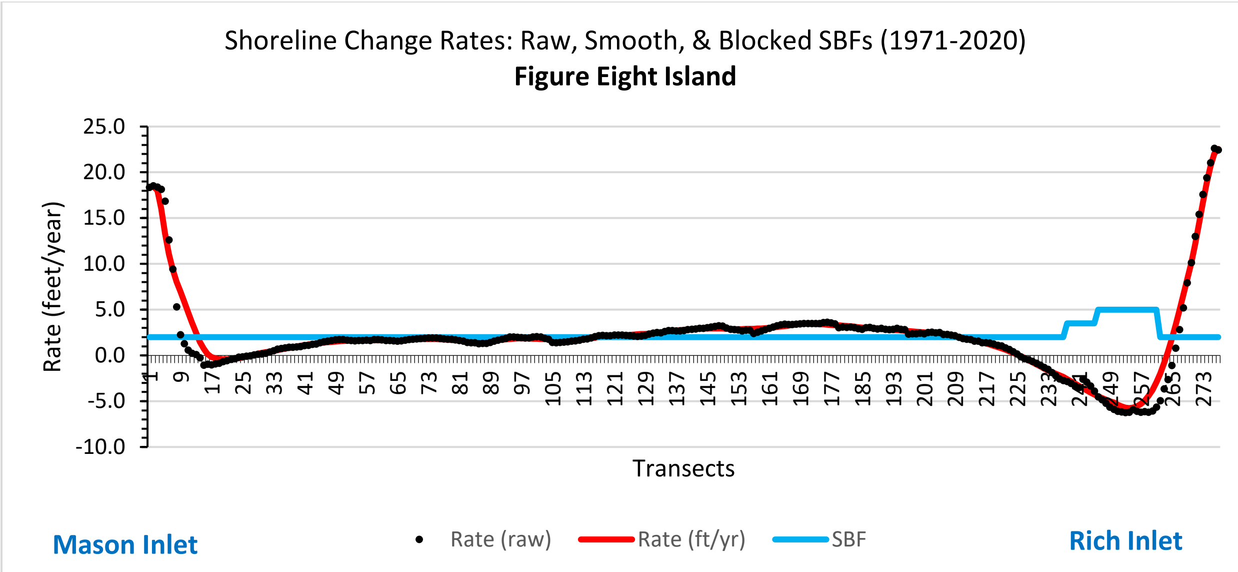


Figure 64. *This graph displays shoreline change rates for the period between 1971 and 2020 represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs.*

Figure 65. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

Within the 2025 updated Inlet Hazard Area (IHA), **Table 11** compares erosion setback factors from this analysis to those from earlier oceanfront erosion rate and setback factor studies. Despite different calculation methods and study periods, the findings of this study remain broadly consistent with earlier studies conducted after beach nourishment projects became more commonplace in the 1980s.

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

Table 11. This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.

3.12 Rich Inlet: Figure Eight Island

Within the 2025 updated Inlet Hazard Area, covering less than 1 mile (5,000 feet) of shoreline from transect-225 to Rich Inlet, the analysis included eighteen shorelines from 1971 to 2020 (**Figure 66**). Although the average shoreline change rate within the IHA is less than 2 feet per year for the period of study, the range varies significantly from 22.5 feet per year (accretion) inside the inlet and -6.2 feet per year (erosion) in ocean to inlet transition area (**Figure 68**). As a result, erosion setback factors range from 2 and 5 (**Figure 69**).

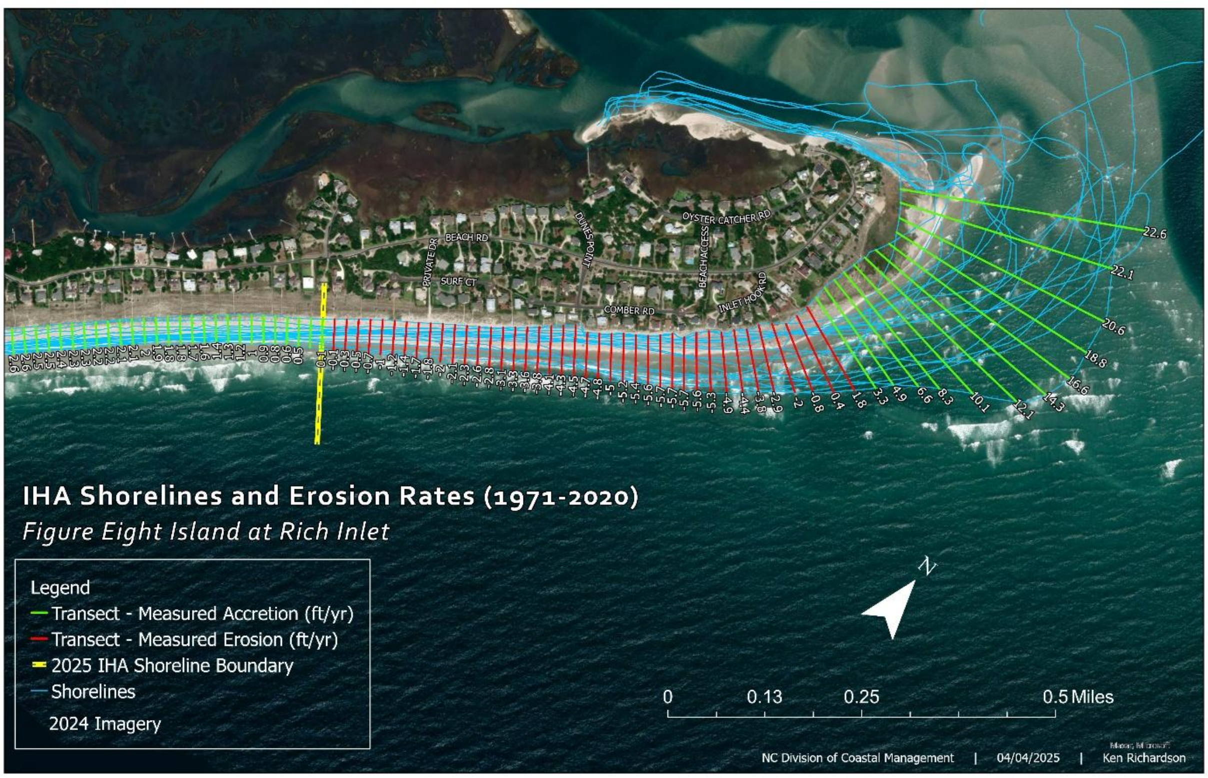


__Figure 66.__ This map illustrates shorelines and erosion rates measured at each transect for the area approaching Rich Inlet from the 2025 updated IHA alongshore boundary (yellow transect).

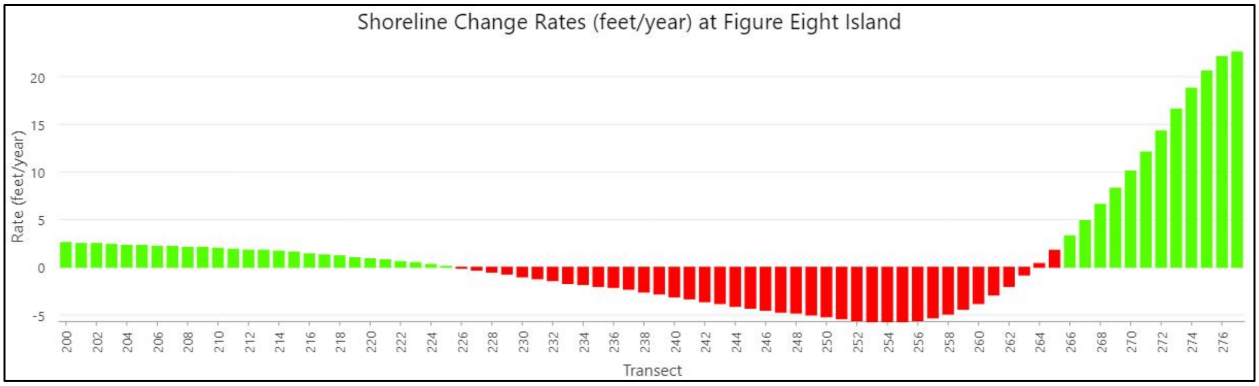


Figure 67. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

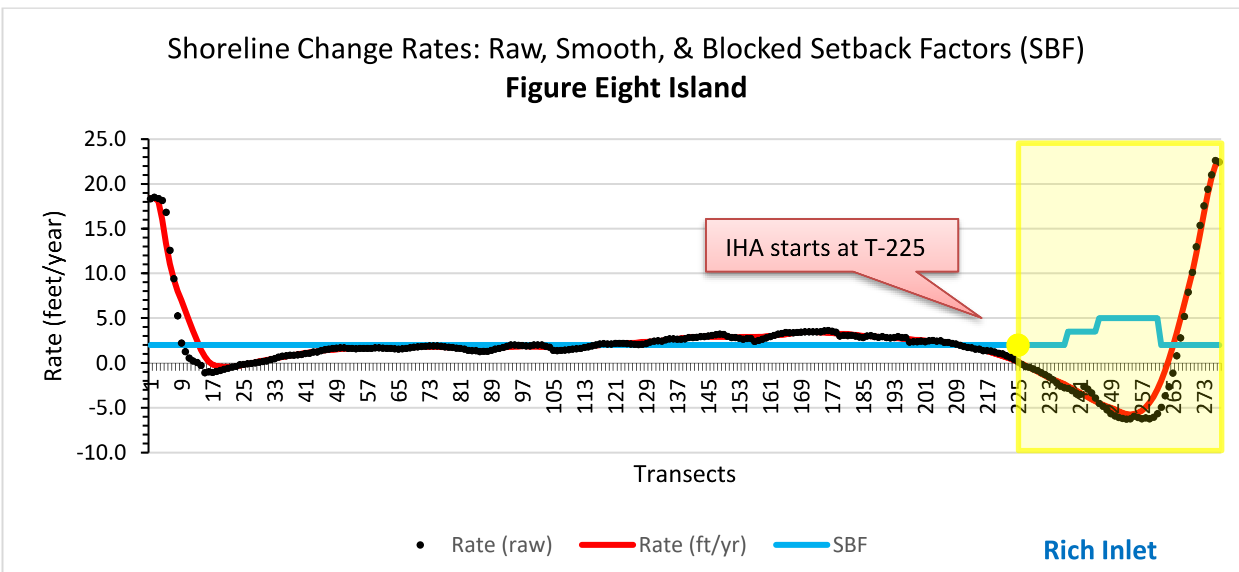


Figure 68. *This graph displays shoreline change rates represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs. The yellow box represents IHA's spatial extent along the shoreline.*

Figure 69. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

Within the 2025 updated Inlet Hazard Area (IHA), **Table 12** compares erosion setback factors from this analysis to those from earlier oceanfront erosion rate and setback factor studies. The area where setback factors are 3.5 and 5 reflect erosion trends between 1971 and 2020. However, earlier reports do not reflect high erosion rates due to the more landward position of pre-1970s shorelines, which capture accretion, and the application of Rule 15A NCAC 07H.310 requiring use of the adjacent Ocean Erodible Area's (OEA) setback factor, both of which collectively reduce historic factors for the same area.

