TOWN OF CASWELL BEACH
2023 BEACH MONITORING REPORT

PREPARED FOR
TOWN OF CASWELL BEACH

PREPARED BY
COASTAL PROTECTION ENGINEERING OF NORTH CAROLINA, INC.
ENGINEERING LICENCE CERTIFICATE #: C-2331

ADAM T. PRIEST, PE NO. 048852 _____ DATE

October 2023

EXECUTIVE SUMMARY

The Town of Caswell Beach is located on a coastal barrier island, approximately 13 miles long, along the Atlantic Ocean on the coastline of Brunswick County in southeastern North Carolina. Caswell Beach is oriented generally in an east/west direction, with a south facing beach. The barrier island is separated from Bald Head Island by the entrance to the Cape Fear River. The Town of Caswell Beach is bordered by Fort Caswell on the east and the Town of Oak Island on the west.

The Town of Caswell Beach and Oak Island are recipients of sediment placed by the USACE through the Wilmington Harbor Sand Management Plan (SMP). This SMP determined that approximately 2/3 of the sand that is removed from the navigation channel comes from Bald Head Island, while 1/3 comes from Caswell Beach/Oak Island (USACE, 2000). In order to account for the 2:1 relationship of sand infilling the channel, the SMP recommended that the material removed from the channel on a biennial basis would be placed on Bald Head Island in Years 2 and 4, with sand being placed on Caswell Beach and Oak Island in Year 6. Maintenance of the Wilmington Harbor Navigation project in February/April 2009 included placement of 123,400 cubic yards of material between the entrance to Fort Caswell and 407 Caswell Beach Road (Stations 60+00 to 95+00) and 941,000 cubic yards between 607 Caswell Beach Road and SE 74th Street (Stations 120+00 to 260+00). The last sand placement along Caswell Beach/Oak Island from the Wilmington Harbor Navigation project occurred in May/June 2018. During that event, approximately 1,140,000 cubic yards of material was placed along Caswell Beach and Oak Island between the 500 block of Caswell Beach Road (Station 110+00) and SE 63rd Street (Station 300+00).

Despite receiving regular deposits of sand from the Wilmington Harbor Navigation project, both Bald Head Island and Oak Island have initiated supplemental beach nourishment projects to mitigate long-term erosion. Over the past five (5) years, the Town of Oak Island and the Village of Bald Head Island have completed projects that included dredging within portions of Jay Bird Shoals (JBS), located just offshore of Caswell Beach. Between December 2014 and October 2020, the Village of Bald Head Island monitored Caswell Beach annually as a condition of their permit to dredge a portion of JBS. In 2020, Oak Island took over monitoring of Caswell Beach and Fort Caswell as a condition of the CAMA Permit #31-20, which allowed the Town of Oak Island to dredge material from a separate portion of JBS even closer to Caswell Beach.

In April/May 2021, the Town of Oak Island conducted a beach nourishment project that removed approximately 885,000 cy of sand from the permitted borrow area within JBS. In accordance with the permit, the Town of Oak Island conducted the pre-construction survey of Caswell Beach in March 2021, prior to the April/May dredging event. A post-construction survey was conducted along Caswell Beach by the Town of Oak Island in October 2021. Both surveys included 19 profiles spaced approximately 1,000 feet apart, located between the eastern end of Fort Caswell (Station 20+00) and 200 feet west of Yaupon Way (Station 200+00). The Town of Caswell Beach hired Coastal Protection Engineering of North Carolina, Inc. (CPE) in 2021 to independently evaluate shoreline and volume changes associated with the 2021 beach nourishment project using the data collected by the Town of Oak Island. The results of that Analysis are included in the *Town of Caswell Beach 2021 Beach Monitoring Report*, prepared by CPE.

In February/April 2022, the Town of Oak Island conducted a second beach nourishment project using a combination of borrow areas that included the permitted area within JBS and a second site located offshore of the western end of Oak Island. The dredge event removed approximately 1,100,000 cy of sand from the permitted borrow area of JBS. A survey was conducted by the Town of Oak Island in May 2022 to monitor for potential impacts to Fort Caswell and Caswell Beach. The May 2022 survey included the same 19 profiles surveyed in March and October 2021. An independent evaluation was again conducted by CPE using the updated data, the results of which are included in the *Town of Caswell Beach 2022 Beach Monitoring Report*.

Again, in May 2023, a survey was conducted by the Town of Oak Island as a condition of their beach nourishment permits. This survey also included the same 19 profiles as the previous survey events. The purpose of this report is to assess shoreline changes and volumetric changes measured between March 2021 and May 2023 and to report any deviations in previously observed trends that may be associated with the April/May 2021 and February/April 2022 dredging events.

Shoreline Changes: Beach profile surveys conducted in March 2021 and May 2023 show the shoreline moved landward on average over the 26-month period. On the eastern portion of the survey area, along the Fort Caswell Section (Stations 20+00 to 60+00), the average shoreline change measured over the 14-month period was -39.4 ft., compared to -19.6 ft. measured between March 2021 and May 2022 (CPE, 2022). The average shoreline changes measured along the East Caswell Beach Section (Stations 60+00 to 130+00) was -4.1 ft. (landward movement). In general, larger negative shoreline changes were measured along the West Caswell Beach Section (Stations 130+00 to 200+00). The average shoreline change measured along this stretch of beach was -28.1 ft. (landward movement). In the 2022 Beach Monitoring Report, which measured changes over the 14-month period between March 2021 and May 2022, shoreline change analyses measured average shoreline changes along both the East (+1.4 ft.) and West (-17.5 ft.) Caswell Beach Sections (CPE, 2022). The shoreline changes have negatively increased over the recent period.

Comparisons of shoreline change rates measured over the monitoring period between March 2021 and May 2023 were made to historic rates measured along Fort Caswell and Caswell Beach. Along the Fort Caswell oceanfront, negative shoreline change trends have been consistently measured between Dec. 2014 and March. 2021. In fact, the longer-term rate measured over this period was -14.4 ft./yr. (Stations 20+00 to 60+00). In comparison, an average shoreline change of -18.2 ft./yr. was measured along the Fort Caswell Section between March 2021 and May 2023. This area is also heavily influenced by the shoaling and sediment transport resulting from the inlet hydrodynamic forces that occur at the entrance to the Cape Fear River.

The rate measured during the 26-month monitoring period along the eastern 6,000 feet of Caswell Beach (Stations 60+00 to 120+00) was -1.2 ft./yr. The rate observed between Dec. 2014 and Nov. 2018 was +7.7 ft./yr., whereas the longer-term rate measured between Dec. 2014 and March 2021 was +1.6 ft./yr. However, average rates of -20.3 ft./yr. and -7.5 ft./yr., measured between Dec. 2014 and Dec. 2015 and Nov. 2018 and Nov. 2019, respectively, demonstrate the variation

observed along this portion of beach historically. The addition of sand along portions of Caswell Beach from the Wilmington Harbor Navigation project has likely influenced the historic shoreline change rates to some extent. Furthermore, this section is heavily influenced by a large shoal that stretches along the shoreface of this section of beach.

Volume Changes: Volume changes were measured above the -12 ft. NAVD88 contour (Stations 20+00 to 130+00) and above the -17 ft. NAVD88 contour (Stations 130+00 to 200+00) between the time periods March 2021 and May 2023 as well as May 2022 and May 2023. The Fort Caswell Section (Stations 20+00 to 60+00) lost an average of -21.7 cy/ft. of material over the 26-month monitoring period above the -12 ft. NAVD88 contour. Volume loss was measured on all of the transects along the Fort Caswell Section.

The East Caswell Beach Section (Stations 60+00 to 130+00) gained an average of 3.6 cy/ft. of material over the 26-month monitoring period above the -12 ft. NAVD88 contour. However, over the 12-month period between the May 2022 and May 2023 surveys, the East Caswell Beach Section lost an average of 3.7 cy/ft. The West Caswell Beach Section (Stations 130+00 to 200+00) gained an average of 17.1 cy/ft. over the 26-month monitoring period above the -17 ft. NAVD88 contour. However, over the 12-month period between the May 2022 and May 2023 surveys, the West Caswell Beach Section saw a volumetric gain on average (+3.5 cy/ft.).

Comparing volumetric changes measured over the period between March 2021 and May 2023 to historic volumetric changes measured along Caswell Beach, the recent trends do appear to align with historic trends. The rate measured along the eastern 6,000 feet of Caswell Beach (Stations 60+00 to 120+00) during the 26-month monitoring period was +14,500 cy/yr. The longer-term rate observed between Dec. 2014 and Nov. 2018 was also positive (+21,500 cy/yr.). Average rates of +10,100 cy/yr. and +42,100 cy/yr. were also measured between Dec. 2014 and Dec. 2015 and Nov. 2018 and Nov. 2019, respectively. The addition of sand along portions of Caswell Beach from the Wilmington Harbor Navigation project likely influenced the historic volume changes to some extent.

Along the Fort Caswell oceanfront, negative volume change has been the trend observed since December 2014. The longer-term rate measured between Dec. 2014 and Nov. 2018 was -37,700 cy/yr. (Stations 20+00 to 60+00). In comparison, an average volume change rate of -44,000 cy/yr. was measured along the Fort Caswell Section between March 2021 and May 2023.

Conclusions: Though the changes observed between March 2021 and May 2023 do not appear to suggest any major short term adverse impacts to Caswell Beach due to the dredging of a portion of JBS by the Town of Oak Island in April/May 2021 and February/April 2022, additional monitoring is necessary to fully evaluate longer-term impacts. Furthermore, while positive volume changes were observed along Caswell Beach (60+00 to 200+00) over the entire 26-month monitoring period, the 12-month trend observed between May 2022 and May 2023 include an average negative volume change in the East Caswell Beach Section and a significantly lower average positive volume change in the West Caswell Beach Section. The difference in the trends observed may be influenced by seasonal variation. To that end, future survey data should be collected at a

similar time of year as the data collected in spring 2023. The permit issued to Oak Island for the dredging of JBS requires the Town to monitor Caswell Beach for a minimum of 3 years after utilizing the JBS borrow area. The Town of Oak Island therefore is obligated to monitor Caswell Beach through at least Spring 2025.

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1 INTRODUCTION

The Town of Caswell Beach is located on a 13-mile-long coastal barrier island on the Atlantic coast of Brunswick County in southeastern North Carolina. Caswell Beach is oriented generally in an east/west direction, with a south facing ocean beach. The barrier island is separated from Bald Head Island by the entrance to the Cape Fear River. The Town of Caswell Beach is bordered by Fort Caswell on the east and the Town of Oak Island on the west.

The Town of Caswell Beach and Oak Island are recipients of sediment placed by the USACE through the Wilmington Harbor Sand Management Plan (SMP). This SMP determined that approximately 2/3 of the sand that is removed from the navigation channel comes from Bald Head Island, while 1/3 comes from Caswell Beach/Oak Island (USACE, 2000). In order to account for the 2:1 relationship of sand infilling the channel, the SMP recommended that the material removed from the channel on a biennial basis would be placed on Bald Head Island in Years 2 and 4, with sand being placed on Caswell Beach and Oak Island in Year 6. There was a maintenance event in February/April 2009 where 123,400 cubic yards of sand was placed between the entrance to Fort Caswell and 407 Caswell Beach Road (Stations 60+00 to 95+00) and 941,000 cubic yards between 607 Caswell Beach Road and SE 74th Street (Stations 120+00 to 260+00) (USACE, 2013). The last maintenance event along Caswell Beach/Oak Island from the Wilmington Harbor Navigation project occurred in May/June 2018. During that event approximately 1,140,000 cubic yards of sand were placed along Caswell Beach and Oak Island between the 500 block of Caswell Beach Road (Station 110+00) and SE 63rd Street (Station 300+00).

