

TOWN OF SOUTHERN SHORES, NORTH CAROLINA
BEACH MANAGEMENT PLAN
ADDENDUM A – January 29, 2020

This document is an addendum to the Town of Southern Shores Beach Management Plan, developed by Aptim Coastal Planning & Engineering of North Carolina, Inc. (APTIM), in December 2018. A subsequent beach assessment report was developed by APTIM and submitted to the Town in September 2019 (APTIM, 2019). In that document, APTIM provided several updates regarding the project extent, project beach fill volume, and project cost estimate, which were based on updated beach profile surveys conducted in May 2019.

In December 2019, the Town of Southern Shores (Town) authorized APTIM to further update the Beach Management Plan based on public comments received by the Town and other communications between APTIM and Town representatives.

Project Goals:

The initial Beach Management Plan (APTIM, 2018), provided three (3) options for the Town to consider, which aimed to achieve the following three (3) stated goals of the Town.

- 1) Provide a reasonable level of storm damage reduction to public and private development;
- 2) Mitigate long-term erosion that could threaten public and private development, recreational opportunities, and biological resources; and
- 3) Maintain a healthy beach that supports valuable shorebird and sea turtle nesting habitat.

The project options were updated based on beach profile surveys conducted in May 2019 (APTIM, 2019). These updates included modification to the project volume and a reduction in the number of options being considered from three (3) to two (2).

The formulation of the original options focused on placing a sufficient volume of sand to achieve a design volume that was determined through an engineering analysis that employed the storm simulation model SBEACH. The design of these original options satisfied each of the three (3) stated goals. The “reasonable level of storm damage reduction” was defined as a beach fill configuration that would allow the crest of the dune to survive a storm comparable to Hurricane Isabel, which impacted the Dare County coast in 2003. The extent of the beach fill options were limited to the approximately 15,000 feet of beach from 3rd Avenue south to the southern Town boundary.

Based on public input, the Town informed APTIM that in addition to the goals for which the initial options were designed, the amount of useable beach was also an important aspect to consider in the development of beach fill options. The Town has requested APTIM consider the following modification of the previously stated 3rd goal as they design beach fill options for the Beach Management Plan:

3. Maintain a healthy beach that *provides sufficient useable beach and* supports valuable shorebird and sea turtle nesting habitat.

Additional Beach Fill Options:

In order to develop additional alternatives to achieve the modified Goal #3 the term “sufficient useable beach” needed to be defined. The first step in defining this term was to first determine how to define “useable beach”. Once this term was defined, APTIM examined the beach conditions along the Town of Southern Shores south of Station -150+00 (located near 3rd Avenue), as well as those portions of Kitty Hawk and Kill Devil Hills that were nourished in 2017 to define what might be considered “sufficient”. The analysis also considered the fact that the direction provided by the Town was that an option that better aligns with Goal #3 should be provided that is comparable in cost to that of Option 1 in the 2019 update (approximately \$14 Million).

In order to define the term “useable beach”, the profile plots provided in the 2019 survey report were evaluated to determine representative elevation contours that would represent the “dry sand beach”. Based on this examination, the +12.0 ft. NAVD88 contour was used as the landward limit of the “dry sand beach”; whereas the +4.0 ft. NAVD88 contour was used as the seaward limit of the “dry sand beach”. Figure 1 shows a beach profile plot for data collected in May 2019 at Station -100+00, which is located at Dolphin Run. The orange vertical lines cross the profile at the +12.0 ft. NAVD88 and +4.0 ft. NAVD88 contour and the distance between would be considered the “useable beach”.