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

Table 12*. This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.*

3.13 Rich & New Topsail Inlets: Lea-Hutaff Island

The updated 2025 Hazard Area (IHA) spans the entirety of Lea-Hutaff Island (4 miles) considering the islands joined together with the closure of Old Topsail Inlet in 1997 and given the strong influences of both Rich and New Topsail Inlets. The study found an average shoreline change rate equal to -8.4 feet per year (erosion) across the IHA, but ranged from -2.1 to -19.8 feet per year (erosion) (**Figures 71 & 72**). As a result, erosion setback factors ranged from 3 to 12.5 (**Figures 73 & 74**).

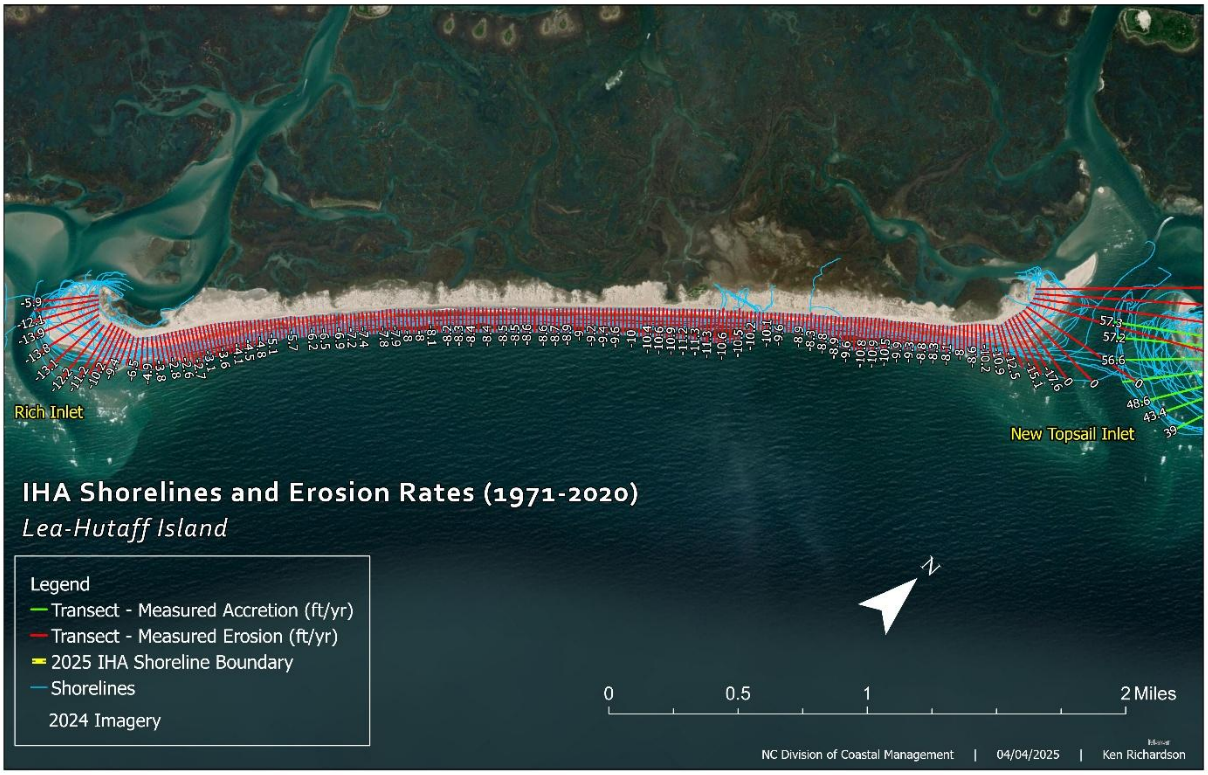


Figure 70. *This map illustrates shorelines and erosion rates measured at each transect.*

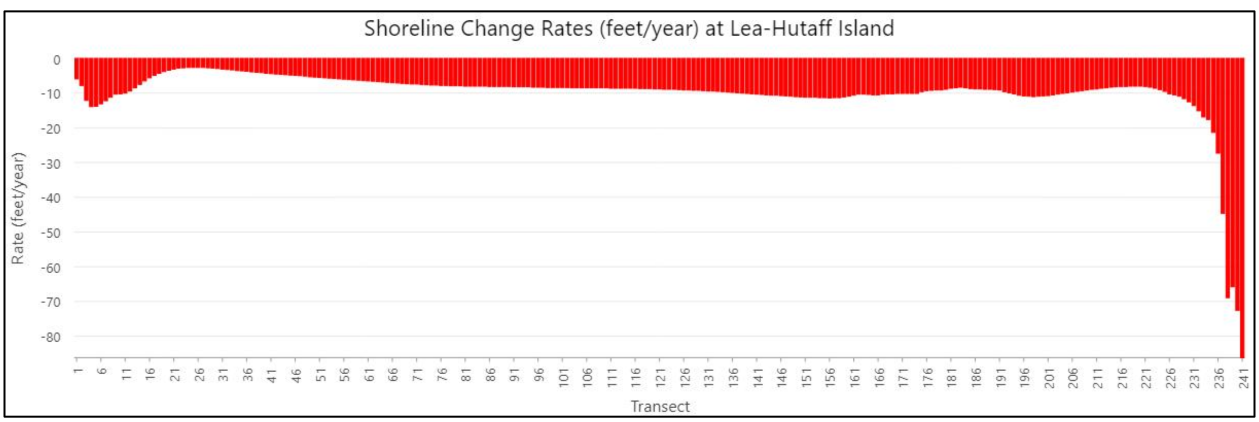


Figure 71. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

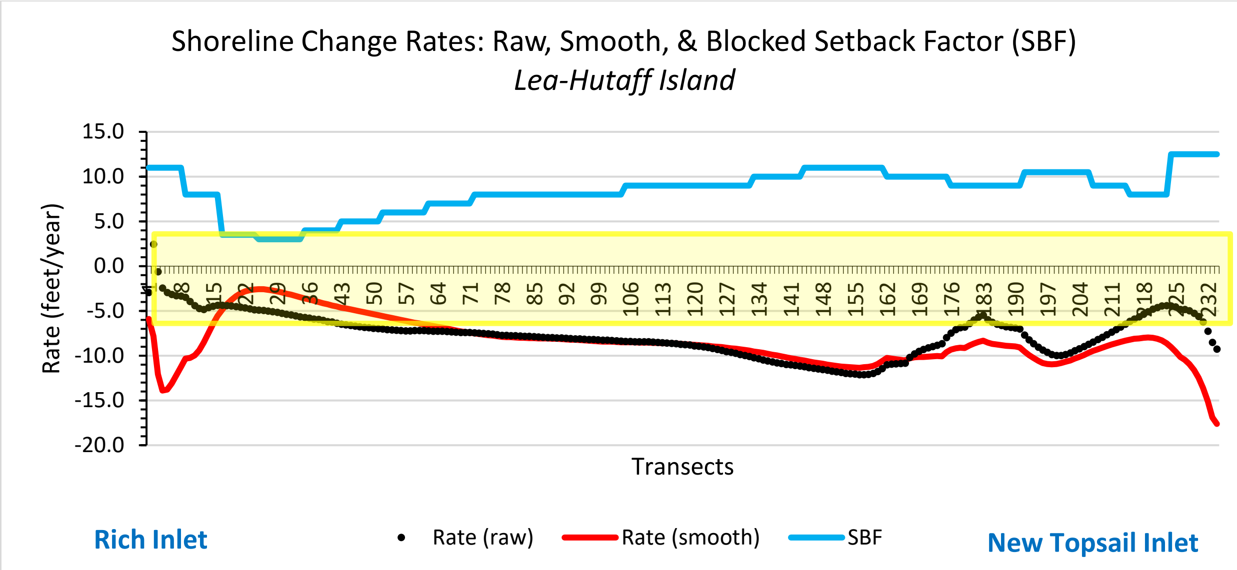


Figure 72. *This graph displays shoreline change rates represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs. The yellow box represents IHA's spatial extent along the shoreline.*