Despite receiving regular deposits of sand from the Wilmington Harbor Navigation Project, both Bald Head Island and Oak Island have initiated supplemental beach nourishment projects to mitigate long-term erosion. Over the past five (5) years, the Town of Oak Island and the Village of Bald Head Island have completed projects that included dredging portions of Jay Bird Shoals (JBS). Between December 2014 and October 2020, the Village of Bald Head Island monitored Caswell Beach on an annual basis as a condition of their permit to dredge a portion of JBS. In 2020, Oak Island took over the monitoring of Caswell Beach and Fort Caswell as a condition of the CAMA Permit #31-20, which allowed the Town of Oak Island to dredge material from a separate portion of JBS that was even closer to Caswell Beach. In addition, the Town of Oak Island agreed to the following terms:

1. The Town will evaluate available historical datasets and calculate mean change and standard deviations for Mean High Water (MHW) shoreline and volume changes above -2 ft. NGVD and out to depth of closure. Efforts will be made to determine overall calculations and calculations within discrete timeframes in order to bracket storms and other effects (from nourishment) to the extent practicable.

2. The Town will collect surveys from Station 20+00 to 200+00 (every 1,000 ft) beginning in Spring 2020 (in addition to the annual surveys collected by the Town every 1,000 ft. from Station 210+00 to 700+00). This initial survey will represent the conditions before the Town constructs its anticipated renourishment project in 2020 utilizing the JBS borrow area. The Town will collect surveys annually within the area identified (Station 20+00 to

200+00), for a minimum of 3 years after utilizing the JBS borrow area. The Town's Engineer will calculate MHW shoreline and volume changes annually and will compare them to the available historical calculations outlined in Item 1.

3. If the average calculated values over any three adjacent beach profile survey transects (covering a 3,000 ft section of shoreline) exceeds the mean values by + one standard deviation, the Town will convene a Technical Advisory Committee (TAC) consisting of three coastal engineers registered in the State of North Carolina, (1 – Oak Island, 1 – Caswell Beach, 1 – Independent) to review the measured MHW shoreline and volume changes and investigate potential causes. The TAC will determine if a cause determination for the exceedance can be made or if additional monitoring is required. If the TAC is not activated within 3 years after utilizing the JBS borrow area, the Caswell Beach monitoring requirements for the Town will cease.

4. If the TAC is engaged and agrees that the utilization of JBS borrow area is causing unintentional effects on Caswell Beach, the Town will be responsible for mitigation. Mitigation will most likely consist of the Town paying the United States Army Corps of Engineers to dredge and place additional material in the affected areas during the next Wilmington Harbor Navigation project when placement is planned for Caswell Beach/Oak Island oceanfront.

In April/May 2021, the Town of Oak Island conducted a beach nourishment project using the permitted borrow area within JBS. The extent and location of this project can be seen in Figure 1. In accordance with the permit, the Town of Oak Island conducted the pre-construction survey of Caswell Beach in March 2021, prior to the April/May dredging event. This dredging event removed approximately 885,600 cy of sand from the permitted borrow area of JBS (Moffatt & Nichol, 2021). A post-construction survey was conducted along Caswell Beach by the Town of Oak Island in October 2021. Both the March 2021 and October 2021 surveys included 19 profiles, spaced approximately 1,000 feet apart, located between the eastern end of Fort Caswell and 200 feet west of Yaupon Way (Stations 20+00 to 200+00). The monitoring profiles along the Caswell Beach and Fort Caswell shorelines are shown in Figure 2. The Town of Caswell Beach hired Coastal Protection Engineering of North Carolina, Inc. (CPE) in 2021 to independently evaluate shoreline and volume changes associated with the 2021 beach nourishment project using the data collected by the Town of Oak Island. The results of that analysis are included in the *Town of Caswell Beach 2021 Beach Monitoring Report*, prepared by CPE.

In February/April 2022, the Town of Oak Island conducted a second beach nourishment project using a combination of the permitted borrow area within JBS and a second site located offshore of the western end of Oak Island. The project placed approximately 658,000 cubic yards of sand between 3rd Place E (Station 466+00) and 69th Place W (Station 680+00). An additional 107,000 cubic yards was placed between 54th Place W (Station 630+00) and 69th Place W (Station 680+00). The dredge event removed approximately 1,100,000 cy of sand from the permitted borrow area of JBS. Figure 3 shows the extent of the 2022 project. Note that the placement area circled on the eastern end of the Town of Oak Island was not awarded and was not constructed during the

2022 project. Following the 2022 project, monitoring surveys were conducted by the Town of Oak Island in May 2022 and May 2023 to monitor for potential impacts to Fort Caswell and Caswell Beach. Both surveys included the same 19 profiles surveyed in March and October 2021. An independent evaluation was conducted by CPE using the 2022 and 2023 data, the results of which are included in the *Town of Caswell Beach 2022 Beach Monitoring Report*, and this report, respectively.

The purpose of this report is to assess shoreline changes and volumetric changes measured between March 2021 and May 2023 and to report any deviations in previously observed trends that may be associated with the April/May 2021 and/or the February/April 2022 dredging events. The report also provides shoreline and volumetric changes measured between the two most recent surveys i.e., May 2022 and May 2023. Shoreline and volumetric changes measured between March 2021 and May 2023 have also been compared to trends observed from historic datasets. Datasets used in this assessment are listed in Table 1. Coordinates for the stations and the azimuths along which survey data were collected are provided in Table 2.

Table 1. Caswell Beach Dataset Descriptions

Responsible Party	Survey Type	Date	Data Range
Bald Head Island	Profile Survey	December 2014	20+00 to 120+00
Bald Head Island	Profile Survey	December 2015	20+00 to 120+00
Bald Head Island	Profile Survey	November 2018	20+00 to 120+00
Bald Head Island	Profile Survey	November 2019	20+00 to 120+00
Oak Island	Profile Survey	March 2021	20+00 to 200+00
Oak Island	Profile Survey	October 2021	20+00 to 200+00
Oak Island	Profile Survey	May 2022	20+00 to 200+00
Oak Island	Profile Survey	May 2023	20+00 to 200+00

Table 2. Caswell Beach Transect List

Station	Easting (ft)	Northing (ft)	Azimuth (°)
20+00	2298941.8	53215.8	128.7
30+00	2298003.7	52869.3	159.7
40+00	2297065.7	52522.8	159.7
50+00	2296111.3	52477.4	194.8
60+00	2295144.6	52733.4	194.8
70+00	2294198.2	52964.3	193.7
80+00	2293204.4	53219.6	193.7
90+00	2292236.8	53476.2	195.0
100+00	2291270.7	53735.7	195.0
110+00	2290356.1	53981.6	195.1
120+00	2289368.5	54349.0	200.4
130+00	2288413.0	54636.7	191.8
140+00	2287434.1	54843.4	191.9
150+00	2286399.6	55061.9	191.9
160+00	2285511.4	55350.7	192.0
170+00	2284569.5	55687.8	199.7
180+00	2283636.1	56068.9	197.3
190+00	2282662.9	56308.3	197.3
200+00	2281697.3	56581.9	197.2

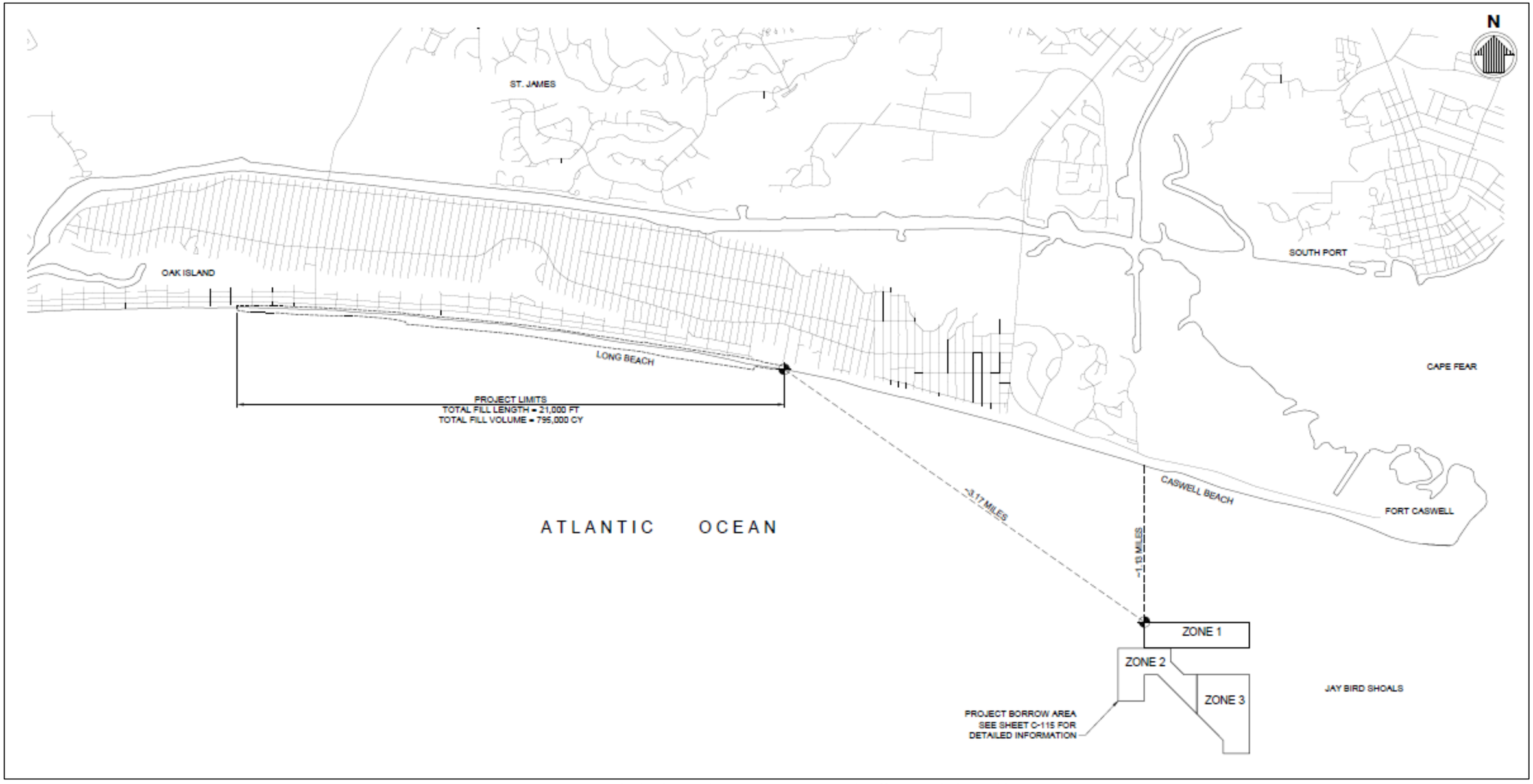

Figure 1. 2021 Oak Island Nourishment Project Location (Moffatt & Nichol, 2019b)