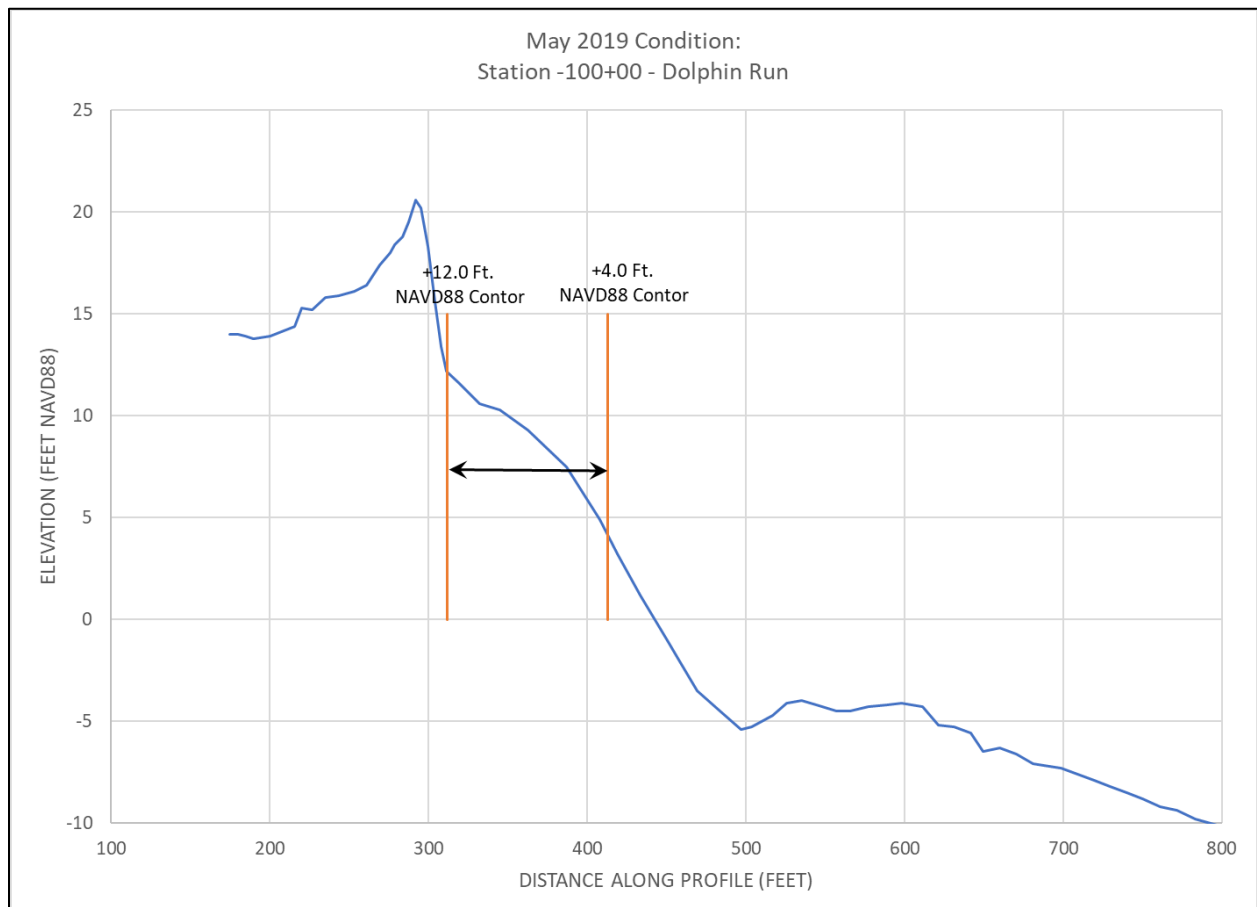


Figure 1. Cross section plot of beach profile data illustrating the defined “useable beach” along Station -100+00 located at Dolphin Run.

Figure 2 shows an image taken in May 2019 from approximately the wet sand at Station -90+00, which is located between Trout and Porpoise Run. The image is used to show the approximate location of the +12 and +4 ft. NAVD88 contours and what the beach width represents.