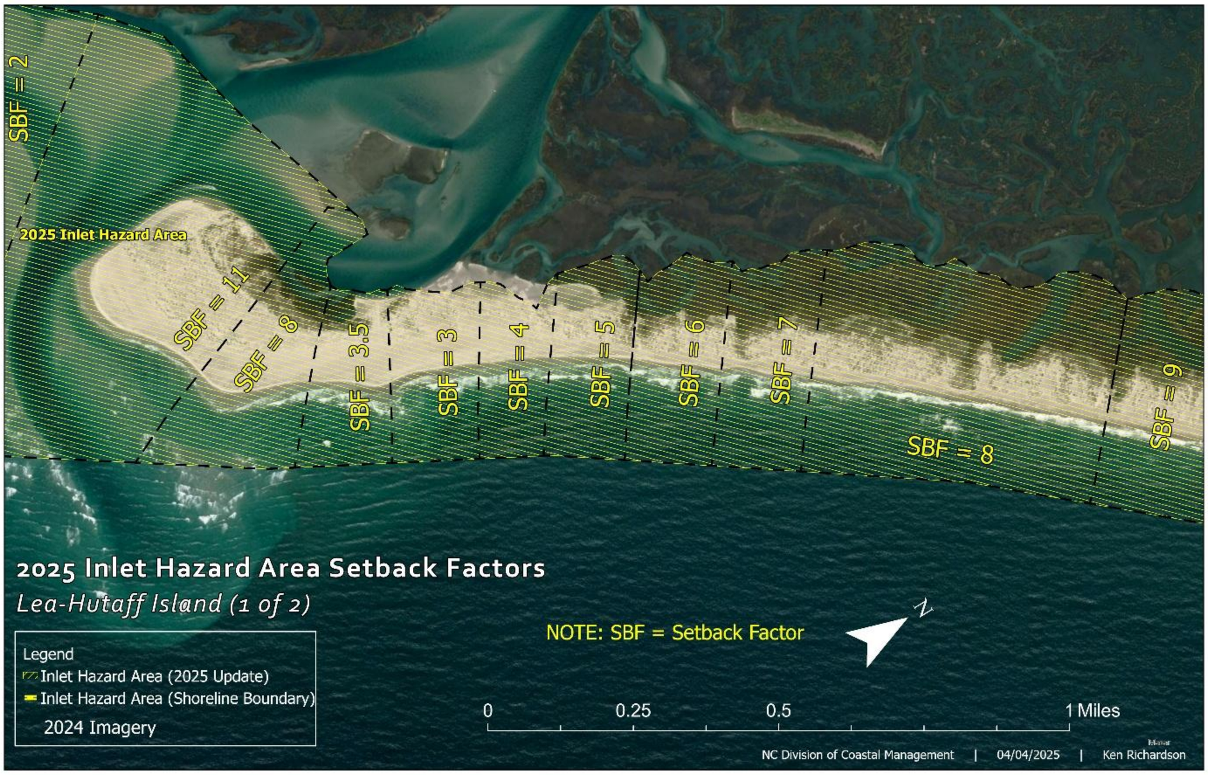


Figure 73. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

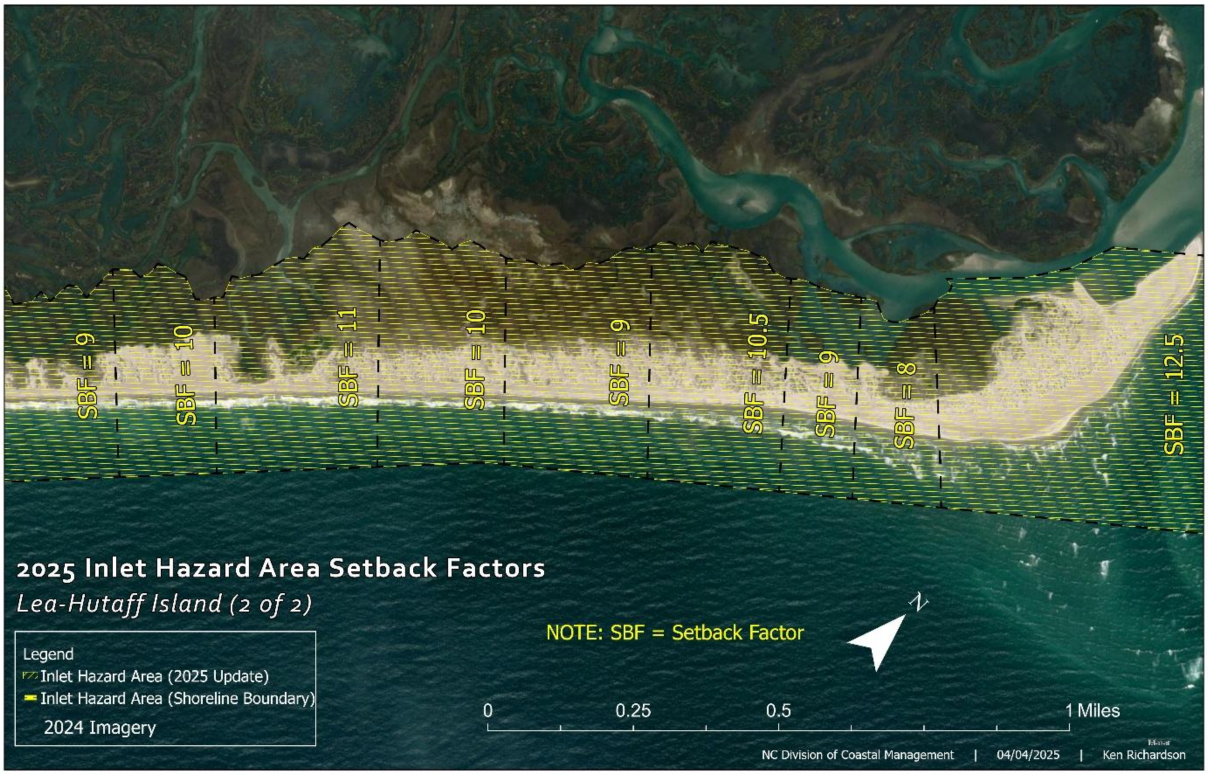


Figure 74. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

Within the 2025 updated Inlet Hazard Area (IHA), **Table 13** compares erosion setback factors from this analysis to those derived from earlier oceanfront erosion rate and setback factor studies. However, direct comparisons are not feasible because the existing (1979) IHAs encompasses a significant portion of the island, including areas around the now closed Old Topsail Inlet, and application of Rule 15A NCAC 07H.310, which requires the use of setback factors from the adjacent Ocean Erodible Area (OEA), means that actual erosion rates within IHAs were not translated into specific setback factors prior to this study.

Area Inside 2025 IHA	2025	2020	2013	2004	1997	1986	1983	1980
SBF = 3 to 12.5	3 to 12.5	4 to 10	2 to 10	2 to 7	2 to 6	5 to 6	2 to 5	2 to 5.7

Table 13. *This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.*

3.14 New Topsail Inlet: Topsail Beach

New Topsail Inlet is recognized as North Carolina's most consistently migrating inlet, shifting approximately 6.2 miles to the southwest over its history. This migration has contributed to significant accretion along the Topsail Beach shoreline, fostering the natural growth of the beachfront. However, this pattern of accretion diminishes once the inlet progresses farther southwest. In addition, direct or near-direct strikes from tropical storm systems have had compounding negative influences on shoreline position and dune system over time. Consequently, loss of beach along the oceanfront required the Town to install its first large-scale beach nourishment in 2011, followed by one maintenance project in 2024. The initial project extended along the Town’s oceanfront, encompassing a 1,100-foot portion of the beach within the 2025 IHA. It tapered off and concluded at the point where development along Ocean Boulevard ends, adjacent to the ocean shoreline.

In the updated 2025 Hazard Area (IHA), which spans approximately half a mile (2,900 feet) from transect 33 to New Topsail Inlet, the analysis examined twenty-two shorelines from 1971 to 2021 (**Figure 75**). The study found an average shoreline change rate equal to 18.5 feet per year (accretion) across the IHA (**Figure 76**). As a result, the erosion setback factor is 2 throughout the IHA (**Figure 78**).

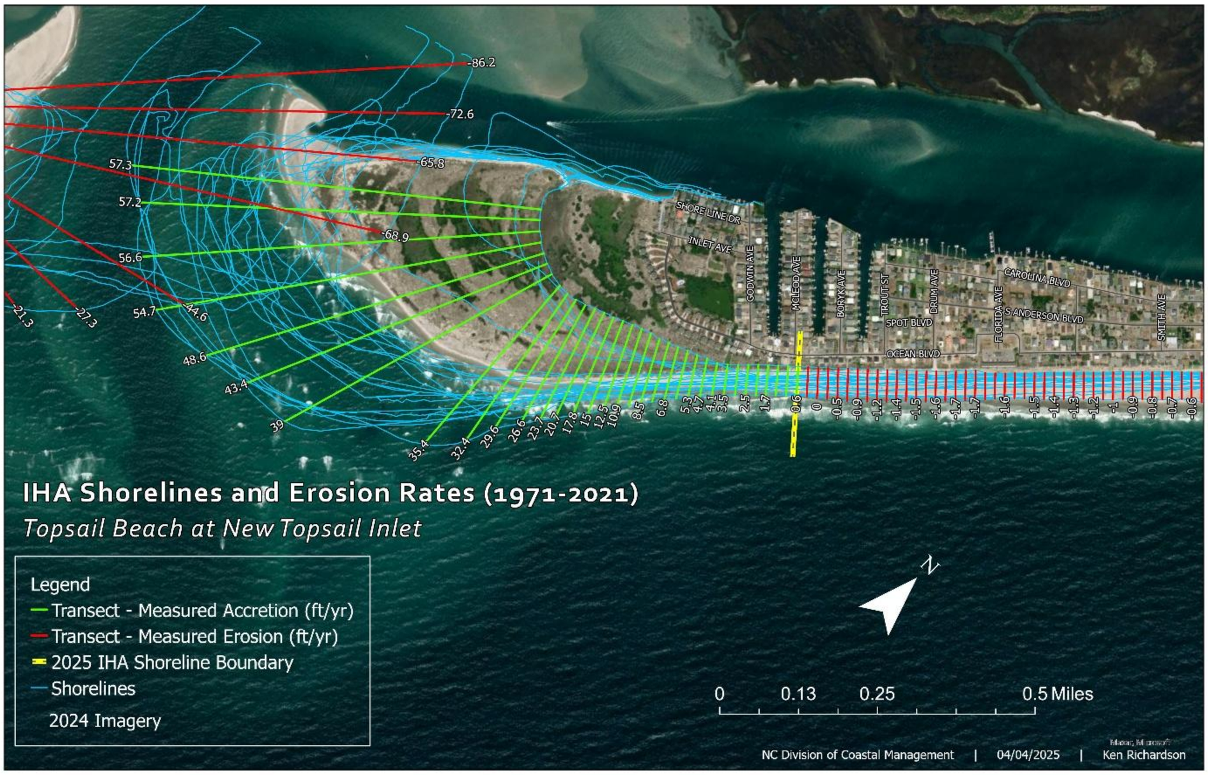


__Figure 75.__ This map illustrates shorelines and erosion rates measured at each transect for the area approaching New Topsail Inlet from the 2025 updated IHA alongshore boundary (yellow transect).

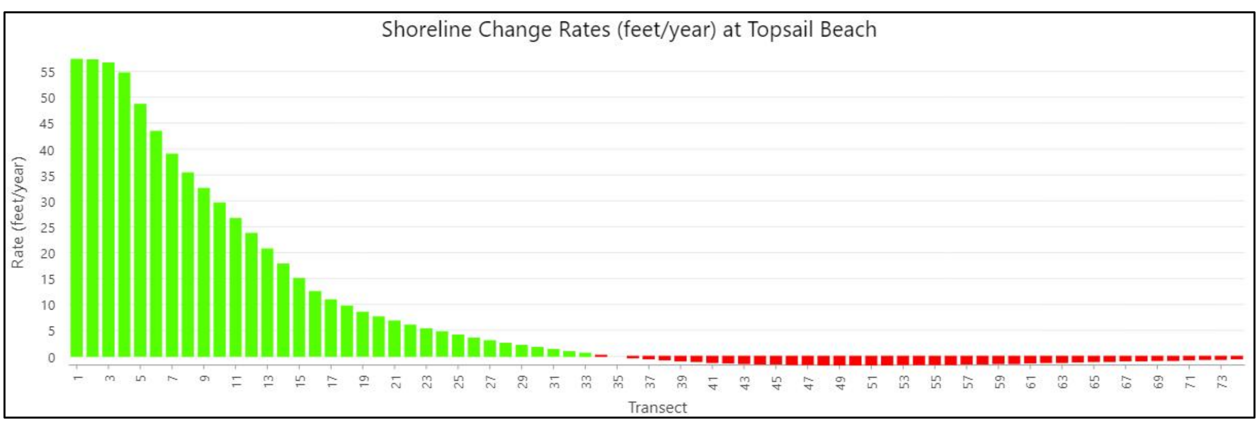


Figure 76. This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.

