Town of Southern Shores
North Carolina

Town of Southern Shores Beach Nourishment Project

Photograph obtained by Coastal Protection Engineering of North Carolina, Inc. (October 21, 2022).

Beach Maintenance Plan

June 2023

Prepared By:
Coastal Protection Engineering of North Carolina, Inc.
Engineering License Certificate #: C-2331
4038 Masonboro Loop Road
Wilmington, NC 28409

EXECUTIVE SUMMARY

The Town of Southern Shores has implemented a beach nourishment project aimed at: 1) provides a reasonable level of storm damage reduction; 2) mitigates long term erosion that could threaten public infrastructure and private property as well as recreational opportunities and biological resources, and 3) maintain a healthy beach that provides sufficient usable beach and supports valuable shorebird and sea turtle nesting habitat. A key aspect to the long term success of the program is the implementation of a maintenance program to document construction achievements and project performance. This document details the maintenance program established by the Town.

The Town successfully completed the initial construction of the townwide Beach Nourishment Project in May 2023. The project placed approximately 1,048,500 cy (gross quantity) of beach fill material in Southern Shores between Sta. 0+00 and -202+00. In 2022, 990,400 cy of material was placed along the Town of Southern Shores, followed by an additional 58,100 cy (gross quantity) placed between Sta. -169+00 and -199+00 to augment the width of usable beach constructed by the project. All material used to construct the project came from Borrow Area A located offshore of Kill Devil Hills and Nags Head.

Periodic maintenance or renourishment is included in the Town's maintenance plan for the Beach Nourishment Project. While post-construction surveys of Borrow Area A will not be completed until July 2023, a sufficient quantity of sand is anticipated to be available for at least one future maintenance event. That said, Dare County, in cooperation with the Towns of Kill Devil Hills, Duck, Southern Shores, and Kitty Hawk, was awarded a grant to provide 50% funding to conduct a regional sand investigation survey aimed at identifying up to 30-years of additional sand resources to support their programs. That work investigation is currently ongoing.

Project monitoring has been implemented to track performance of the placed material and is used to update nourishment requirements. The initial baseline monitoring event was conducted in November 2022. The baseline survey includes beach profile surveys at approximately 1,000 foot intervals. Additional data south and north of the project area, available from the neighboring Towns of Kill Devil Hills and Southern Shores, are also incorporated into the monitoring. The beach profile surveys have been designed and are conducted to capture changes along the active profile of the beach both within and adjacent to the project area.

This Maintenance Plan serves as documentation that the Town of Southern Shores' Beach Nourishment Project meets the criteria established by 44 CFR 206.226(j)(2). The Maintenance Plan has been developed in a way consistent with the Public Assistance Program and Policy Guide (Version 4). This Maintenance Plan will be updated regularly to reflect results of monitoring, construction of additional projects, maintenance events and changes in schedules.

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

The Town of Southern Shores has implemented a beach nourishment project aimed at: 1) provides a reasonable level of storm damage reduction; 2) mitigates long term erosion that could threaten public infrastructure and private property as well as recreational opportunities and biological resources, and 3) maintain a healthy beach that provides sufficient usable beach and supports valuable shorebird and sea turtle nesting habitat.

A Vulnerability Assessment and Beach Management Plan was completed for the Town of Southern Shores in 2018 (CPE-NC, 2018). This initial Plan was updated in 2020 (CPE-NC, 2020). The beach management plan evaluated several different beach fill options focused on achieving goals established by the Town, which are stated in the preceding paragraph. The options included various designs focused on addressing storm vulnerability and the need for sufficient usable beach.

In 2020, the Town Council voted to move forward with the permitting and design of a beach nourishment project along the full extent of the Town's ocean shoreline. As stated in the resulting Erosion *& Shoreline Management Design Report* (CPE, 2021C), the final recommended beach fill included two different designs for the beach south and north of 4th Avenue (Sta. -153+05). South of 4th Avenue, the recommended design focused on providing a reasonable level of storm damage reduction to public and private development and mitigating long-term erosion impacts. North of 4th Avenue, the recommended design focused on providing sufficient usable beach for recreation and wildlife.

Initial construction of the beach nourishment project was completed in May 2023. The project placed approximately 1,048,500 cy (gross quantity) of beach fill material in Southern Shores. The project included placement of 990,400 cubic yards (gross quantity) of beach compatible sand in October and November 2022. An additional 58,100 cy (gross quantity) was placed on the north end in May 2023 between Sta. -169+00 and Sta. -199+00. Following the construction of the project, the Town implemented a maintenance program to monitor the performance of the Beach Nourishment Project and determine when periodic renourishment is needed to maintain the goals of the project.