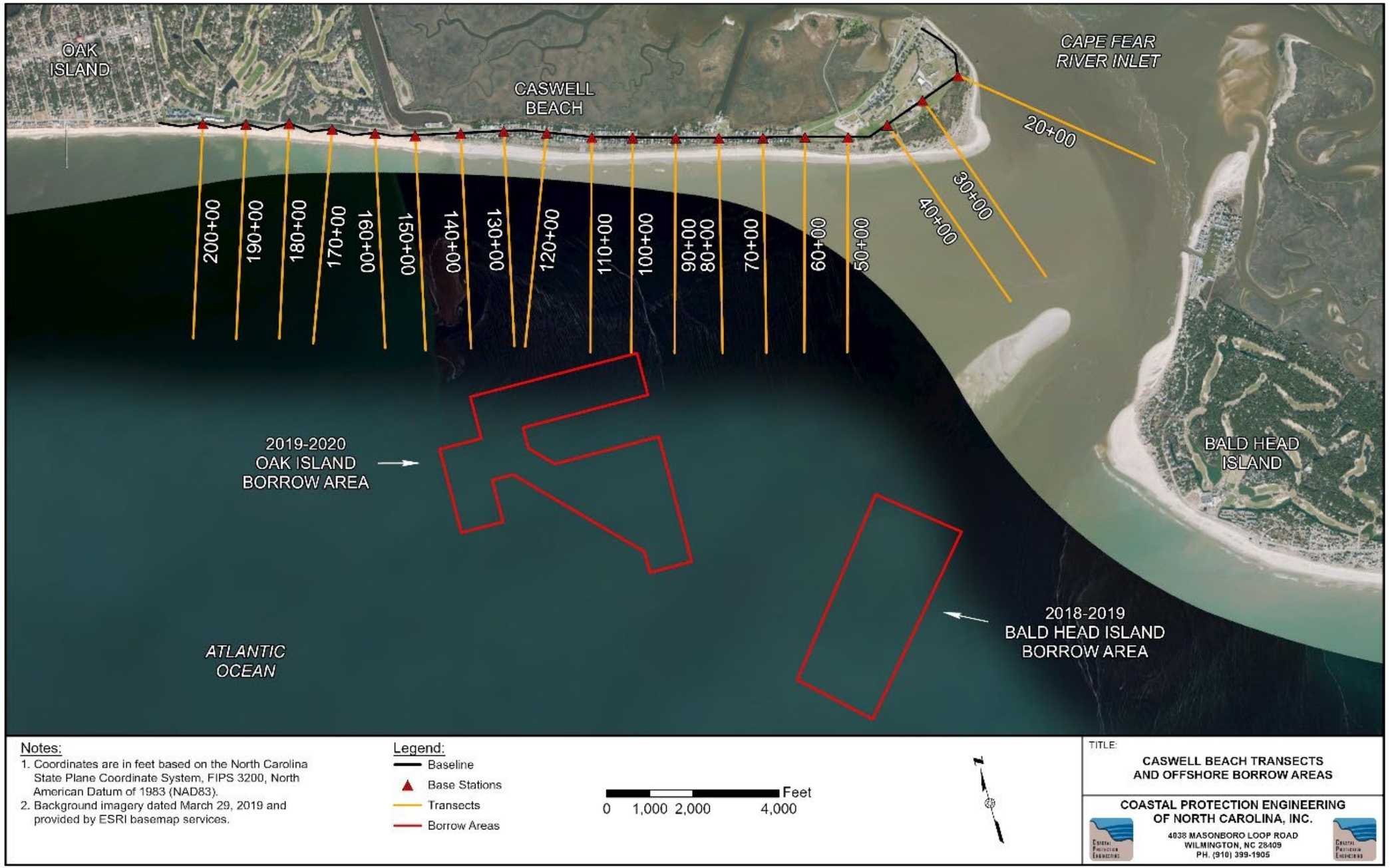

Figure 2. Location Map

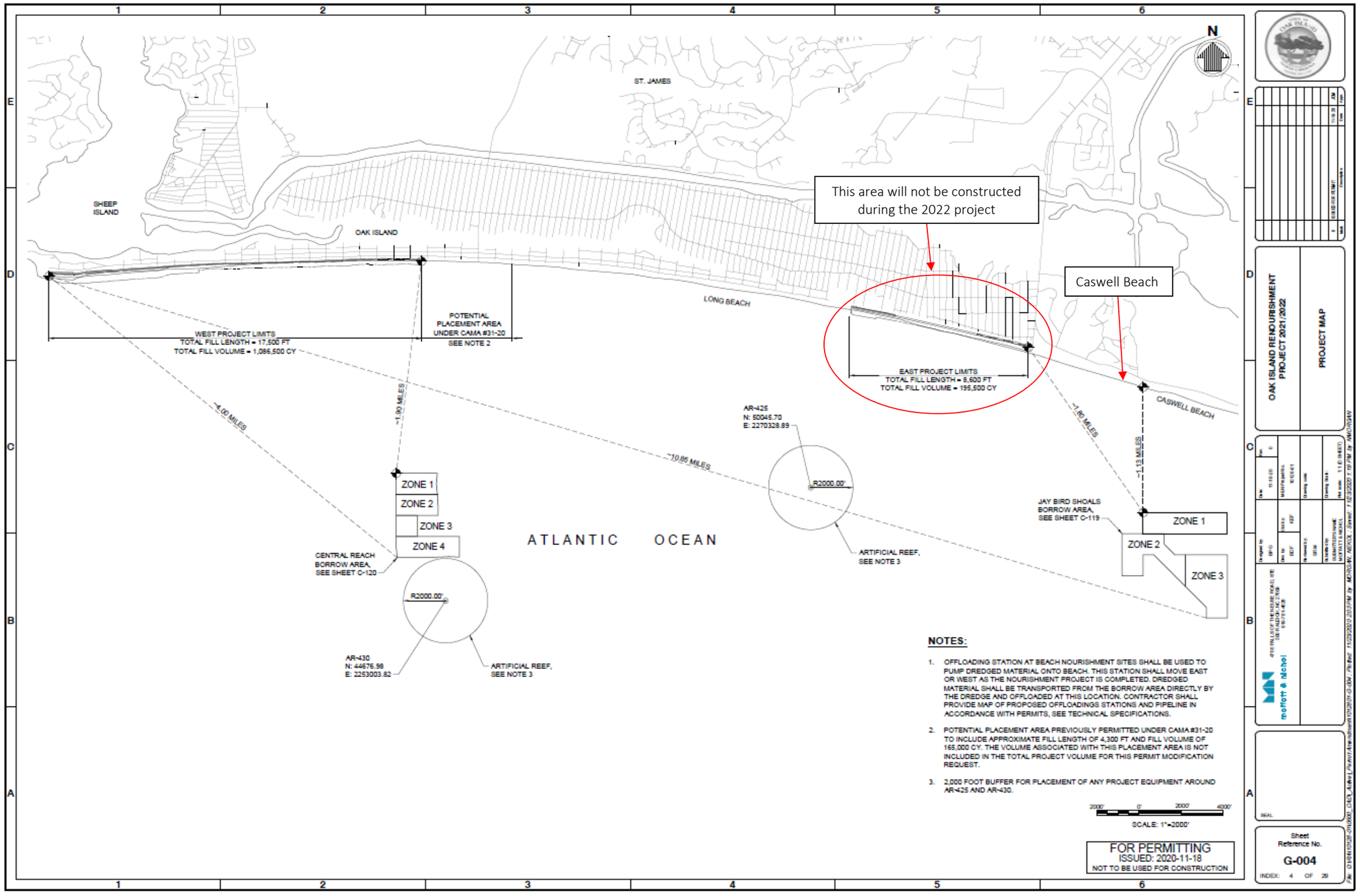

Figure 3. Oak Island Renourishment Project Location (Moffatt & Nichol, 2020)

For the purposes of this analysis, the Caswell Beach shoreline was divided into three sections. The three sections are defined as the Fort Caswell Section (Stations 20+00 to 60+00), the East Caswell Beach Section (Stations 60+00 to 130+00), and the West Caswell Beach Section (Stations 130+00 to 200+00). Caswell Beach was broken up into an East and West Section, primarily due to the difference in closure depth along the Town's oceanfront, which is associated with the Cape Fear River ebb shoal system. The stations are shown in Figure 2, and the geographical limits and baseline stations for each section are provided in Table 3.

Table 3. Caswell Beach Section Descriptions

Section Name	Geographic Extent	Baseline Stations
Fort Caswell	Shoreline along Fort Caswell	20+00 to 60+00
East Caswell Beach	Between the entrance to Fort Caswell and 638 Caswell Beach Road	60+00 to 130+00
West Caswell Beach	Between 638 Caswell Beach Road and 200 feet west of Yaupon Way	130+00 to 200+00

Vertical data described in this report was either collected in, or converted to, the North American Vertical Datum of 1988 (NAVD88). All horizontal data is provided in the North Carolina State Plane Coordinate System, North American Datum of 1983(2011) (NAD83(2011)). Table 4 shows individual tide levels referenced to NAVD88 which are from the *Bald Head Island, NC Beach Monitoring Program: Monitoring Report No. 19 (May 2020 to May 2021)* (Olsen, 2021).

Table 4. Tidal Datums

Datum	Elevation (ft., NAVD88)
Mean High Water (MHW)	+1.41
Mean Tide Level (MTL)	-0.75
Mean Low Water (MLW)	-2.91

2 SHORELINE ANALYSES

2.1 Methodology

Shoreline change is calculated by comparing shoreline positions along shore perpendicular transects over time. This linear change in the position of the shoreline moving either landward or seaward, is often easier for the general public to visualize. Shoreline change can be provided in terms of the actual linear change measured between surveys or as a rate in an annualized form. The rate is calculated by dividing the measured distance of shoreline change by the time period (number of years) between survey events (i.e., feet per year). These rates are described in terms of positive (+) for advance (shoreline moving seaward) and negative (-) for recession (shoreline moving landward). The average shoreline changes and rates for a section were determined by computing a weighted average based on the length between stations.

As it relates to shoreline change, the "shoreline" is typically defined as a specified elevation contour. The Mean High Water (MHW) contour was chosen as the representative contour for this assessment. Figure 4 shows a typical comparison plot of two beach profiles at Station 90+00 surveyed approximately 7 months apart, illustrating how the shoreline change is measured.

It is important for the reader to note that although shoreline change can be an indicator of loss or gain of beach width, the nature of sand movement in response to wave and water level conditions makes shoreline position highly variable temporally.