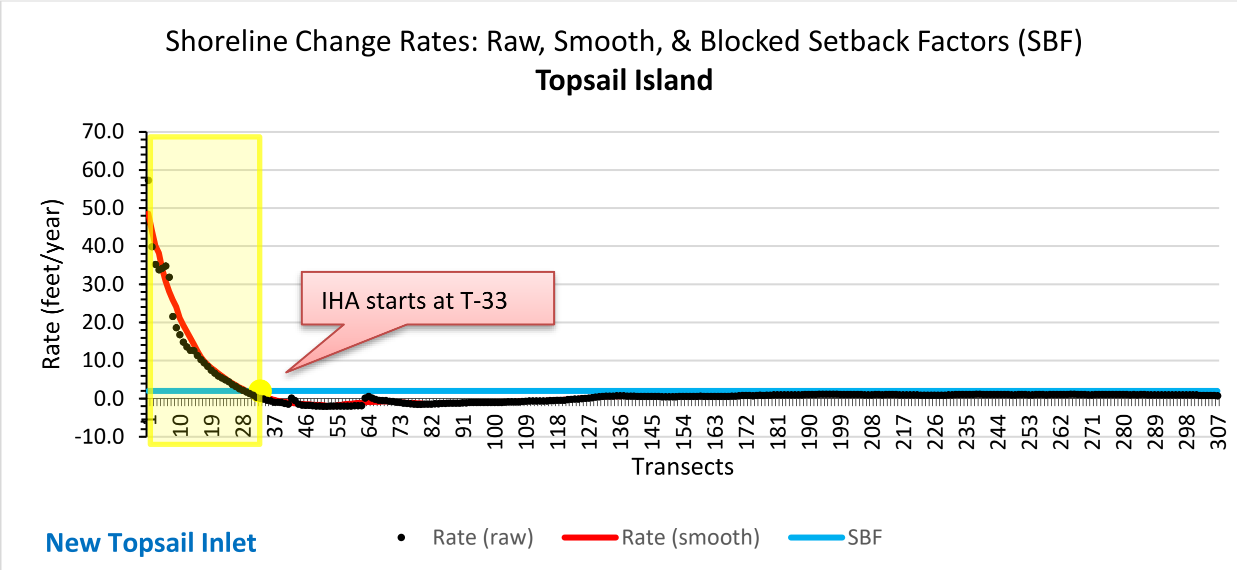


Figure 77. *This graph displays shoreline change rates represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs. The yellow box represents IHA's spatial extent along the shoreline.*

Figure 78. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

Within the 2025 updated Inlet Hazard Area (IHA), **Table 14** compares erosion setback factors from this analysis to those derived from earlier oceanfront erosion rate and setback factor studies. Given the history of inlet migration and accretion, the erosion setback factors default to 2 as per Rule 15A NCAC 07H.0304(1).

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

Table 14. *This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.*

3.15 New River Inlet: North Topsail Beach

The New River Inlet is classified as a migrating inlet, and over the past 25 years, North Topsail Beach has faced persistent erosion issues along the ocean-inlet shoreline. To challenge this, approximately 3,000 feet of shoreline have been reinforced with sandbag structures designed to halt or slow the erosion process. In 2013, the town undertook a large-scale beach nourishment project, which covered most of the oceanfront shoreline within the 2025 IHA, providing a much-needed erosion buffer, but unfortunately, this project was short-lived due to a series of tropical storm systems.

Between 2019 and 2024 truck-hauled sediments were placed to address erosion damage and restore compromised sections of dunes and beaches. These measures were part of FEMA-supported erosion mitigation projects initiated in response to damage from Hurricanes Matthew (2016), Florence (2018), and Dorian (2019).

In the updated 2025 Hazard Area (IHA), which spans approximately 1.4 miles (7,100 feet) from transect 1353 to New River Inlet, the analysis examined twenty shorelines from 1971 to 2021 (Figure 79). The study found an average shoreline change rate equal to -9.6 feet per year (erosion) across the IHA (**Figures 80 & 81**); however, rates ranged from less than -2 feet per year to -16 feet per year. It is expected that without the sandbag structures in place, that erosion rates would have measured significantly higher. As a result, the erosion setback factors range from 2 to 10 within the 2025 IHA (**Figure 82**).

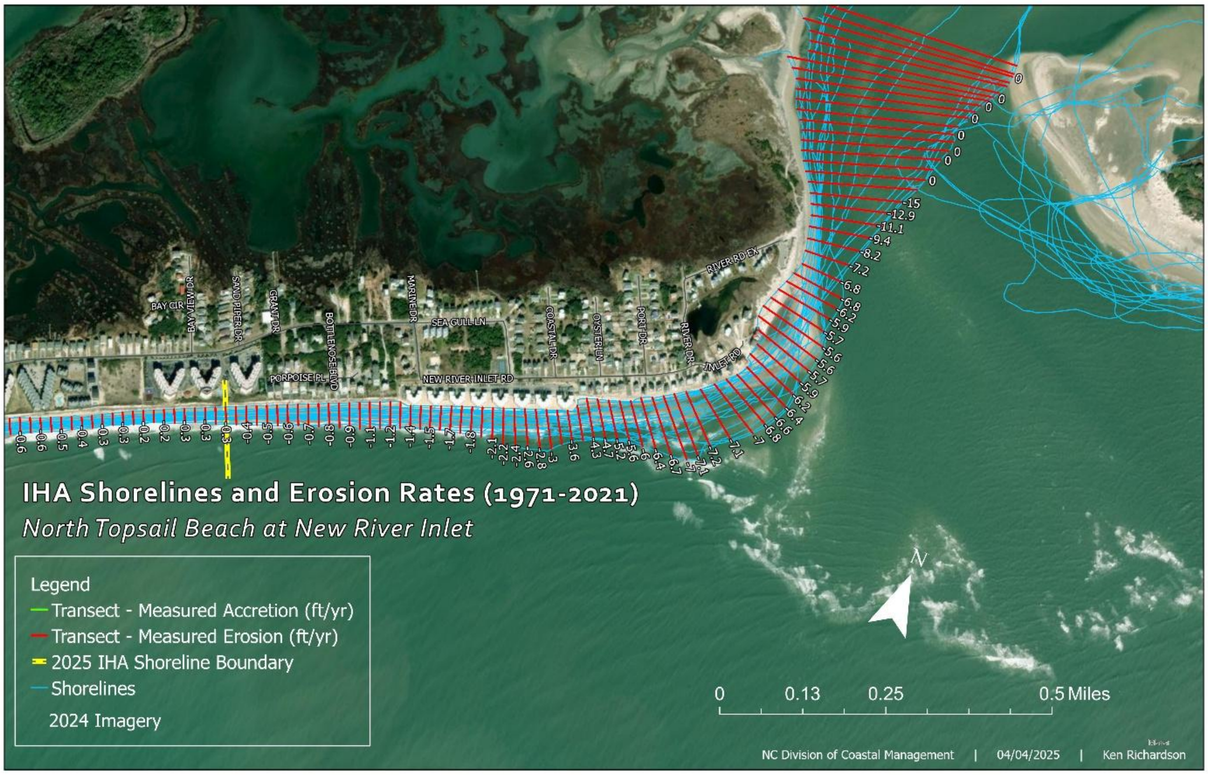


Figure 79. *This map illustrates shorelines and erosion rates measured at each transect for the area approaching New River Inlet from the 2025 updated IHA alongshore boundary (yellow transect).*

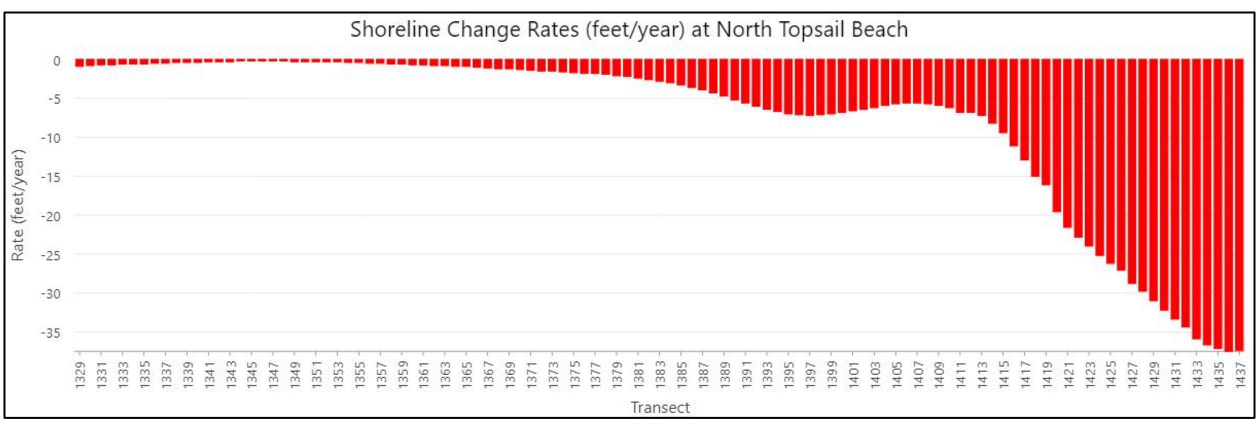


Figure 80. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

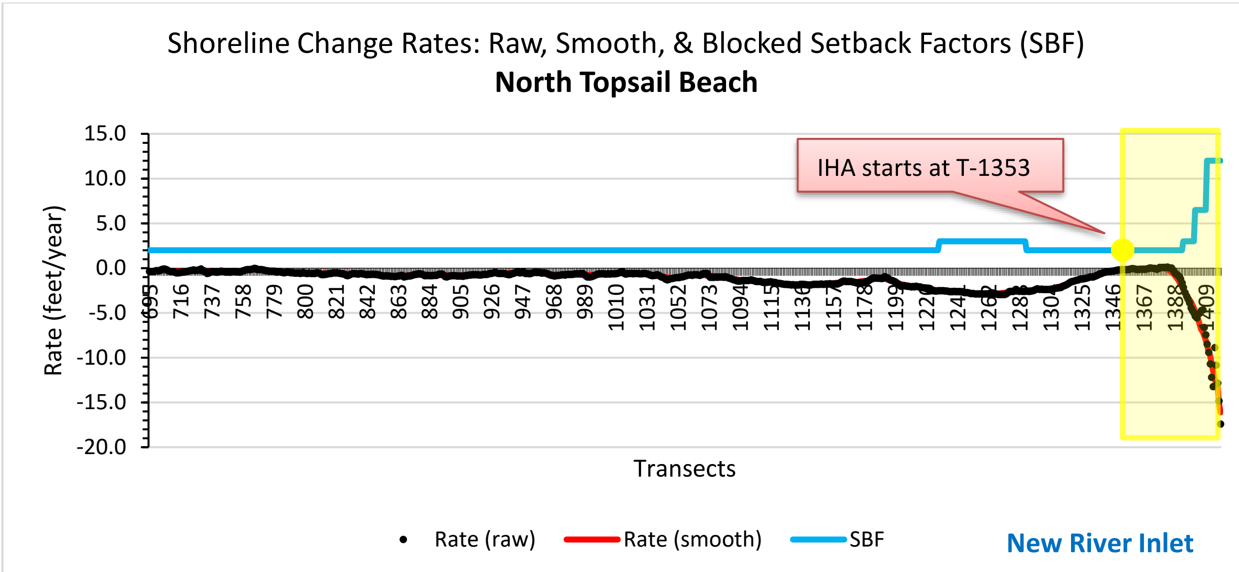


Figure 81. *This graph displays shoreline change rates represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs. The yellow box represents IHA's spatial extent along the shoreline.*

Figure 82. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

For the same area within the 2025 updated IHA, **Table 15** compares the resulting erosion setback factors with those from previous oceanfront erosion rates and setback factors studies. Although earlier studies have measured various degrees of erosion near the inlet, the use of ocean-perpendicular transects ending at the inlet, combined with the application of existing Rule 15A NCAC 07H.310, which requires using the adjacent Ocean Erodible Area (OEA), has affected the resulting setbacks by consistently reducing the setback factor to two. While the setback factor is higher, it is reflective of inlet erosion rates, and without the use of sandbags it is expected that the erosion would have a greater impact on structures along this section of shoreline.