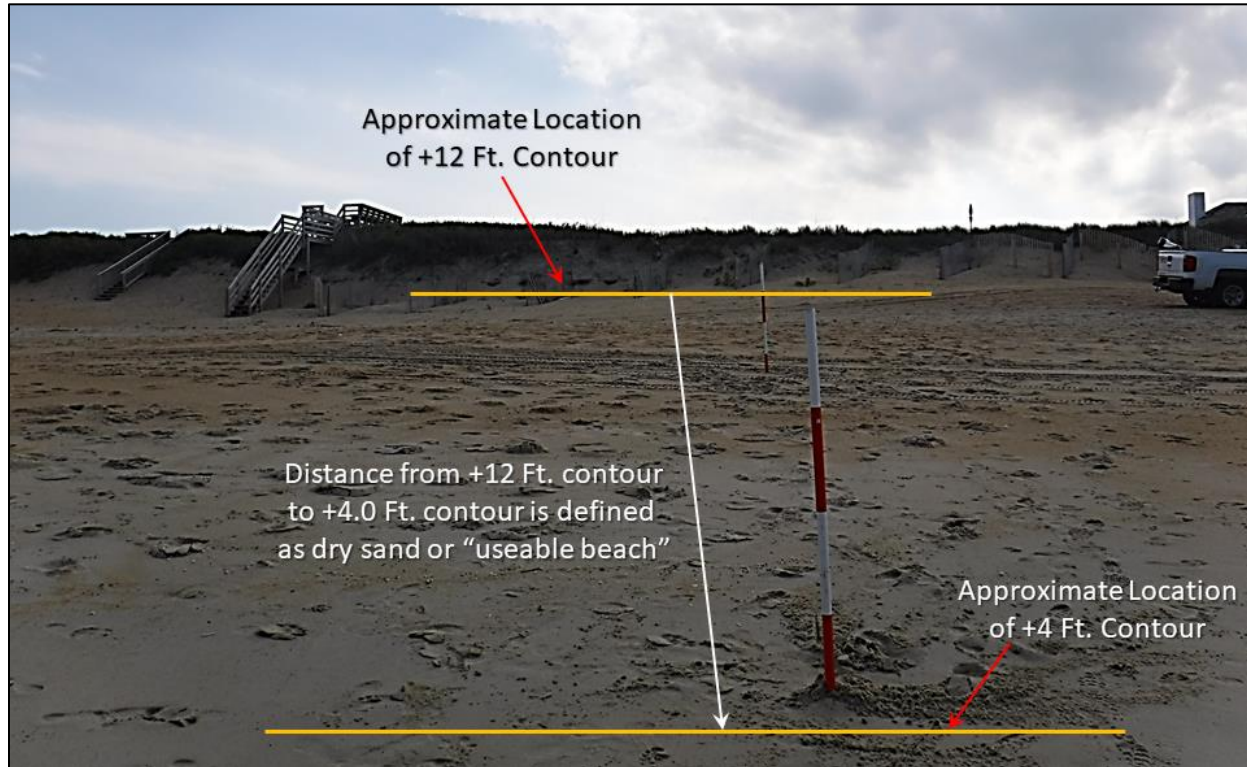


Figure 2. Graph showing the beach width as measured between the +12 ft. and +4 ft. NAVD88 contours from the northern Town limit of Southern Shores to approximately E Baum Street in Kill Devil Hills.

The useable beach width, as defined as the distance between the +12 ft. NAVD88 contour and the +4.0 ft. NAVD88 contour, was computed along the entire Town of Southern Shores and the Town of Kitty Hawk, and along the portion of Kill Devil Hills, in which beach nourishment was conducted in 2017. Figure 3 shows a plot of this data.

In order to determine useable beach widths that may meet the Town's desired criteria of "sufficient", several segments of the Towns of Southern Shores, Kitty Hawk, and Kill Devil Hills were evaluated. Likewise, individual profiles were examined to help Town representatives visualize the concept of "sufficient" in terms of "useable beach".

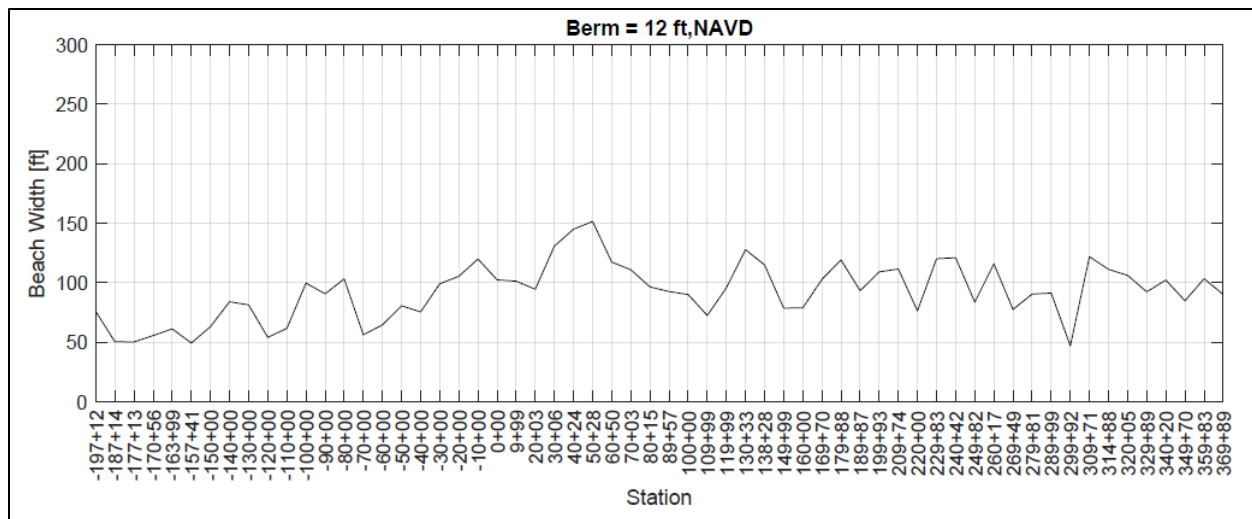


Figure 3. Graph showing the beach width as measured between the +12 ft. and +4 ft. NAVD88 contours from the northern Town limit of Southern Shores to approximately E Baum Street in Kill Devil Hills.