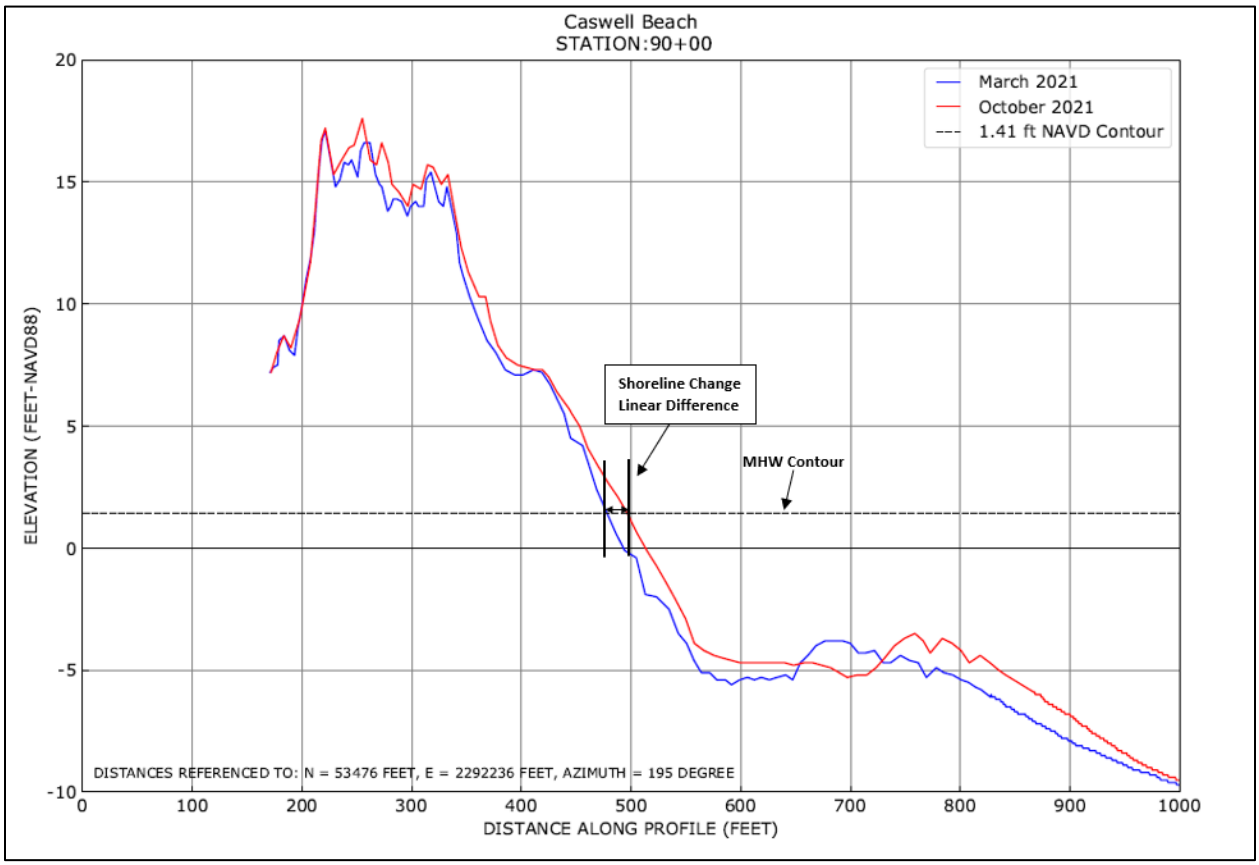

Figure 4. Beach Profile Cross Section Illustrating Shoreline Change

2.2 Long-Term Time Period (March 2021 to May 2023)

The average change in the location of the MHW contour, measured over the 26-month monitoring period between March 2021 (pre-construction) and May 2023, along the entire project area (Stations 20+00 to 200+00), which includes portions of the Fort Caswell shoreline, was -21.2 feet (landward movement). This equates to an average shoreline change rate of -9.8 ft./yr. Along the Caswell Beach oceanfront from the entrance to Fort Caswell (Station 60+00) to 200 feet west of Yaupon Way (Station 200+00), the average shoreline change was -15.3 feet (landward movement),

which equates to an average rate of -7.1 ft./yr. Along the Fort Caswell oceanfront from Station 20+00 to the entrance to Fort Caswell (Station 60+00), the average shoreline change was -39.4 feet (landward movement), which equates to an average rate of -18.2 ft./yr. The measured shoreline changes and rates for each station are provided in Table 5. Figure 5 shows a graphical comparison of the measured shoreline change computed at each station over the 26-month period.

The average shoreline change along the East Caswell Beach Section (Stations 60+00 to 130+00) was -4.1 feet over the 26-month period, which equates to an average annual rate of -1.9 ft./yr. A profile-by-profile comparison shows shoreline changes in this section ranged from -33.3 ft. at Station 130+00 to +24.7 ft. at Station 90+00.

The average shoreline change in the West Caswell Beach Section (Stations 130+00 to 200+00) was -28.1 ft., which equates to an annual average rate of -13.0 ft./yr. A profile-by-profile comparison shows shoreline changes in this section ranged from -42.3 ft. (Station 160+00) to -10.5 ft. (Station 200+00). Higher shoreline losses were observed between Stations 130+00 and 170+00 in West Caswell Beach, with the average MHW shoreline change being -35.4 ft. (landward movement) along this approximate 5,000-foot section of the Town.

2.3 Recent Period (May 2022 to May 2023)

The average rate of change in the location of the MHW contour measured between May 2022 and May 2023, along the entire project area (Stations 20+00 to 200+00), which includes portions of the Fort Caswell shoreline, was -9.9 ft./yr. (landward movement). Only 3 stations had a positive rate along the entire study area during this 12-month period. Along the Caswell Beach oceanfront from the entrance to Fort Caswell (Station 60+00) to 200 feet west of Yaupon Way (Station 200+00), the average shoreline change rate was -8.4 ft./yr. (landward movement). Along the Fort Caswell oceanfront from Station 20+00 to the entrance to Fort Caswell (Station 60+00), the average shoreline change rate was -13.3 ft./yr. (landward movement). The measured shoreline change rates for each station are provided in Table 6. Figure 6 shows a graphical comparison of the measured shoreline change computed at each station over the 12-month period.

The average shoreline change rate along the East Caswell Beach Section (Stations 60+00 to 130+00) was -7.6 ft./yr. over the 12-month period. A profile-by-profile comparison shows shoreline change rates in this section ranged from -21.5 ft./yr. at Station 110+00 to +16.0 ft./yr. at Station 120+00.

The average shoreline change rate in the West Caswell Beach Section (Stations 130+00 to 200+00) was -10.4 ft./yr. over the 12-month period. A profile-by-profile comparison shows shoreline changes in this section ranged from -32.4 ft./yr. (Station 140+00) to -1.3 ft./yr. (Station 150+00).

Table 5. Summary of Monitoring Period (March 2021 to May 2023) Shoreline Changes

Station	Shoreline Change (ft.) (March 2021 to May 2023)	Shoreline Change Rate (ft./yr.) (March 2021 to May 2023)
20+00	3.0	1.4
30+00	-105.7	-48.8
40+00	-1.2	-0.5
50+00	-40.8	-18.8
60+00	-22.0	-10.1
70+00	-5.8	-2.7
80+00	-12.7	-5.9
90+00	24.7	11.4
100+00	11.1	5.1
110+00	-24.3	-11.2
120+00	6.0	2.7
130+00	-33.3	-15.4
140+00	-32.9	-15.2
150+00	-33.5	-15.5
160+00	-42.3	-19.5
170+00	-34.9	-16.1
180+00	-18.3	-8.5
190+00	-13.6	-6.3
200+00	-10.5	-4.8
Total Project Avg. (Stations 20+00 to 200+00)	**-21.2**	**-9.8**
Fort Caswell (Stations 20+00 to 60+00)	**-39.4**	**-18.2**
East Caswell Beach (Stations 60+00 to 130+00)	**-4.1**	**-1.9**
West Caswell Beach (Stations 130+00 to 200+00)	**-28.1**	**-13.0**
Caswell Beach (Stations 60+00 to 200+00)	**-15.3**	**-7.1**

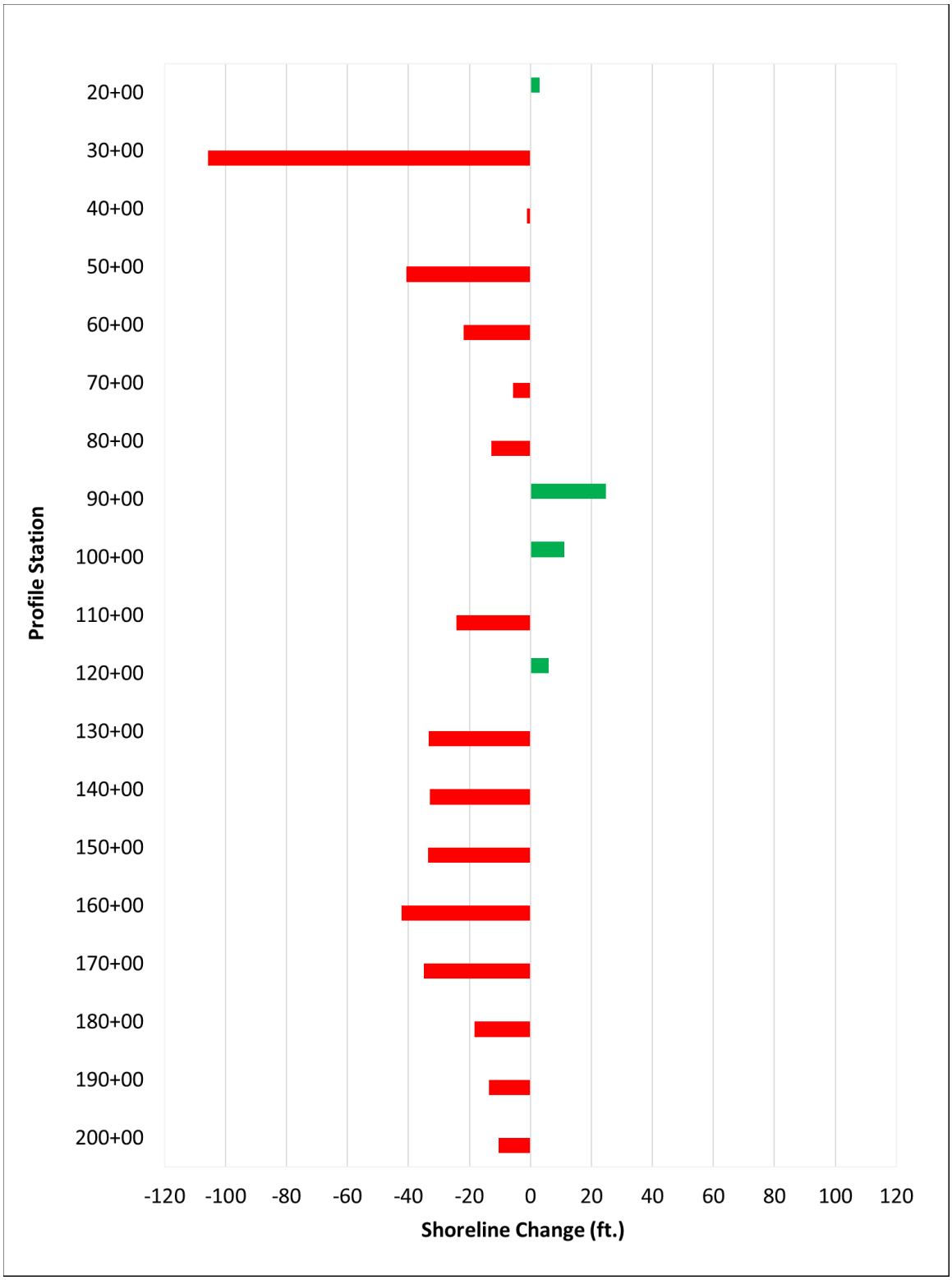

Figure 5. MHW Shoreline Change - March 2021 to May 2023

Table 6. Summary of Recent Period (May 2022 to May 2023) Shoreline Change Rates

Station	Shoreline Change Rate (ft./yr.) (May 2022 to May 2023)
20+00	-15.3
30+00	2.9
40+00	-5.1
50+00	-35.9
60+00	-15.1
70+00	-5.5
80+00	-17.2
90+00	6.8
100+00	-19.2
110+00	-21.5
120+00	16.0
130+00	-11.3
140+00	-32.4
150+00	-1.3
160+00	-7.6
170+00	-7.7
180+00	-12.0
190+00	-3.0
200+00	-4.3
Total Project Avg. (Stations 20+00 to 200+00)	**-9.9**
Fort Caswell (Stations 20+00 to 60+00)	**-13.3**
East Caswell Beach (Stations 60+00 to 130+00)	**-7.6**
West Caswell Beach (Stations 130+00 to 200+00)	**-10.4**
Caswell Beach (Stations 60+00 to 200+00)	**-8.4**