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

Table 15. *This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.*

3.16 Bogue Inlet: Emerald Isle

Bogue Inlet, a dynamic and oscillatory inlet, has been continuously open in its general location since it was first mapped in 1585. However, in 2005, chronic erosion along the shoreline of Bogue Banks near Emerald Isle had become a significant concern, threatening structures, habitats, and recreational areas. To address this, an extensive relocation project was undertaken, shifting the ebb channel approximately 3,200 feet westward. This engineering intervention was designed to reduce erosion impacts and improve sediment distribution along the adjacent shoreline.

Since the relocation, Bogue Inlet has been subject to regular monitoring and detailed hydrographic surveys to track changes in channel morphology and shoreline conditions. When necessary, further realignment of the channel is implemented to maintain the delicate balance between natural inlet dynamics and shoreline stability.

In the updated 2025 Hazard Area (IHA), which spans approximately 1.2 miles (6,234 feet) from transect 75 to Bogue Inlet, the analysis examined seventeen shorelines from 1971 to 2022. The study found an average shoreline change rate equal to 5.8 feet per year (accretion) across the IHA (**Figure 85**); however, it is expected that without inlet management that shoreline change rates would trend erosional. As a result, the erosion setback factors default to 2 within the 2025 IHA (**Figure 86**).

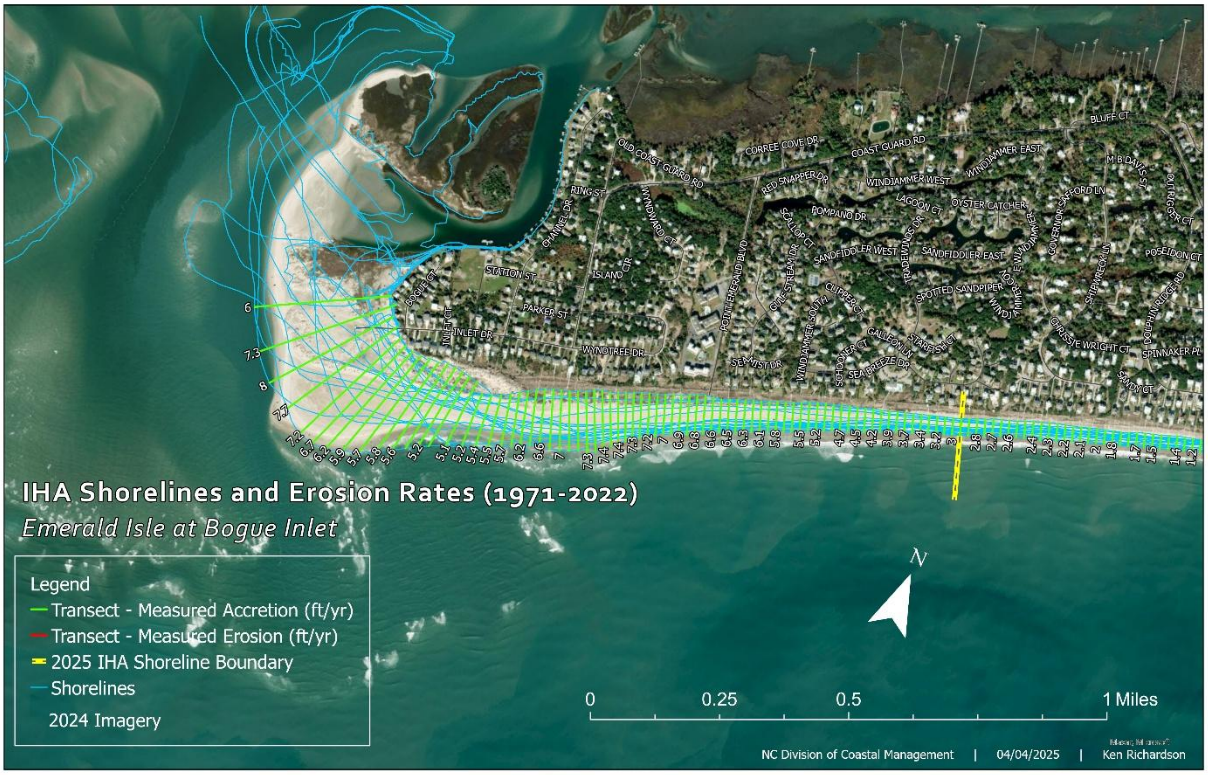


Figure 83. *This map illustrates shorelines and erosion rates measured at each transect for the area approaching Bogue Inlet from the 2025 updated IHA alongshore boundary (yellow transect).*

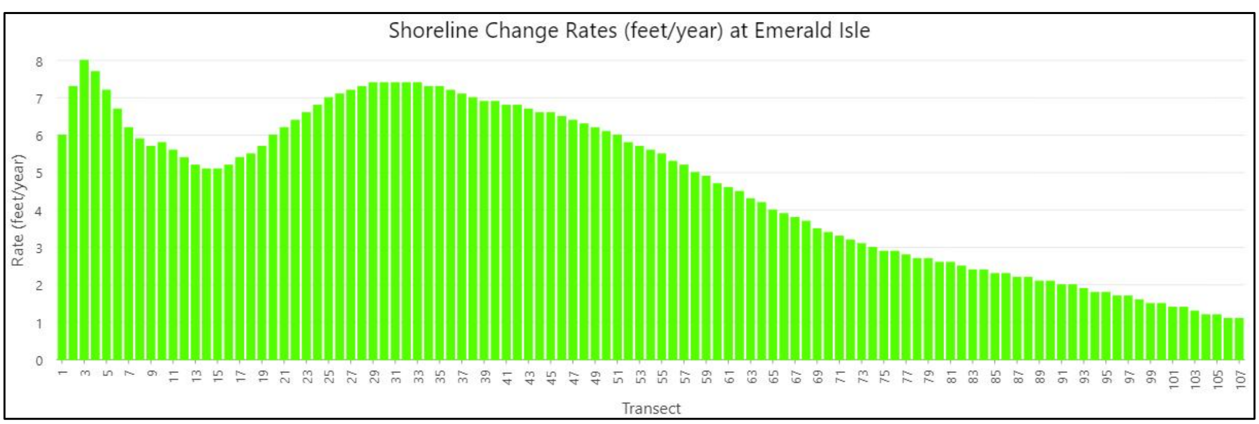


Figure 84. *This graph illustrates shoreline change rates measured at each transect, with green bars representing areas of accretion and red lines indicating areas of erosion.*

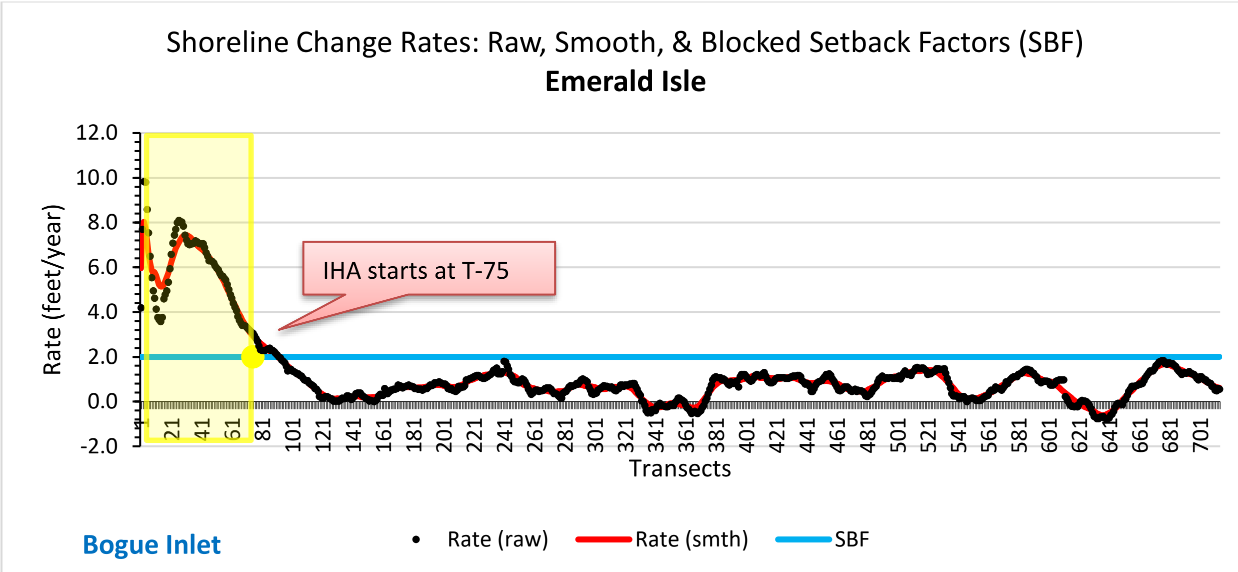


Figure 85. *This graph displays shoreline change rates represented by raw data (black dots), smoothed trends (red line), and blocked rates (blue line). Negative values indicate erosion, while positive values represent accretion. For illustration purposes, the blocked erosion setbacks are shown as positive but correspond to the actual erosion rate. The default erosion setback is set to 2 where erosion is less than -2 feet per year or where accretion occurs. The yellow box represents IHA's spatial extent along the shoreline.*

Figure 86. *This map image illustrates 2025 inlet erosion setback factors in relation to the updated IHA boundary.*

Within the 2025 updated Inlet Hazard Area (IHA), **Table 16** compares erosion setback factors from this analysis to those derived from earlier oceanfront erosion rate and setback factor studies. Prior to 2005, studies measured various degrees of erosion near the inlet; however, the use of ocean-perpendicular transects ending at the inlet, combined with the application of existing Rule 15A NCAC 07H.310, which requires using the adjacent Ocean Erodible Area (OEA), has affected the resulting setbacks. Given the history of inlet management since 2005 and its influences on the adjacent shoreline, the erosion setback factors default to 2 as per Rule 15A NCAC 07H.0304(1).