Documentation of the construction and subsequent monitoring events has been archived as evidence of the Town's commitment towards maintaining the Beach Nourishment Project. This information is required for eligibility under the Public Assistance (PA) program administered by FEMA. If the project is impacted by a presidentially declared disaster or emergency, justification that the maintenance plan has been implemented must be provided to receive federal aid. This stipulation is mandated by 44 CFR 206.226(j)(2), which states:

> *Work on an improved beach may be eligible under the following conditions:*
> *(i) The beach was constructed by the placement of sand (of proper grain size) to a designed elevation, width, and slope; and,*
> *(ii) A maintenance program involving periodic renourishment of sand must have been established and adhered to by the applicant.*

The amount of sand replacement eligible for FEMA funding is limited to the material volume lost as a result of the declared disaster or emergency. Pre- and post-storm profiles, when available, are used to determine the eligible volume of sand. If pre-storm profiles are not available, the estimated erosion from the design study and renourishment history can be used to determine a pre-storm condition. Surveys collected during the monitoring can also be used to determine the pre-storm condition.

This Maintenance Plan serves as documentation that the Town of Southern Shores' Beach Nourishment Project meets the criteria established by 44 CFR 206.226(j)(2). The Maintenance Plan has been developed in a way consistent with FEMA's Public Assistance Program and Policy Guide (Version 4). The Maintenance Plan includes a description of the project design, construction activities to date, anticipated volume and cost for maintenance, schedule of maintenance and the monitoring protocols being employed by the Town of Southern Shores. This Maintenance Plan will be updated regularly to reflect results of monitoring, construction of additional projects, maintenance events, and changes in schedules.

CONSTRUCTION EVENTS

Beach Fill

Sand Placement (2017):

In the summer of 2016, prior to project construction, an erosional hotspot was observed within the northern taper section of the Kitty Hawk project. The Town of Southern Shores approached both Kitty Hawk and the Town's engineering firm regarding the possibility of designing and permitting a beach fill project that would cover the approximately 1,500-foot long hotspot area in Southern Shores. In January 2017, the Town of Kitty Hawk agreed to modify their USACE permit to allow for the modification of the project to include the 1,500 ft. portion of the Town of Southern Shores as well as a 1,000 ft. taper. This resulted in a 2,500 ft. section of the project being located within the Town of Southern Shores. A 1,500 ft. berm only fill section was constructed from Sta. 0+00 to Sta. -15+08 in Southern Shores to account for an erosion hot spot. The project also included a 1,000-foot long taper on the north end, which extended from Sta. -15+08 to -25+08. The construction was started and was completed in August 2017, and included placement of 80,500 cy of beach compatible sand, which equates to an average fill density of approximately 54 cy/lf, along 1,500 feet of beach (between Sta. 0+00 and Sta. -15+08). Approximately 32,000 cy was also placed in the taper between -15+08 and -25+08, but this volume is associated with the Kitty Hawk project and was paid for by the Town of Kitty Hawk. Figure 1 shows the extent of the project including the Southern Shores fill section, the northern taper, the Kitty Hawk main fill area, and the construction baseline. Sand used to construct the project was dredged from the permitted offshore borrow area referred to as Borrow Area A, using trailing suction hopper dredges (Figure 2).