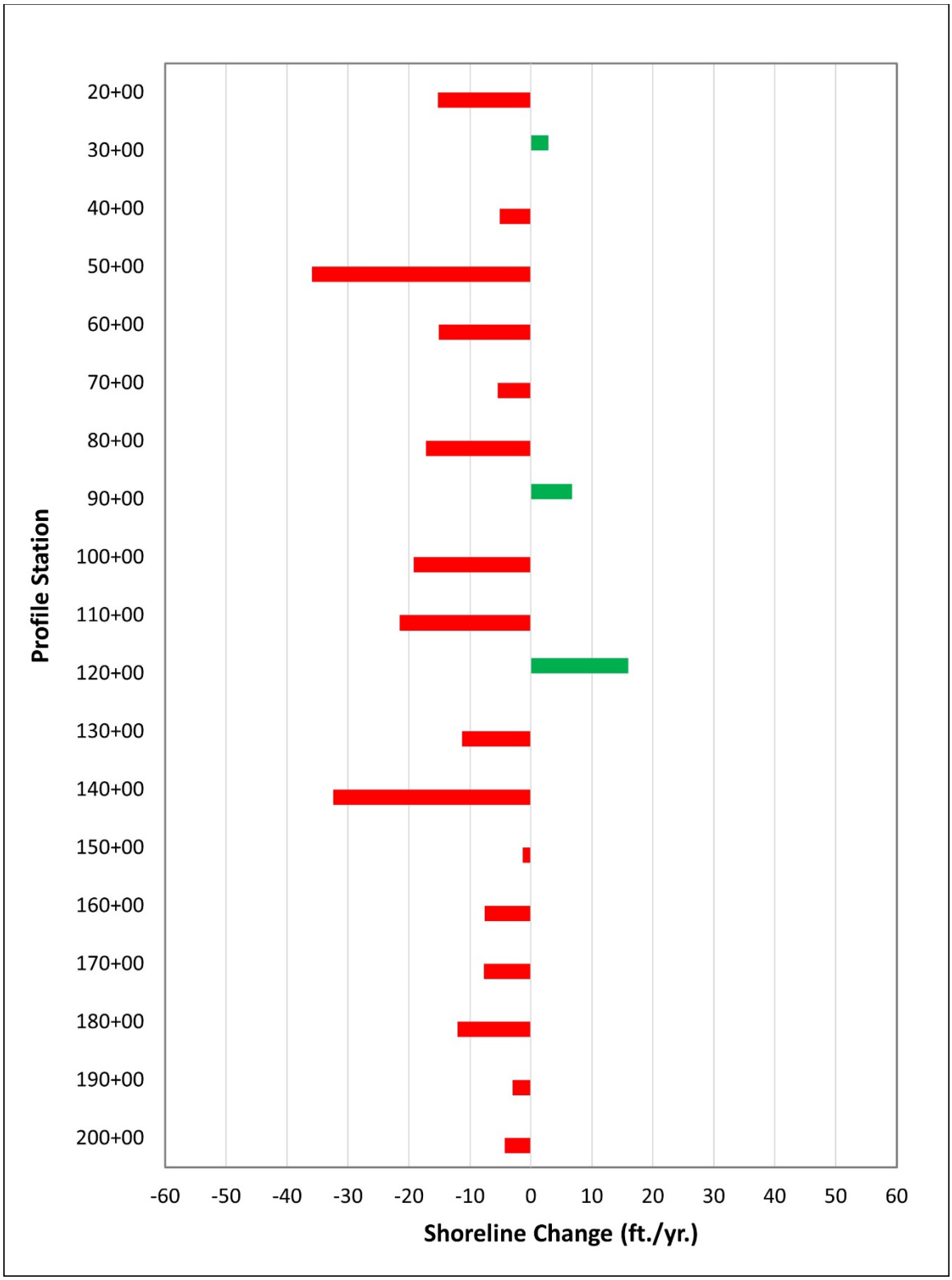

Figure 6. MHW Shoreline Change Rate - May 2022 to May 2023

2.4 Historic Rates

Historic shoreline change rates, reported in *Terminal Groin Project Inlet Management Plan Oak Island Monitoring (Nov 2018 – Nov 2019) Report* (Olsen, 2019), were also evaluated and compared to the recent shoreline changes. With respect to the Caswell Beach and Fort Caswell oceanfront, monitoring conducted as part of the 2019 study only included the profiles from Station 20+00 to 120+00. Shoreline change rates reported in the Olsen (2019) report, are provided in Table 7. Furthermore, using data provided in the report, longer-term rates between Dec. 2014 and March 2021 were computed. It is important to note that the Dec. 2014 to Nov. 2018 rates may have been influenced by the placement of sand along portions of Caswell Beach as part of the Wilmington Harbor Navigation project in May-June 2018.

Table 7. Comparison of Historic and Monitoring Period (Mar. 2021-May 2023) Shoreline Change Rates (ft./yr.)

Station	Dec. 2014 to Dec. 2015	Nov. 2018 to Nov. 2019	Dec. 2014 to Nov. 2018	Dec. 2014 to March 2021	March 2021 to May 2023
20+00	-3.7	-17.1	-10.2	-12.5	1.4
30+00	-7.3	-9.8	-29.0	-16.9	-48.8
40+00	-61.5	-33.6	-35.2	-32.8	-0.5
50+00	-14.8	44.0	-8.7	5.3	-18.8
60+00	-35.1	-5.2	6.1	-1.9	-10.1
70+00	-35.9	-42.0	11.3	-3.7	-2.7
80+00	-15.8	-36.4	20.5	2.1	-5.9
90+00	-15.2	-18.8	8.8	-0.2	11.4
100+00	-21.6	20.8	-2.5	-1.2	5.1
110+00	-16.2	28.8	0.5	4.3	-11.2
120+00	-0.3	12.1	8.3	9.1	2.7
Fort Caswell (Stations 20+00 to 60+00)	**-25.8**	**-2.6**	**-18.7**	**-12.9**	**-18.2**
Caswell Beach (Stations 60+00 to 120+00)	**-20.3**	**-7.5**	**+7.7**	**+0.8**	**-1.2**

Over the 12-month period between December 2014 and December 2015, the average shoreline change rate measured along this same eastern portion of Caswell Beach was -20.3 ft./yr. In the year following the placement of the material as part of the Wilmington Harbor Navigation project (May-June 2018), between November 2018 and November 2019, the average shoreline change rate along this same eastern portion of Caswell Beach was -7.5 ft./yr. Between December 2014 and November 2018, the shoreline change rate measured along the eastern approximately 6,000 feet of Caswell Beach, between the entrance to Fort Caswell and 607 Caswell Beach Road (Stations 60+00 to 120+00) was +7.7 ft./yr. This period would have included placement of sand along portions of Caswell Beach during the 2018 maintenance of the Wilmington Harbor. In comparison, the shoreline change rate measured along the same 6,000-foot section of beach between March

2021 and May 2023 was -1.2 ft./yr. The long-term rate measured along this same eastern portion of the Town, between December 2014 and March 2021, was +0.8 ft./yr.

Between December 2014 and December 2015, the average shoreline change rate calculated along the Fort Caswell shoreline (Stations 20+00 to 60+00) was -25.8 ft./yr. In the year following the placement of the material as part of the Wilmington Harbor Navigation project, between November 2018 and November 2019, the average shoreline change rate along this same portion of Fort Caswell was -2.6 ft./yr. The shoreline change rate measured along the Fort Caswell oceanfront was -18.7 ft./yr. between the December 2014 and November 2018 surveys. In comparison, the shoreline change rate measured along this beach section between March 2021 and May 2023 was -18.2 ft./yr. The long-term rate measured along this same portion of Fort Caswell, between December 2014 and March 2021, was -12.9 ft./yr.

3 VOLUME ANALYSES

3.1 Methodology

As discussed in the previous section, changes in the shoreline position represented by a single elevation contour can vary considerably based on sea conditions leading up to the time in which the surveys were conducted. Sand on the beach is distributed by wind and wave action over the entire active profile (from the dunes out to the depth of closure). The dry beach represents a fraction of the active beach profile. Therefore, the volume of sand measured on the entire profile is an important parameter to track to gauge the health of the beach. The volume of sand in place is the metric that defines the three-dimensional beach that provides storm protection. Figure 7 shows the same profiles depicted in Figure 4 with areas between the profiles shaded to show areas of volume gains in green (accretion) and volumes losses in red (erosion) along the profile. The net difference between these gains and losses is referred to as the volume change.

All volumetric changes along a profile, or averaged over multiple profiles, are given in cubic yards per linear foot. At times, this report also provides total volume in cubic yards measured between certain profiles. These volumes are determined using the average end area method; whereby the average volume change between adjacent profiles is multiplied by the distance between those profiles. The volumetric changes are calculated along the entirety of the profile from the depth of closure to the landward most point at which overlapping data exists. Due to the influence of the ebb shoal system associated with the Cape Fear River on the eastern portion of the survey area, separate closure depths were used to compute the volume changes. Volumes were computed above the -12 ft. NAVD88 contour from Stations 20+00 to 130+00; whereas volumes were computed above the -17 ft. NAVD88 contour for Stations 130+00 to 200+00.