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

Table 16. *This table compares 2025 results to previous oceanfront erosion rate and setback factor updates.*

4.0 Summary

As anticipated, the analysis of inlet shoreline change rates along the study area reveals a fluctuating trend of shoreline retreat (erosion) and accretion, with a collective average erosion rate of less than -2 feet per year within the 2025 IHAs. However, this average should not be misinterpreted as indicative of minimal risk at each inlet, as this average is heavily influenced by the balance between very high erosion rates exceeding -20 feet per year and significant accretion rates resulting in construction setback factors ranging between 2 and 18. These findings underscore the substantial impact of natural inlet processes, such as tides, wave action, storm events, and sea-level rise, compounded by anthropogenic influences like coastal development and engineering practices, including dredging, beach nourishment, and erosion control structures.

The spatial variability in erosion rates highlights the critical roles of local geomorphology, sediment availability, and human interventions. Since 1979, construction setbacks have been instrumental in creating a buffer zone between structures and the dynamic coastal environment, allowing natural processes like erosion and accretion to occur without posing immediate short-term risks in some areas. However, longer-term risks remain inevitable when natural processes outpace engineering efforts. By consistently updating erosion rate setbacks based on current data, setbacks can reduce the need for costly erosion mitigation measures when development is properly sited. Additionally, they provide a critical margin for future changes in erosion rates driven by sea-level rise and extreme weather events, ultimately enhancing long-term resilience and minimizing economic losses.

Future studies should prioritize determining optimal setback distances tailored to specific shoreline conditions and integrating adaptive management strategies. These documented rates of erosion pose significant risks to coastal ecosystems, infrastructure, and property owners. Therefore, understanding and mitigating these risks is essential to ensuring the long-term sustainability and resilience of the coastal environment.

References

Davis, R. (1978). *Coastal Sedimentary Environments.* New York, NY: Springer-Verlag.

Dean, R. G., and Dalrymple, R. A. (2002). *Coastal Processes with Engineering Applications.* Cambridge University Press.

Dolan, R., et al, 1979, *Shoreline Erosion Rates Along the Middle Atlantic Coast of the United States*: Geology, v.7, 602-606.

Dolan, R., Fenster, M.S. and Holme, S.J., 1991, *Temporal Analysis of Shoreline Recession and Accretion*, Journal of Coastal Research, 7(3), 723-744.

Genz, A.S., Fletcher, C.H., Dunn, R.A., Frazer, L.N., and Rooney, J.J., 2007. *The predictive accuracy of shoreline change rate methods and alongshore beach variation on Maui, Hawaii*. Journal of Coastal Research, 23(1), 87–105.

U.S. Army Corps of Engineers – Wilmington Office, 2015. *Figure Eight Island Shoreline Management Project Environmental Impact Statement (EIS).*

Himmelstoss, E.A., Henderson, R.E., Farris, A.S., Kratzmann, M.G., Bartlett, M.K., Ergul, A., McAndrews, J., Cibaj, R., Zichichi, J.L., and Thieler, E.R., 2024, Digital Shoreline Analysis System version 6.0: U.S. Geological Survey software release, https://doi.org/10.5066/P13WIZ8M.

Limber, P.W., List, J.H., Warren, J.D., 2007a, *Applications of a LiDAR-derived mean high-water shoreline in North Carolina. Proceedings of Coastal Zone 07, Portland, OR*, July 22-26. 5 pp.

Limber, P.W., List, J.H., Warren, J.D., 2007b, *using topographic LiDAR to delineate the North Carolina shoreline in Kraus N.C. and Rosati J.D. (eds.), Coastal Sediments '07 volume three: Proceedings of the sixth international symposium on coastal engineering and science of coastal sediment processes,* May 13-17, New Orleans, LA, p. 1837-1850.

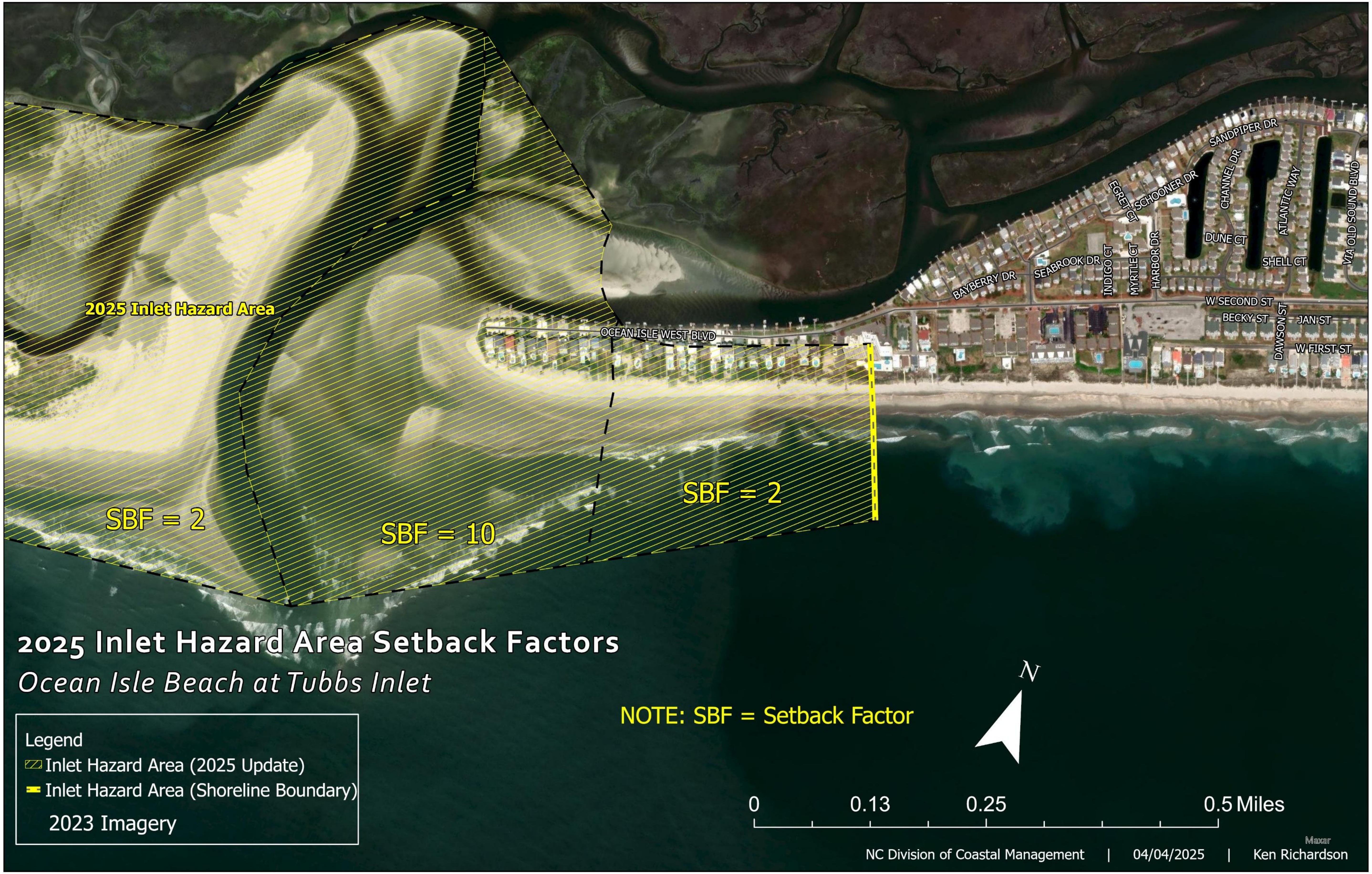
NC Coastal Resources Commission's (CRC) Science Panel & NC DCM, 2019., *Inlet Hazard Area Boundary, 2019 Update: Science Panel Recommendations to the North Carolina Coastal Resources Commission. Open-File Report.* February 2019.

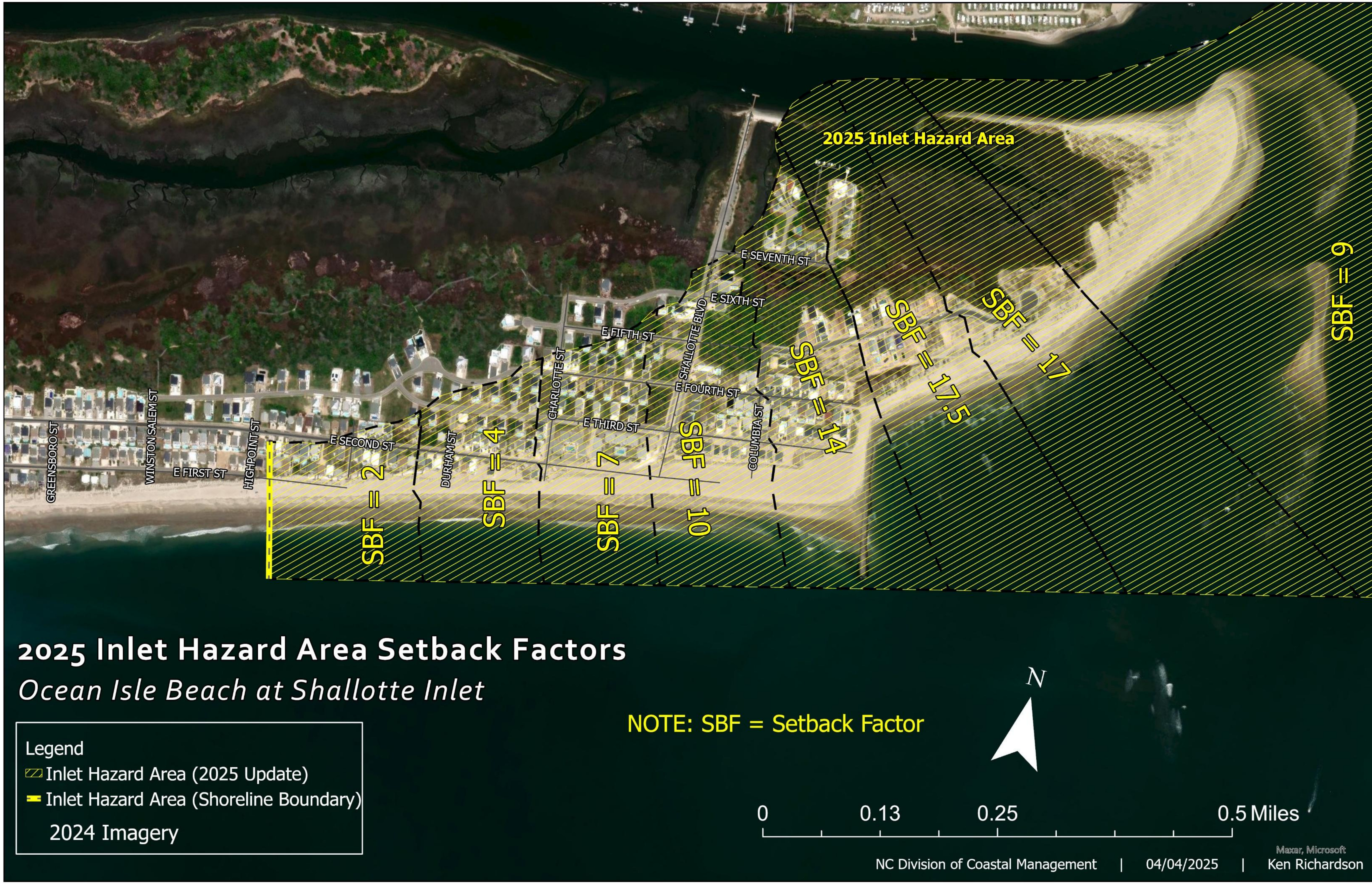
NC Division of Coastal Management, 2019., *North Carolina 2019 Oceanfront Setback Factors & Long-term Average Annual Erosion Rate Update Study. Open-File Report.* January 2019.