Average useable beach widths as defined herein were computed along the portion of Southern Shores from 3rd Avenue (Station -150+00) south to the southern Town limit (Station 0+00) and along the entire portion of Southern Shores, Kitty Hawk, and Kill Devil Hills that received sand during the 2017 beach nourishment project. This area extends from around Skyline Road (Station -20+00) in Southern Shores, south to a point approximately 200 ft. south of the public beach access in Kill Devil Hills at Asheville Street (Station 320+00). Based on data collected in May 2019, the average useable beach width along Southern Shores south of 3rd Avenue was 84 ft. The average useable beach width in the larger area, where sand was placed during the 2017 beach nourishment project in the three Towns, was 103 ft. as measured in May 2019.

The feedback from Town representatives suggested that the area from the northern Town limit down to approximately 5th Avenue (Station 157+41) was the area in which useable beach was insufficient. Coincidentally, this portion of the Town was the portion that the initial shoreline vulnerability assessment found was least vulnerable to storm impacts, and thus was not included in the initial beach fill options. The average useable beach width along this portion of the Town's oceanfront was 57 ft. based on the May 2019 survey data.

Table 1 shows a comparison of the different average useable beach widths evaluated. The discrepancy between the average useable beach width along the northern portion of the Town (57 feet) and the average along the rest of the Town (84 feet), is 27 feet. Assuming a constructed beach fill berm of +6.0 ft. NAVD88 and a depth of closure of -24 ft. NAVD88, a design fill density of 30 cy/ft. would be required to widen the beach 27 feet between the northern town limit and 5th Avenue.

Table 1. Comparison of the average useable beach width computed for various portions of Southern Shores, Kitty Hawk, and Kill Devil Hills

Beach Section	Profile Stations	Average Useable Beach Width
Town of Southern Shores from 3rd Avenue South to Southern Town Limit	-150+00 to 0+00	84
2017 Sand Placement Area (Skyline Road to Asheville Street)	-20+00 to 320+05	103
Northern Section of Southern Shores from 5th Avenue North to Northern Town Limit	-197+12 to -157+41	57

Option 4

The previous studies included discussions on Options 1 through 3, therefore, the proposed additional options discussed herein are referred to as Options 4 and 5. Option 4 consists of an even beach fill design of 30 cy/ft. based on the dry sand beach width discussed in the previous section. Placing a design volume density of 30 cy/ft. along the Town of Southern Shores 19,712 foot oceanfront shoreline would require approximately 591,400 cy. Table 2 provides the updated design volume, diffusion loss volume, advanced fill volume, and taper volume for Option 4, which requires a total project volume of 878,300 cy.

Option 4 was designed to provide a sufficient useable beach. Based on the analysis described herein, Option 4 would meet that design objective. Based on the method in which “sufficient useable beach” was defined, the portion of Southern Shores south of 3rd Avenue had sufficient useable beach as of May 2019. A design volume of 30 cy/ft. from 3rd Avenue (Station -150+00) south to approximately 450 feet south of Chicahawk Trail (Station -50+00) would not fully meet the recommended design beach fill density described in the September 2019 update to the Beach Management Plan. That design fill density was 36 cy/ft. The 36 cy/ft. design fill density was based on maintaining an average volume envelope density to provide sufficient storm damage reduction for a storm with characteristics of Hurricane Isabel that impacted the area in 2003. While Option 4 would place less than 36 cy/ft. along this section, a design volume of 30 cy/ft. would provide some storm damage reduction for this portion of the beach. Additional analysis will be required to quantify the level of storm damage reduction that would be provided by a fill density of 30 cy/ft. along this section of the shoreline.