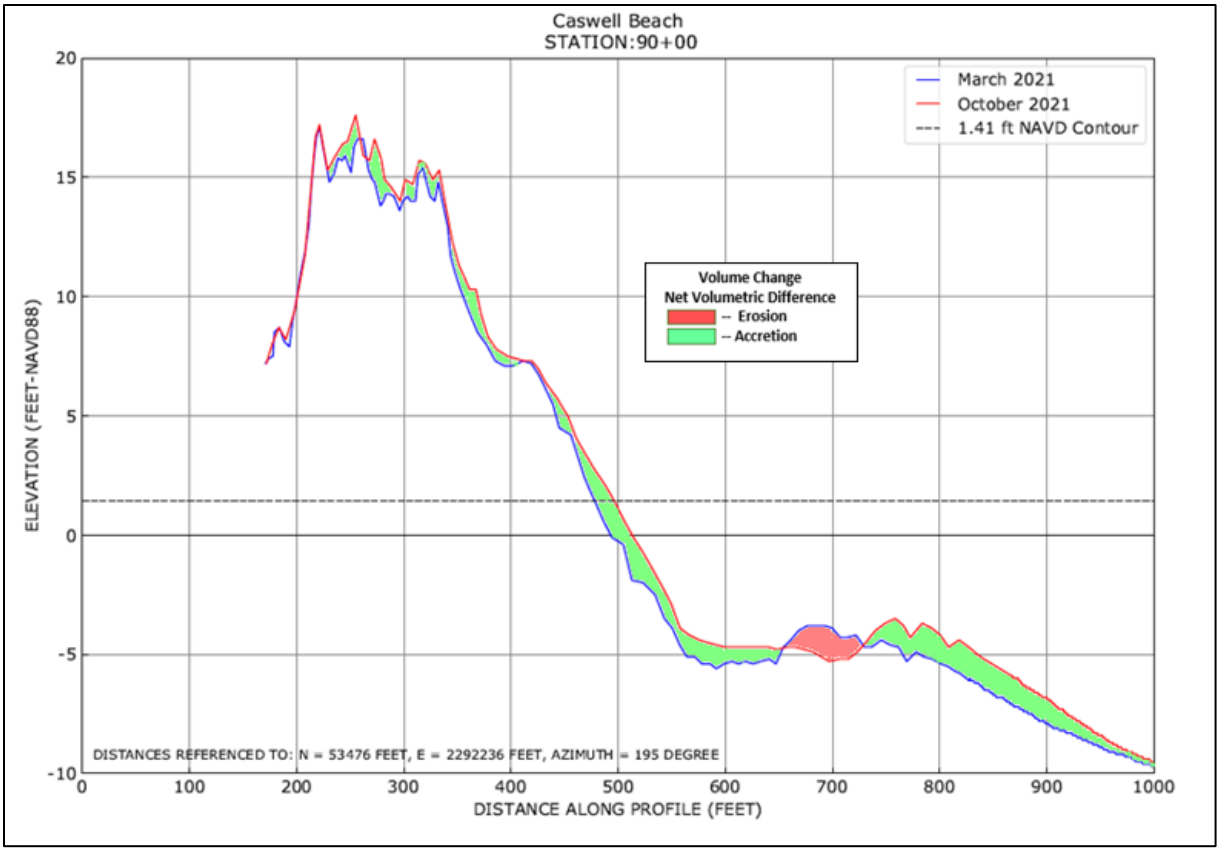

Figure 7. Beach Profile Cross Section Illustrating Volume Change

Historic volumetric change data obtained from the Village of Bald Head Island provided comparison with recent volumetric change data. However, the historic volumetric change computations were based on changes occurring above the -2 ft. NGVD contour and above the observed depth of closure. The depth of closure elevation used in the historic volumetric change analysis was derived from each ensemble of comparative profiles at each monitoring station due to the variable nature of the depth of closure along Oak Island's shorefront (Olsen and Associates, 2021).

3.2 Long-Term Period (March 2021 to May 2023)

A positive volumetric change of approximately 74,000 cy of sand was measured along the Project Area from Station 20+00 to 200+00, between March 2021 and May 2023. The average density change measured along the Project Area (Stations 20+00 to 200+00) between March 2021 and May 2023, was +4.3 cy/ft., equivalent to a volume gain of approximately 74,000 cy. The average density change along the Caswell Beach oceanfront (Stations 60+00 to 200+00) was +11.7 cy/ft., equivalent to a volume gain of approximately 169,400 cy during the 26-month period. Density

changes were computed along each of the 19 profiles and are provided in Table 8 and shown graphically in Figure 8.

Table 8. Summary of Monitoring Period (March 2021 to May 2023) Density Changes

Station	Density Change (cy/ft.)
20+00[1]	-8.5
30+00[1]	-36.4
40+00[1]	-39.1
50+00[1]	-11.0
60+00[1]	-13.4
70+00[1]	-6.4
80+00[1]	7.6
90+00[1]	20.6
100+00[1]	-3.8
110+00[1]	3.5
120+00[1]	31.0
130+00[1]	-10.4
130+00[2]	11.2
140+00[2]	33.6
150+00[2]	21.8
160+00[2]	29.5
170+00[2]	7.3
180+00[2]	16.0
190+00[2]	10.1
200+00[2]	7.4
Total Project Avg. (Stations 20+00 to 200+00)	**+4.3**
Fort Caswell (Stations 20+00 to 60+00)	**-21.7**
East Caswell Beach (Stations 60+00 to 130+00)	**+3.6**
West Caswell Beach (Stations 130+00 to 200+00)	**+17.1**

[1] Calculated above the -12 ft. NAVD88 Contour
[2] Calculated above the -17 ft. NAVD88 Contour

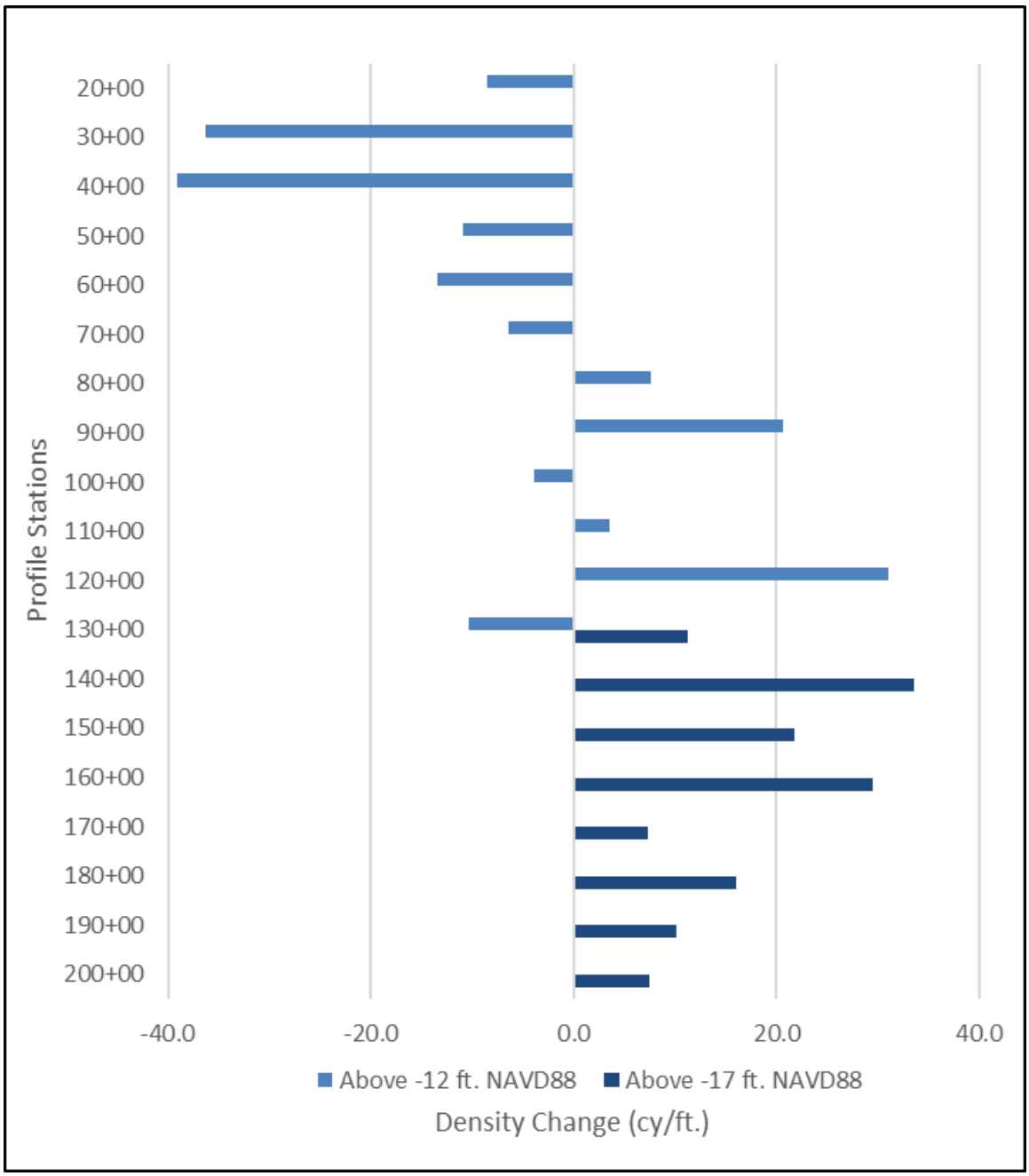

Figure 8. Density Changes (cy/ft.) March 2021 to May 2023

As previously stated, the volume change was computed above the -12 ft. NAVD88 contour from Station 20+00 to 130+00. A negative volume change was measured along the Fort Caswell Section (Stations 20+00 to 60+00) over the 26-month period between March 2021 and May 2023. The average volume change was -21.7 cy/ft., this equates to a volume loss of approximately -95,400 cubic yards. The average volume change along the East Caswell Beach Section (Stations 60+00 to 130+00) was +3.6 cy/ft., this equates to a gain of approximately 41,800 cubic yards.

Volume change calculations for the West Caswell Beach Section (Stations 130+00 to 200+00) were based on changes calculated above the -17 ft. NAVD88 contour. The average volume change along the West Caswell Beach Section was +17.1 cy/ft., equivalent to a volume gain of approximately 127,600 cubic yards. Positive volume changes were computed on all profiles in this section. Volume changes computed on each profile in this section over the 26-month period are provided in Table 9.

Table 9. Summary of Monitoring Period (March 2021 to May 2023) Volume Changes

Stations	Volume Change (cy)
20+00 to 30+00[(1)]	-21,600
30+00 to 40+00[(1)]	-37,700
40+00 to 50+00[(1)]	-23,900
50+00 to 60+00[(1)]	-12,200
60+00 to 70+00[(1)]	-9,700
70+00 to 80+00[(1)]	600
80+00 to 90+00[(1)]	14,100
90+00 to 100+00[(1)]	8,400
100+00 to 110+00[(1)]	-100
110+00 to 120+00[(1)]	18,200
120+00 to 130+00[(1)]	10,300
130+00 to 140+00[(2)]	22,400
140+00 to 150+00[(2)]	29,300
150+00 to 160+00[(2)]	23,900
160+00 to 170+00[(2)]	18,400
170+00 to 180+00[(2)]	11,700
180+00 to 190+00[(2)]	13,100
190+00 to 200+00[(2)]	8,800
Total Project Sum (Stations 20+00 to 200+00)	**74,000**
Fort Caswell (Stations 20+00 to 60+00)	**-95,400**
East Caswell Beach (Stations 60+00 to 130+00)	**41,800**
West Caswell Beach (Stations 130+00 to 200+00)	**127,600**

[(1)] Calculated above the -12 ft. NAVD88 Contour
[(2)] Calculated above the -17 ft. NAVD88 Contour

3.3 Recent Period (May 2022 to May 2023)

A negative volumetric change of approximately 17,100 cy of sand was measured along the surveyed area from Station 20+00 to 200+00 between May 2022 and May 2023. The average density change measured along the surveyed area (Stations 20+00 to 200+00) was -0.9 cy/ft. The average density change along the Caswell Beach oceanfront (Stations 60+00 to 200+00) was +0.7 cy/ft., equivalent to a volume gain of approximately 12,200 cy during the 12-month period. Density changes computed along each of the 19 profiles are provided in Table 10 and shown graphically in Figure 9.