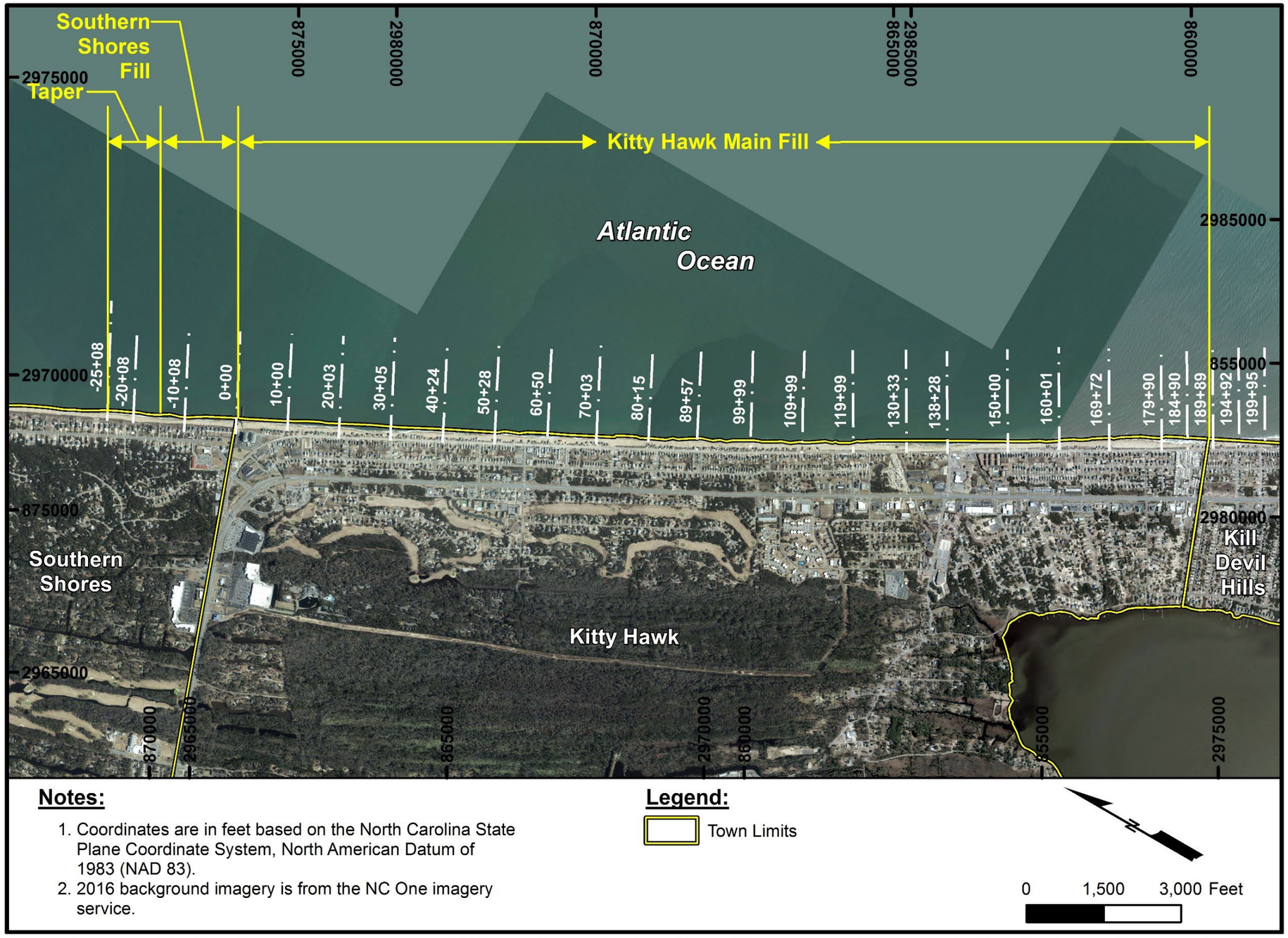

Figure 1. Map showing the extent of the Kitty Hawk construction project (2017) including the Southern Shores fill area, the northern taper, the Kitty Hawk main fill area, and the construction baseline.