Option 5

Option 5 is essentially the same beach fill configuration proposed in Option 1 from 3rd Avenue south to the southern Town limit. Option 5 also includes the placement of 30 cy/ft from 3rd Avenue north to the northern Town limit. The 30 cy/ft. beach fill density along the northern section is based on the dry sand beach width discussed previously. The design volume for Option 5 is 681,400 cy. Table 2

provides the updated design volume, diffusion loss volume, advanced fill volume, and taper volume for Option 5, which requires a total project volume of 968,300 cy.

Table 2. Comparison of volumes calculated for each of the beach fill options

Design	Design Volume ⁽¹⁾	Diffusion Loss Volume ⁽²⁾	Advanced Fill Volume ⁽³⁾	Taper Volume ⁽⁴⁾	Total Volume	Avg. Fill Density ⁽⁵⁾
Option 1 ⁽⁶⁾	540,000	54,400	225,000	9,000	828,400	36
Option 2	N/A - Design Volumes and Transition Area Volumes are the Same as Option 1.					
Option 3 ⁽⁶⁾	720,000	68,800	225,000	12,000	1,025,800	48
Option 4	591,400	54,400	225,000	7,500	878,300	30
Option 5	681,400	54,400	225,000	7,500	968,300	35

⁽¹⁾ Volume (CY) necessary to achieve the design goal of each option. This number excludes diffusion loss, advanced fill, and tapers.

⁽²⁾ Volume (CY) included to account for diffusion losses and background erosion (APTIM, 2018).

⁽³⁾ Volume (CY) included to account for background erosion expected to occur throughout the nourishment interval. Re-nourishment interval assumed to be 5 years.

⁽⁴⁾ Volume (CY) to construct a 500-foot taper on the northern end of the beach fill. Taper is dependent on the fill density at the northern extent of the project.

⁽⁵⁾ Total Volume included in the Design Volume divided by the length of the beach fill (CY/FT).

⁽⁶⁾ Options that only include placement of beach fill south of 3rd Avenue.

During the development of Options 1 and 3, the advanced fill was calculated based on the average volume change rate between December 2017 and May 2019 along the portion of the Town in which fill was proposed (-3 cy/ft/yr). Those options only proposed placing fill from 3rd Avenue south to the southern Town limit. As previously stated, Options 4 and 5 propose to place fill along the entire length of the Town's oceanfront. The average volume change rate between December 2017 and May 2019 along the entire length of the Town's oceanfront is less than 1 cy/ft./yr. Using the actual computed volume change rate to calculate advanced fill would have resulted in an advanced fill volume less than what was used for Options 1 and 3. Options 4 and 5 assumes the same advanced fill volume as what was included in Options 1 and 3.

Summary of Beach Fill Options:

Table 3 provides a breakdown of the cost estimates for Options 4 and 5, as well as a comparison to cost estimates previously provided for Options 1 and 3. As previously stated, the direction provided by the Town was that an additional option that better aligns with Goal #3 should be provided that is comparable in cost to that of Option 1 (approximately \$14 Million). As shown in Table 3, the estimated cost of Option 4 is \$14,755,600. Option 5, which maintains the same beach fill density as Option 1 from 3rd Avenue south to the southern Town limit and includes beach fill north of 3rd Avenue with a density of 30 cy/ft. is estimated to cost approximately \$16,196,500.

Table 3. Project Option Cost Estimates

Option	Permitting/ Design Soft Cost ⁽¹⁾	Volume (cy) ⁽²⁾	Construction Cost ⁽³⁾	Construction Soft Cost ⁽⁴⁾	Construction Env. Monitoring Costs ⁽⁵⁾	Contingency Cost (10%)	TOTAL COST
1	\$435,000	828,400	\$11,758,000	\$235,500 ⁽⁶⁾	\$275,300	\$1,270,400	\$13,974,200
3	\$435,000	1,025,800	\$14,146,000	\$255,500	\$332,400	\$1,516,900	\$16,685,800
4	\$435,000	878,300	\$12,505,000	\$241,500	\$232,700	\$1,341,400	\$14,755,600
5	\$435,000	968,300	\$13,783,000	\$249,500	\$256,600	\$1,472,400	\$16,196,500

⁽¹⁾ Professional services costs associated with the permitting and design of the beach fill project. These costs include design surveys of the beach and offshore sand investigations.

⁽²⁾ Total volume (CY) estimated for the Option including design volume, diffusion losses, advanced fill, and tapers.

⁽³⁾ Costs associated with mobilization/demobilization, sand placement, and other costs paid directly to the dredge contractor.

⁽⁴⁾ Costs associated with development of construction bid package, bidding assistance, and construction administration.