Table 10. Summary of Recent Period (May 2022 to May 2023) Density Changes

Station	Density Change (cy/ft.)
20+00[(1)]	-5.9
30+00[(1)]	6.6
40+00[(1)]	-8.1
50+00[(1)]	-20.7
60+00[(1)]	-9.5
70+00[(1)]	-9.5
80+00[(1)]	-1.0
90+00[(1)]	6.9
100+00[(1)]	-13.1
110+00[(1)]	-7.2
120+00[(1)]	16.0
130+00[(1)]	-11.8
130+00[(2)]	-8.0
140+00[(2)]	4.4
150+00[(2)]	-1.0
160+00[(2)]	20.3
170+00[(2)]	4.0
180+00[(2)]	3.5
190+00[(2)]	1.6
200+00[(2)]	3.1
Total Project Avg. (Stations 20+00 to 200+00)	**-0.9**
Fort Caswell (Stations 20+00 to 60+00)	**-7.5**
East Caswell Beach (Stations 60+00 to 130+00)	**-3.7**
West Caswell Beach (Stations 130+00 to 200+00)	**3.5**

[(1)] Calculated above the -12 ft. NAVD88 Contour
[(2)] Calculated above the -17 ft. NAVD88 Contour

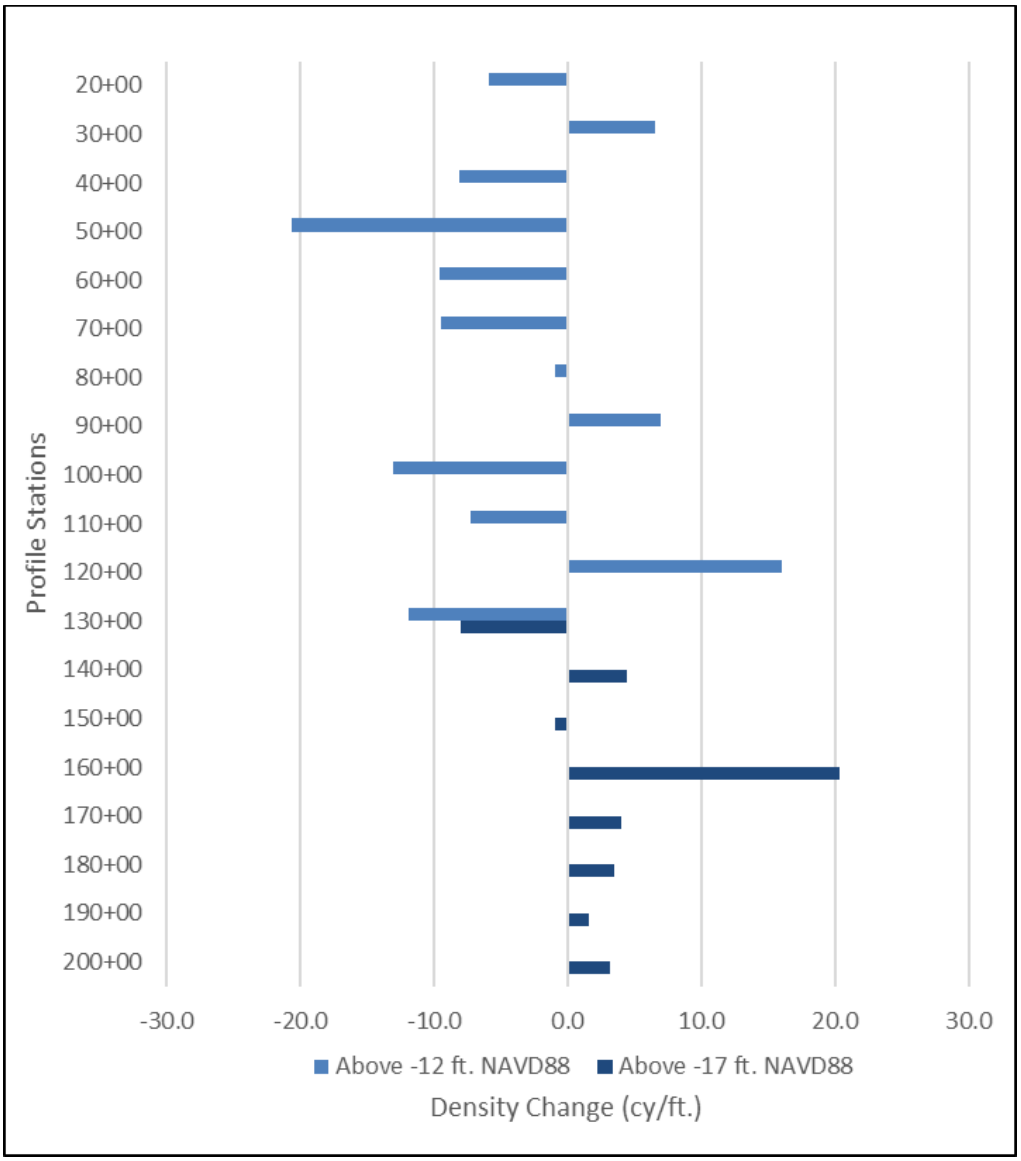

Figure 9. Recent Density Changes (cy/ft.) May 2022 to May 2023

As previously stated, the volume change was computed above -12 ft. NAVD88 from Station 20+00 to 130+00. A negative volume change was measured along the Fort Caswell Section (Stations 20+00 to 60+00) between May 2022 and May 2023. The average volume change was -7.5 cy/ft., this equates to a volume loss of approximately 29,300 cubic yards. The average volume change over the 12-month period, along the East Caswell Beach Section (Stations 60+00 to 130+00) was -3.7 cy/ft. This equates to a loss of approximately 17,700 cubic yards.

Volume change calculations for the West Caswell Beach Section (Stations 130+00 to 200+00) were based on changes calculated above the -17 ft. NAVD88 contour. The average volume change along the West Caswell Beach Section was +3.5 cy/ft.; this equates to a volume gain of approximately

29,900 cubic yards. Volume changes computed between each profile in this section over the 12-month period are provided in Table 11.

Table 11. Summary of Recent Period (May 2022 to May 2023) Volume Changes

Stations	Volume Change (cy)
20+00 to 30+00	300[1]
30+00 to 40+00	-800[1]
40+00 to 50+00	-13,700[1]
50+00 to 60+00	-15,100[1]
60+00 to 70+00	-9,300[1]
70+00 to 80+00	-5,400[1]
80+00 to 90+00	3,000[1]
90+00 to 100+00	-3,100[1]
100+00 to 110+00	-9,600[1]
110+00 to 120+00	4,600[1]
120+00 to 130+00	2,100[1]
130+00 to 140+00	-1,800[2]
140+00 to 150+00	1,800[2]
150+00 to 160+00	9,000[2]
160+00 to 170+00	12,100[2]
170+00 to 180+00	3,800[2]
180+00 to 190+00	2,600[2]
190+00 to 200+00	2,400[2]
Total Project Sum (Stations 20+00 to 200+00)	**-17,100**
Fort Caswell (Stations 20+00 to 60+00)	**-29,300**
East Caswell Beach (Stations 60+00 to 130+00)	**-17,700**
West Caswell Beach (Stations 130+00 to 200+00)	**29,900**

[1] Calculated above the -12 ft. NAVD88 Contour
[2] Calculated above the -17 ft. NAVD88 Contour

3.4 Historic Volumetric Changes

Historic volumetric changes, reported in *Terminal Groin Project Inlet Management Plan Oak Island Monitoring (Nov 2018 – Nov 2019) Report* (Olsen, 2019), were also evaluated and compared to the recent volumetric changes. However, it should be noted that the depth of closure used to determine the historic volume changes was not a single contour but rather was derived from each ensemble of comparative profiles at a monitoring station. That being the case, the comparison of

the historic and recent volumetric changes is focused more on trends of the changes rather than actual densities or rates.

As stated in the Shoreline Change section, monitoring conducted as part of the Olsen (2019) study only included the profiles from Stations 20+00 to 120+00, with respect to the Fort Caswell and Caswell Beach Sections. Volumetric changes reported in the Olsen (2019) report along the 10,000 feet of Caswell Beach and the Fort Caswell oceanfront, are provided in Table 12. It is important to also note that the rates calculated between the December 2014 to November 2018 monitoring events were likely influenced by the placement of material along portions of Caswell beach as part of the Wilmington Harbor Navigation project in May-June 2018.

Between December 2014 and November 2018, the volumetric change rate measured along the eastern approximately 6,000 feet of Caswell Beach, between the entrance to Fort Caswell and 607 Caswell Beach Road (60+00 to 120+00) was +21,500 cy/yr. This period would have included placement of sand along portions of Caswell Beach during the 2018 maintenance of the Wilmington Harbor. Over the 12-month period between December 2014 and December 2015, the volumetric change rate measured along this same eastern portion of Caswell Beach was +10,100 cy/yr. In the year following the placement of the material as part of the Wilmington Harbor Navigation project, between November 2018 and November 2019, the volumetric change rate measured along this same eastern portion of Caswell Beach was +42,100 cy/yr. In comparison, the trend of the volumetric change rate measured along this 6,000-foot section of Caswell beach was also positive between March 2021 and May 2023 (+14,500 cy/yr.).

Between December 2014 and November 2018, the volumetric change rate measured along the Fort Caswell oceanfront, between Stations 20+00 and 60+00, was -37,700 cy/yr. As previously stated, this period would have included placement of sand along portions of Caswell Beach during the 2018 maintenance of the Wilmington Harbor. Over the 12-month period between December 2014 and December 2015, the volumetric change rate measured along the Fort Caswell Section was -29,600 cy/yr. In the year following the placement of the material as part of the Wilmington Harbor Navigation project, between November 2018 and November 2019, the volumetric change rate measured along this same portion of Fort Caswell was -37,000 cy/yr. In comparison, the trend of the volumetric change rate measured along the Fort Caswell Section also indicated erosion between March 2021 and May 2023 at a rate of -44,000 cy/yr.

Table 12. Summary of Historic and Monitoring Period (Mar. 2021 – May 2023) Volumetric Change Rates (cy/yr.)

Station	Dec. 2014 to Nov. 2018	Dec. 2014 to Dec. 2015	Nov. 2018 to Nov. 2019	Dec. 2014 to Mar. 2021	Mar. 2021 to May 2023
Fort Caswell (20+00 to 60+00)	-37,700	-29,600	-37,000	-36,900	-44,000
Eastern Caswell Beach (60+00 to 120+00)	21,500	10,100	42,100	5,600	14,500

4 SUMMARY

In April/May 2021 and February/April 2022, the Town of Oak Island conducted two beach nourishment projects using the permitted borrow area within JBS. In accordance with the permit, the Town of Oak Island conducted the pre-construction survey of Caswell Beach in March 2021, prior to the April/May 2021 dredging event. A survey was conducted by the Town of Oak Island in October 2021 after the 2021 project but prior to the 2022 project. Following completion of the 2022 project, another survey was conducted in May 2022. A year later another survey was conducted in May 2023. All four surveys conducted in March 2021, October 2021, May 2022, and May 2023 included 19 profiles spaced approximately 1,000 feet apart and were located between the eastern end of Fort Caswell and 200 feet west of Yaupon Way (Stations 20+00 to 200+00). Shoreline and volume change analyses were conducted to evaluate changes that occurred over the 26-month period from March 2021 to May 2023. Furthermore, shoreline and volume change analyses were also conducted to evaluate changes that occurred between the 12-month period between the most recent two survey events (May 2022 to May 2023). The results of the analyses, described in Sections 2.2 and 3.2, were compared to trends observed from historic datasets.