Thieler, E.R., Himmelstoss, E.A., Zichichi, J.L., and Ergul, A., 2009, *Digital Shoreline Analysis System (DSAS) version 4.0 – An ArcGIS Extension for Calculating Shoreline Change: U.S. Geological Survey Open-File Report 2008-1278*., updated for version 4.3.

Appendix A: Inlet Hazard Area Setback Factor Maps


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
2025 Inlet Hazard Area
SBF = 2
SBF = 10
N
0
0.13
0.25
0.5 Miles
CEDAR PT DR
RIVERSIDE DR
NORTH SHORE DR
CANAL DR
E MAIN ST
5TH ST SW
6TH ST
7TH ST
8TH ST
9TH ST
10TH ST
11TH ST
MARLIN ST
SAILFISH ST
DOLPHIN ST
COBIA ST
16TH ST
17TH ST
18TH ST
19TH ST
Maxar
NC Division of Coastal Management | 04/04/2025 | Ken Richardson


2025 Inlet Hazard Area
OCEAN ISLE WEST BLVD
SANDPIPER DR
CHANNEL DR
ATLANTIC WAY
VIA OLD SOUND BLVD
EGRET CT
SCHOONER DR
DUNE CT
SHELL CT
INDIGO CT
MYRTLE CT
HARBOR DR
SEABROOK DR
BAYBERRY DR
W SECOND ST
BECKY ST
JAN ST
DAWSON ST
W FIRST ST
SBF = 2
SBF = 10
SBF = 2
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
NOTE: SBF = Setback Factor
N
0
0.13
0.25
0.5 Miles
Maxar
NC Division of Coastal Management | 04/04/2025 | Ken Richardson


2025 Inlet Hazard Area
E SEVENTH ST
E SIXTH ST
E FIFTH ST
SHALLOTTE BLVD
E FOURTH ST
E THIRD ST
E SECOND ST
E FIRST ST
GREENSBORO ST
WINSTON SALEM ST
HIGHPOINT ST
DURHAM ST
CHARLOTTE ST
COLUMBIA ST
SBF = 2
SBF = 4
SBF = 7
SBF = 10
SBF = 14
SBF = 17.5
SBF = 17
SBF = 9
2025 Inlet Hazard Area Setback Factors
Ocean Isle Beach at Shallotte Inlet
NOTE: SBF = Setback Factor
N
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
0
0.13
0.25
0.5 Miles
Maxar, Microsoft
NC Division of Coastal Management | 04/04/2025 | Ken Richardson

SBF = 16
SBF = 9
SBF = 2
2025 Inlet Hazard Area
WINDY POINT RD SW
RIVER VIEW LN SW
OCEAN BLVD W
TIDE RIDGE DR
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
N
0
0.25
0.5
1 Miles
NC Division of Coastal Management | 04/04/2025 | Ken Richardson

B-VAR RD SW
ISLAND VIEW RD SW
CANAL DR
SHRIMP ST
CRAB ST S
CONCH ST
MULLET ST
IRON AGE DR
BLOCKADE RUNNER
RANGER ST
ELIZABETH ST
FIRST ST
OCEAN BLVD E
AVE B AVE
MCCRAY ST
DUNESCAPE DR
WINDSWEPT WAY
SERENITY LN
AVE D AVE
AVE E ST
2025 Inlet Hazard Area
SBF = 5
SBF = 2
2025 Inlet Hazard Area Setback Factors
Holden Beach at Lockwood Folly Inlet
NOTE: SBF = Setback Factor
N
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
0
0.13
0.25
0.5 Miles
NC Division of Coastal Management | 04/04/2025 | Ken Richardson

2025 Inlet Hazard Area Setback Factors
Oak Island at Lockwood Folly Inlet
SBF = 2
2025 Inlet Hazard Area
NOTE: SBF = Setback Factor
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
N
0
0.25
0.5
1 Miles
Maxar
NC Division of Coastal Management | 04/04/2025 | Ken Richardson
CEDAR VIEW DR SE
BRUNSWICK ST SE
RIVERVIEW DR SE
HOLLYVIEW DR SE
PINEVIEW DR SE
SUNSET HARBOR RD SE
ROXBORO ST SE
CROSS ST SE
LOCKWOOD FOLLY RD SE
KINGS LYNN DR
69TH PL SE
66TH PL W
60TH PL W
57TH PL W
W DOLPHIN DR
W BEACH DR
54TH PL W
51ST PL W


2025 Inlet Hazard Area Setback Factors
Carolina Beach at Carolina Beach Inlet
NOTE: SBF = Setback Factor
SBF = 2
SBF = 7
SBF = 11.5
SBF = 15
SBF = 18
2025 Inlet Hazard Area
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
0
0.25
0.5
1 Miles
N
GROUPER CT
ROSCOE FREEMAN RD
STATE AVE
PARK AVE
SEABREEZE RD
ELM ST
FLORIDA AVE
MARYLAND AVE
MARINA ST
GEORGIA AVE
OCEANA WAY
VIRGINIA AVE
SANDFIDDLER LN
CANAL DR
PRIVATE
CAROLINA BEACH AVE
NC Division of Coastal Management | 04/04/2025 | Ken Richardson
Maxar


SBF = 7
SBF = 11.5
SBF = 15
SBF = 2
SBF = 18
SBF = 14
SBF = 10
SBF = 9
SBF = 11
SBF = 13
SBF = 14
SBF = 15
SBF = 16
SBF = 15
SBF = 16
SBF = 15
2025 Inlet Hazard Area Setback Factors
Masonboro Island (1 of 4)
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
NOTE: SBF = Setback Factor
N
0
0.25
0.5
1 Miles
Maxar, Microsoft
NC Division of Coastal Management | 04/04/2025 | Ken Richardson


SBF = 15
SBF = 14
SBF = 13
SBF = 12
SBF = 11
SBF = 10
SBF = 9
SBF = 8
SBF = 7
SBF = 6
2025 Inlet Hazard Area
2025 Inlet Hazard Area Setback Factors
Masonboro Island (2 of 4)
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
NOTE: SBF = Setback Factor
N
0
0.25
0.5
1 Miles
Maxar
NC Division of Coastal Management | 04/04/2025 | Ken Richardson


SBF = 7
SBF = 6
SBF = 5
SBF = 4
SBF = 3
SBF = 2
2025 Inlet Hazard Area
2025 Inlet Hazard Area Setback Factors
Masonboro Island (3 of 4)
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
NOTE: SBF = Setback Factor
N
0
0.25
0.5
1 Miles
Maxar
NC Division of Coastal Management | 04/04/2025 | Ken Richardson

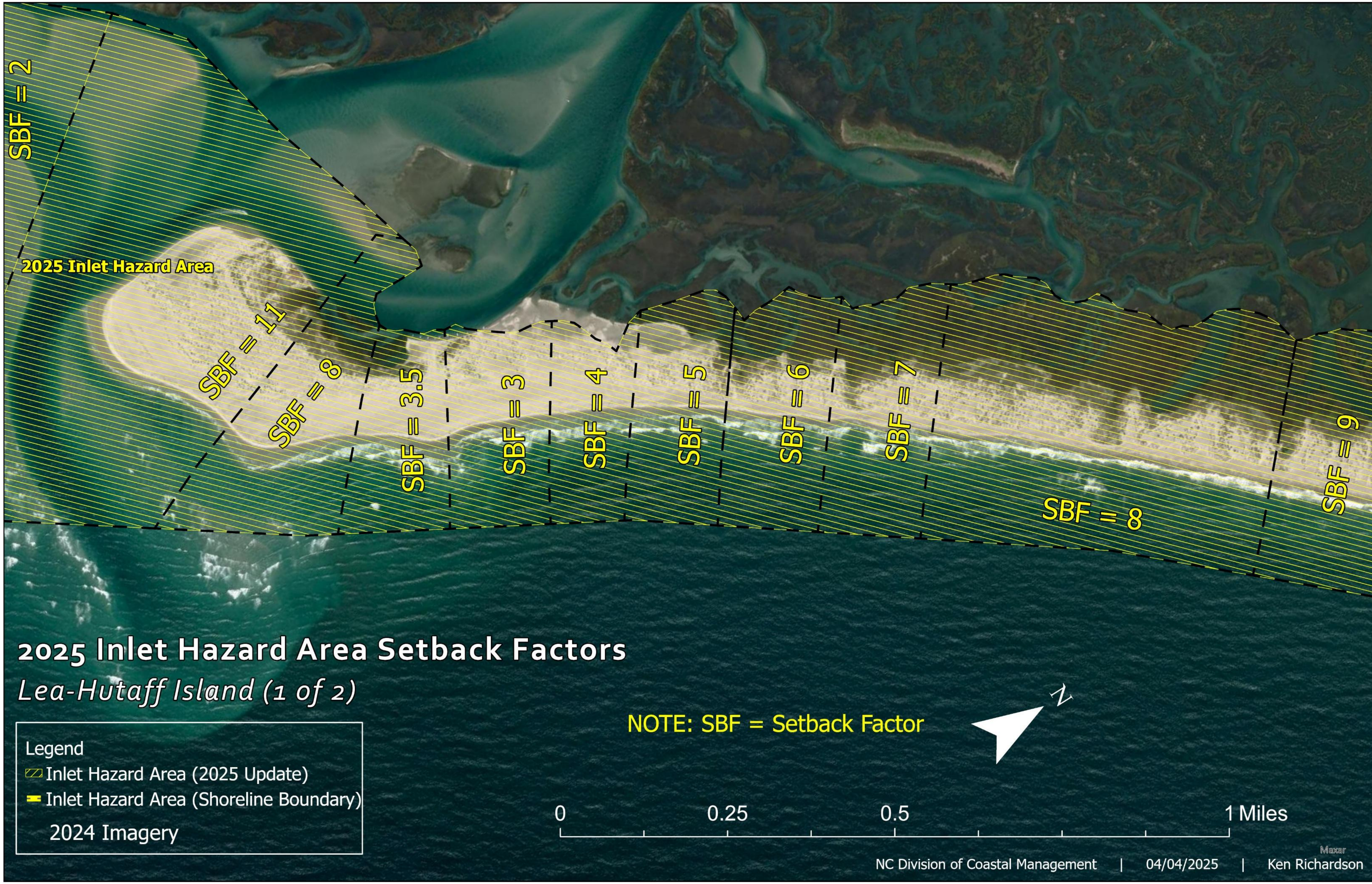

2025 Inlet Hazard Area Setback Factors
Masonboro Island (4 of 4)
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
SBF = 2
SBF = 2
2025 Inlet Hazard Area
NOTE: SBF = Setback Factor
N
0
0.25
0.5
1 Miles
Maxar
NC Division of Coastal Management | 04/04/2025 | Ken Richardson