⁽⁵⁾ Costs anticipated for estimated environmental monitoring that may be required by permit condition.

⁽⁶⁾ Updated Construction Soft Costs from those included in the September 2019 update. The updating of these cost estimates resulted in a slight decrease in the Total Cost estimate.

Attachments:

- Town of Southern Shores Historical Shoreline Change Figure 2A – Figure comparing imagery from 2008 and 2018 and shoreline positions from August 2009 and June 2018 between 9th Avenue and 5th Avenue.
- Town of Southern Shores Historical Shoreline Change Figure 2 - Figure comparing imagery from 2008 and 2018 and shoreline positions from January 2001, August 2009 and June 2018 between 9th Avenue and 5th Avenue.
- Town of Southern Shores Historical Shoreline Change Figure 5 – Figure comparing imagery from 2008 and 2018 and shoreline positions from August 2009 and June 2018 between Mullet Circle and Porpoise Run.

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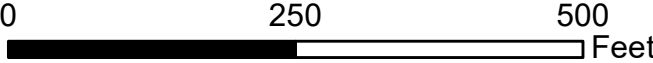


Notes:

1. Coordinates are in feet based on the North Carolina State Plane Coordinate System, FIPS 3200, North American Datum of 1983 (NAD 83).
2. Contour data extracted from USGS & USACE LiDAR datasets accessed through NOAA's Digital Coast. LiDAR data collection dates: March - January 2001, August 2009, May - June 2018.
3. March 2008 Imagery provided by NOAA Digital Coast. January 2018 Imagery provided by Dare County, NC.

Legend:

2001 Contours	2009 Contours	2018 Contours
+4 NAVD88 FT	+4 NAVD88 FT	+4 NAVD88 FT
+12 NAVD88 FT	+12 NAVD88 FT	+12 NAVD88 FT
Monitoring Profiles		



TITLE:
**Town of Southern Shores
Historical Shoreline Change
Southern Shores, North Carolina**

**COASTAL PLANNING & ENGINEERING
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Date: 01/16/20 By: TDM Comm No. : 636003891 **Figure No.:2**

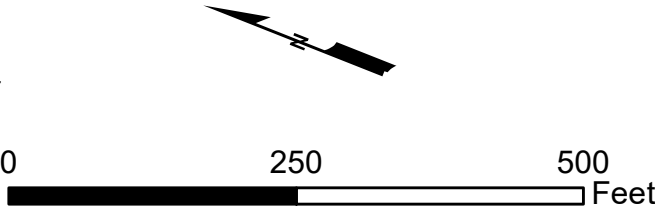


Notes:

1. Coordinates are in feet based on the North Carolina State Plane Coordinate System, FIPS 3200, North American Datum of 1983 (NAD 83).
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3. March 2008 Imagery provided by NOAA Digital Coast. January 2018 Imagery provided by Dare County, NC.

Legend:

- | | |
|----------------------|----------------------|
| 2009 Contours | 2018 Contours |
| +4 NAVD88 FT | +4 NAVD88 FT |
| +12 NAVD88 FT | +12 NAVD88 FT |
| Monitoring Profiles | |



TITLE: Town of Southern Shores Historical Shoreline Change Southern Shores, North Carolina			
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Date: 01/16/20	By: TDM	Comm No. : 636003891	Figure No.:2A

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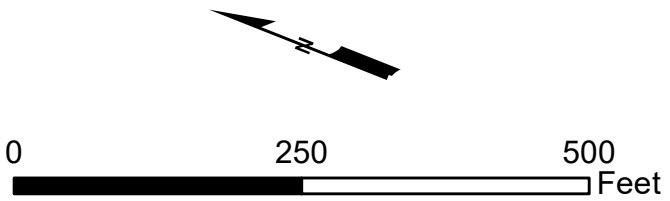
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Notes:

1. Coordinates are in feet based on the North Carolina State Plane Coordinate System, FIPS 3200, North American Datum of 1983 (NAD 83).
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3. March 2008 Imagery provided by NOAA Digital Coast. January 2018 Imagery provided by Dare County, NC.

Legend:

- | | |
|----------------------|----------------------|
| 2009 Contours | 2018 Contours |
| +4 NAVD88 FT | +4 NAVD88 FT |
| +12 NAVD88 FT | +12 NAVD88 FT |
| Monitoring Profiles | |



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Date: 01/16/20	By: TDM	Comm No. : 636003891	Figure No.:5
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