Both shoreline and volume changes that occur along the Fort Caswell oceanfront and Caswell Beach are likely influenced by the extensive ebb shoal system associated with the entrance of the Cape Fear River. Figure 10, is taken from the *2019/2020 Renourishment Project Oak Island, North Carolina: Jay Bird Shoals Borrow Area Modeling report* (Moffat & Nichol, 2019a), and shows the extent of these shoals. This figure also shows a representation of the JBS borrow area offshore of Caswell Beach if dredged to the maximum extent simulated in the Moffat & Nichol report. The nearshore portion of the shoal located along the eastern portion of Caswell Beach, indicated by the red arrow in Figure 10, is the reason why a shallower depth of closure was used along the eastern portion of the Caswell Beach survey area (Stations 60+00 to 130+00). The shoreline and volume changes along the Fort Caswell oceanfort area is also influenced by the marginal flood channel directly adjacent to the beach.

Beach profile surveys conducted in March 2021 and May 2023 show the shoreline moved landward on average over the 26-month period. In general, larger negative shoreline changes were measured along the West Caswell Beach Section (Stations 130+00 to 200+00). The average shoreline change along this stretch of beach was -28.1 ft. (landward movement). The average shoreline changes measured along the East Caswell Beach Section (Stations 60+00 to 130+00) was -4.1 ft. (landward movement). In the 2021 Beach Monitoring Report, which measured changes over the 7-month period between March 2021 and October 2021, shoreline change analyses measured positive average shoreline changes along both the East (+3.4 ft.) and West (+6.7 ft.) Caswell Beach Sections (CPE, 2021). In the 2022 Beach Monitoring Report, which measured changes over the 14-month period between March 2021 and May 2022, shoreline change analyses measured shoreline changes along both the East (+1.4 ft.) and West (-17.5 ft.) Caswell Beach

Sections (CPE, 2022). Since March 2021, this is the first time a negative shorline change was measured over the long-term period in the East Caswell Beach section.

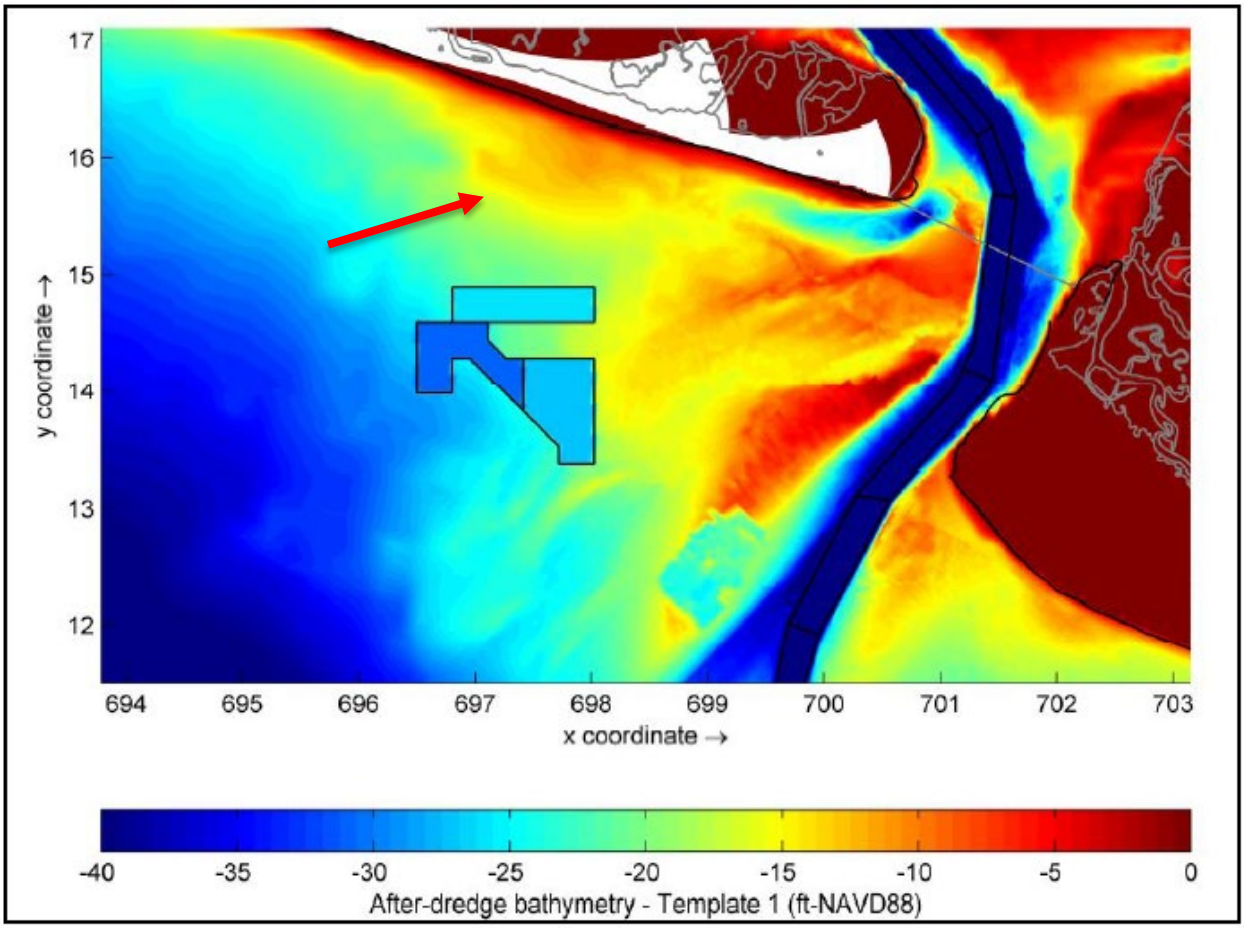

Figure 10. Bathymetric survey chart showing shoals associated with the mouth of the Cape Fear River (Moffatt & Nichol, 2019a)

In the 2021 Beach Monitoring Report, which measured changes over the 7-month period between March 2021 and October 2021, shoreline change analyses measured negative average shoreline changes (-3.0 ft) along the Fort Caswell Section (CPE, 2021). A negative shoreline change trend has continued to be observed along this section through each subsequent monitoring event. The average shoreline change measured over the 14-month period measured between March 2021 and May 2022 was -19.6 ft. (CPE, 2022) whereas the average shoreline change measured over the 26-month period from March 2021 to May 2023 was -39.4 ft..

The shoreline change trends observed over the monitoring period (March 2021 to May 2023) along Caswell Beach and Fort Caswell appear to be consistent with historic rates. The rate measured during the monitoring period along the eastern 6,000 feet of Caswell Beach (Stations 60+00 to 120+00) was -1.2 ft./yr. compared to the long-term rate measured from December 2014

through March 2021 of 0.8 ft./yr. Variability over a subset of that period have been measured, including postive rates as high as +7.7 ft./yr (between December 2014 and November 2018) and negative rates as low as -20.3 ft./yr. (between December 2014 and December 2015). It should be noted that sand placement occurred along portions of Caswell Beach as part of the Wilmington Harbor Navigation project in May-June 2018. Furthermore, this section is heavily influenced by a large shoal that stretches across the entirety of this section as shown in Figure 10.

Along the Fort Caswell oceanfront, negative shoreline change trends have been consitently measured between Dec. 2014 and March 2021. In fact, the longer-term rate measured over this period was -12.9 ft./yr. (Stations 20+00 to 60+00). In comparison, an average shoreline change of -18.2 ft./yr. was measured along the Fort Caswell Section between March 2021 and May 2023. This area is also heavily influenced by the the marginal flood channel directly adjacent to the beach as well as shoaling and sediment transport caused by the Cape Fear River Inlet.

Volume changes were measured above the -12 ft. NAVD88 contour (Stations 20+00 to 130+00) and above the -17 ft. NAVD88 contour (Stations 130+00 to 200+00) between March 2021 and May 2023. The Fort Caswell Section (Stations 20+00 to 60+00) lost an average of 21.7 cy/ft. of material over the 26-month monitoring period above the -12 ft. NAVD88 contour. Volume loss was measured on all of the transects along the Fort Caswell Section. Over the 12-month period between the May 2022 and May 2023 surveys, the Fort Caswell Section lost an average of 7.5 cy/ft.

The East Caswell Beach Section (Stations 60+00 to 130+00) gained an average of 3.6 cy/ft. of material over the 26-month monitoring period above the -12 ft. NAVD88 contour. However, during the recent 12-month period between the May 2022 and May 2023 survey events, an average 3.7 cy/ft. was lost from the East Caswell Beach Section.

The West Caswell Beach Section (Stations 130+00 to 200+00) gained an average of 17.1 cy/ft. over the 26-month monitoring period above the -17 ft. NAVD88 contour. Over the 12-month period between the May 2022 and May 2023 surveys, the West Caswell Beach Section experienced an average gain of 3.5 cy/ft..

The recent volumetric change trends observed along Caswell Beach and Fort Caswell Beach appear to generally align with historic rates. The rate measured along the eastern 6,000 feet of Caswell Beach during the 26-month monitoring period was positive at a rate of 14,500 cy/yr. The longer-term rate observed between Dec. 2014 and Nov. 2018 was also positive (+21,500 cy/yr.). Average rates of +10,100 cy/yr. and +42,100 cy/yr., were measured betweeen Dec. 2014 and Dec. 2015 and Nov. 2018 and Nov. 2019, respectively. Furthermore, the addition of sand along portions of Caswell Beach from the Wilmington Harbor Navigation project has likely influenced these numbers to some extent.

Along the Fort Caswell oceanfront (Stations 20+00 to 60+00), negative volume change has been the trend observed since December 2014. The longer-term rate measured between Dec. 2014 and Nov. 2018 was -37,700 cy/yr. In comparison, an average volume change rate of -44,000 cy/yr. was measured along the Fort Caswell Section between March 2021 and May 2023.

5 CONCLUSION

Though the changes observed between March 2021 and May 2023 do not appear to suggest any major short term adverse impacts to Caswell Beach due to the dredging of a portion of JBS by the Town of Oak Island in April/May 2021 and February/April 2022, additional monitoring is necessary to fully evaluate longer-term impacts. Furthermore, while positive volume changes were observed along Caswell Beach (Stations 60+00 to 200+00) over the entire 26-month monitoring period, the 12-month trend observed between May 2022 and May 2023 include an average negative volume change in the East Caswell Beach Section and a decrease in the average positive volume change in the West Caswell Beach Section. The difference in the trends observed may be influenced by seasonal variation. To that end, future survey data should be collected at a similar time of year as the data collected in spring 2023. The permit issued to Oak Island for the dredging of JBS requires the Town to monitor Caswell Beach for a minimum of 3 years after utilizing the JBS borrow area. The Town of Oak Island therefore is obligated to monitor Caswell Beach through at least Spring 2025.

6 REFERENCES

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