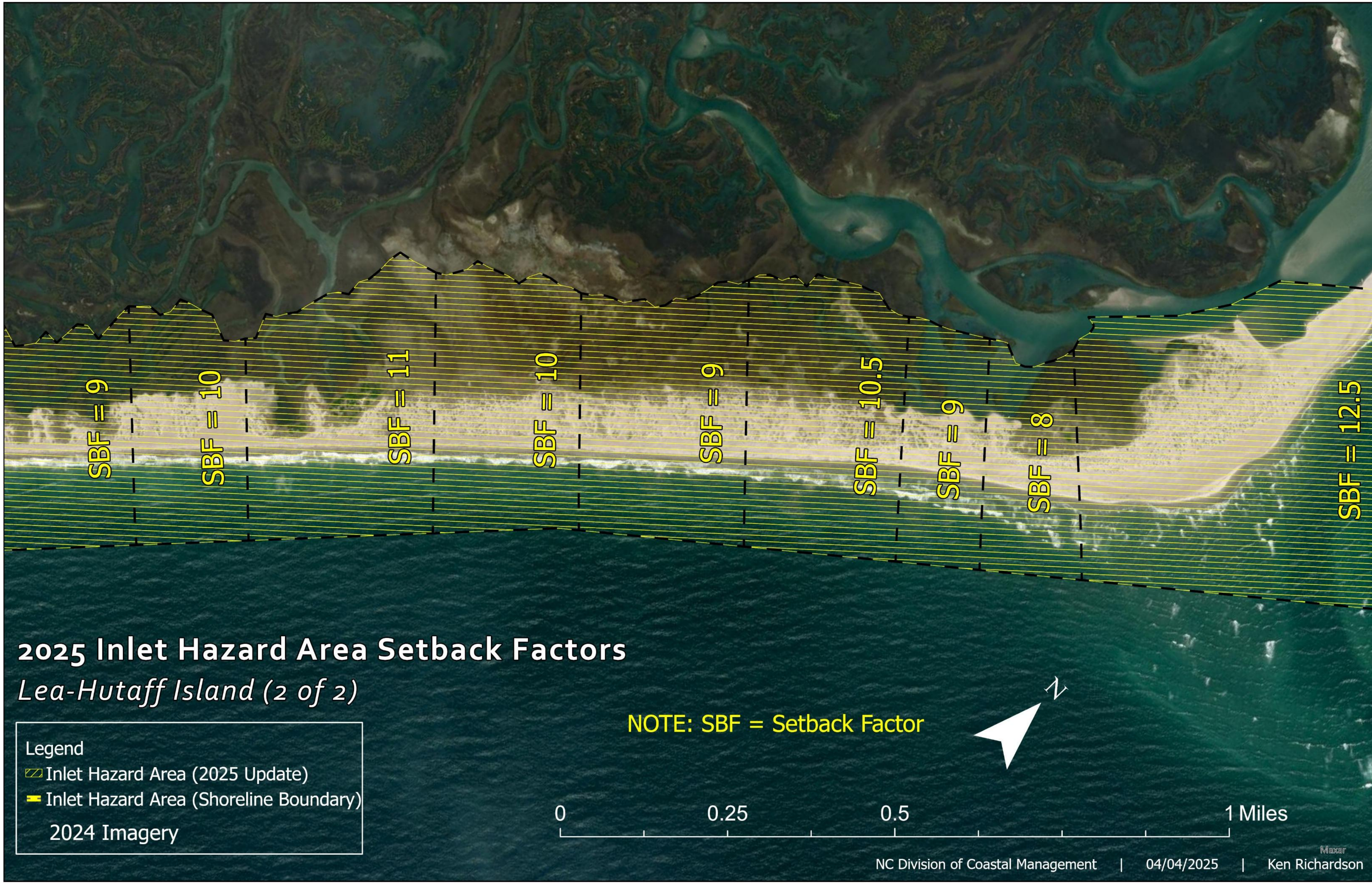
SBF = 2
SBF = 2
2025 Inlet Hazard Area
WATER ST
SCHLOSS ST
ALBRIGHT ST
NORTHROP ST
TAYLOR ST
CORBETT ST
SHORT ST
LUMINA AVE
WRIGHT ST
MEIER AVE
SUNSET AVE
NATHAN ST
IULA ST
COBURN AVE
WAYNICK BLV
SPRUNT ST
2025 Inlet Hazard Area Setback Factors
Wrightsville Beach at Masonboro Inlet
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
NOTE: SBF = Setback Factor
N
0
0.13
0.25
0.5 Miles
Maxar
NC Division of Coastal Management | 04/04/2025 | Ken Richardson

PRIVATE
LUMINA AVE
2025 Inlet Hazard Area
SBF = 2
SBF = 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
N
0
0.13
0.25
0.5 Miles
Maxar, Microsoft
NC Division of Coastal Management | 04/04/2025 | Ken Richardson


2025 Inlet Hazard Area
SOUNDS POINT
SALTMEADOW RD
LITTLE NECK RD
PIPERS NECK RD
SKIMMER RD
JIB RD
BEACH RD
SHORTWATER RD
BANKS RD
SBF = 2
2025 Inlet Hazard Area Setback Factors
Figure Eight Island at Mason Inlet
NOTE: SBF = Setback Factor
N
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
0
0.13
0.25
0.5 Miles
Maxar, Microsoft
NC Division of Coastal Management | 04/04/2025 | Ken Richardson


2025 Inlet Hazard Area
BEACH RD
PRIVATE DR
SURF CT
DUNES POINT
BEACH ACCESS
OYSTER CATCHER RD
COMBER RD
INLET HOOK RD
SBF = 2
SBF = 3.5
SBF = 5
SBF = 2
2025 Inlet Hazard Area Setback Factors
Figure Eight Island at Rich Inlet
NOTE: SBF = Setback Factor
N
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
0 0.13 0.25 0.5 Miles
Maxar, Microsoft
NC Division of Coastal Management | 04/04/2025 | Ken Richardson


SBF = 2
2025 Inlet Hazard Area
SBF = 11
SBF = 8
SBF = 3.5
SBF = 3
SBF = 4
SBF = 5
SBF = 6
SBF = 7
SBF = 8
SBF = 9
2025 Inlet Hazard Area Setback Factors
Lea-Hutaff Island (1 of 2)
NOTE: SBF = Setback Factor
N
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
0
0.25
0.5
1 Miles
Maxar
NC Division of Coastal Management | 04/04/2025 | Ken Richardson



2025 Inlet Hazard Area Setback Factors
Lea-Hutaff Island (2 of 2)
SBF = 9
SBF = 10
SBF = 11
SBF = 10
SBF = 9
SBF = 10.5
SBF = 9
SBF = 8
SBF = 12.5
NOTE: SBF = Setback Factor
N
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
0
0.25
0.5
1 Miles
Maxar
NC Division of Coastal Management | 04/04/2025 | Ken Richardson


SHORE LINE DR
INLET AVE
GODWIN AVE
MCLEOD AVE
BORYK AVE
TROUT ST
CAROLINA BLVD
DRUM AVE
FLORIDA AVE
S ANDERSON BLVD
CLARK AVE
SPOT BLVD
OCEAN BLVD
2025 Inlet Hazard Area
SBF = 2
2025 Inlet Hazard Area Setback Factors
Topsail Beach at New Topsail Inlet
NOTE: SBF = Setback Factor
N
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
0
0.13
0.25
0.5 Miles
Maxar
NC Division of Coastal Management | 04/04/2025 | Ken Richardson


2025 Inlet Hazard Area
SBF = 10
RIVER RD EX
BAY VIEW DR
SAND PIPER DR
GRANT DR
BOTTLENOSE BLVD
MARINE DR
SEA GULL LN
COASTAL DR
OYSTER LN
PORT DR
RIVER DR
INLET RD
PORPOISE PL
NEW RIVER INLET RD
SBF = 2.5
SBF = 5
SBF = 7
SBF = 6
SBF = 2
2025 Inlet Hazard Area Setback Factors
North Topsail Beach at New River Inlet
NOTE: SBF = Setback Factor
N
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
0
0.13
0.25
0.5 Miles
NC CGIA, Maxar, Microsoft
NC Division of Coastal Management | 04/04/2025 | Ken Richardson


2025 Inlet Hazard Area
SBF = 2
2025 Inlet Hazard Area Setback Factors
Emerald Isle at Bogue Inlet
NOTE: SBF = Setback Factor
Legend
Inlet Hazard Area (2025 Update)
Inlet Hazard Area (Shoreline Boundary)
2024 Imagery
N
0 0.13 0.25 0.5 Miles
NC Division of Coastal Management | 04/04/2025 | Ken Richardson
Maxar
OLD COAST GUARD RD
CORREE COVE DR
COAST GUARD RD
BLUFF CT
RING ST
STATION ST
PARKER ST
INLET DR
WYNDTREE DR
BOGUE CT
INLET CT
CHANNEL DR
ISLAND CIR
WYNDWARD CT
POINT EMERALD BLVD
RED SNAPPER DR
POMPANO DR
SCALLOP CT
WINDJAMMER WEST
WINDJAMMER EAST
TRADEWINDS DR
LAGOON CT
OYSTER CATCHER
SANDFIDDLER WEST
SANDFIDDLER EAST
LOBSTER LN
SPOTTED SANDPIPER
CLIPPER CT
GALLEON LN
STARFISH CT
SCHOONER CT
SEA BREEZE DR
SEA MIST DR
WHITE SANDS DR
GULF STREAM DR
WINDJAMMER SOUTH
E WINDJAMMER
WINDJAMMER COV
GOVERNOR SAFFORD LN
ABERLADY BAY
CHRISSIE WRIGHT CT
SHIPWRECK LN
M B DAVIS ST
OUTRIGGER CT
POSEIDON CT
DOLPHIN RIDGE RD
SPINNAKER PL
SANDY CT