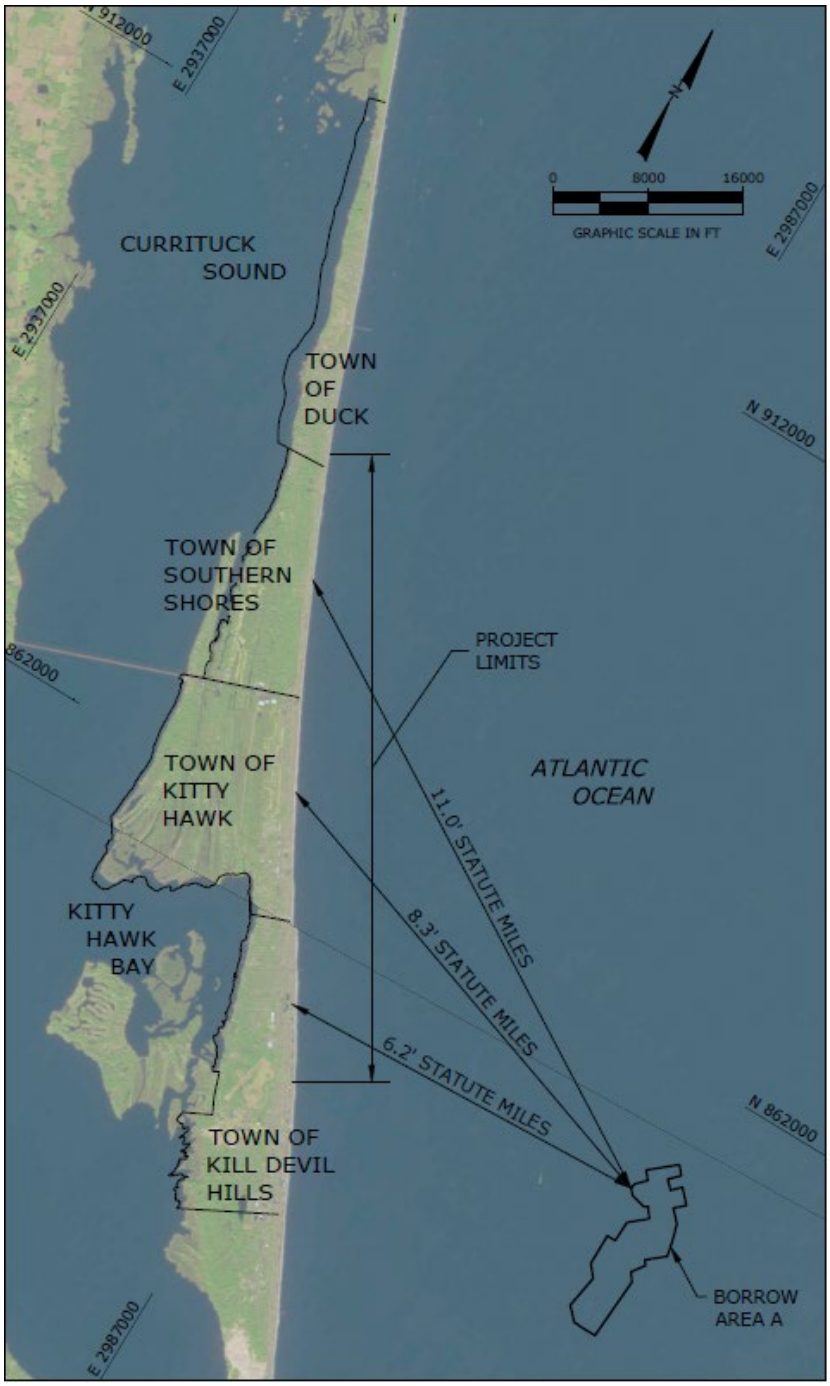

Figure 2. Map showing the location of offshore borrow area used for the construction of the 2017 and 2022/2023 projects.

Initial Construction of Townwide Project (2022/2023): Placement of beach fill associated with the initial construction of the townwide Town of Southern Shores Beach Nourishment Project was completed in May 2023. The overall goal of the project focused on providing a reasonable level of storm damage reduction to public and private development, mitigating long-term erosion

impacts, and providing sufficient usable beach for recreation and wildlife (CPE, 2021C). The project included the construction of a beach nourishment project along the entire shoreline of Southern Shores. Figure 3 and Figure 4 show the extent of the project. Sand used to construct the project was dredged from the permitted offshore borrow area referred to as Borrow Area A, using trailing suction hopper dredges (Figure 2).

The design for the 2022 renourishment aimed to provide a sufficient level of storm damage reduction south of 4th Avenue and sufficient usable beach north of 4th Avenue (Sta. -153+00). The project design called for the uniform distribution of approximately 49 cy/ft. south of 4th Avenue to provide a reasonable level of storm damage reduction and to account for anticipated background erosion and diffusion over 5-years. The design also included additional fill (10 cy/lf) to mitigate the potential for hot spot erosion in the central 3,900 feet of the project area between Sta. -70+00 and Sta. -110+00. North of 4th Avenue, the project design called for the distribution of approximately 22 cy/ft. of beach fill. This volume was based on the design goal of achieving an average usable beach width of at least 84 feet along the beach north of 4th Avenue. Usable beach width is defined as the linear distance between the +12 ft. NAVD88 contour and the +4 ft. NAVD88 contour. The volume estimated to be placed north of 4th Avenue was based on conditions observed in April 2021.

The beach fill constructed in 2022/2023 included placement of approximately 1,048,500 cy (gross quantity) of beach compatible sand. Between October and November 2022, approximately 990,400 cy of sand was placed along 20,100 feet of beach (approximately 3.8 miles) between Sta. 0+00 and -202+00. This equates to an average fill density of approximately 49.3 cy/lf. South of 4th Avenue, approximately 924,500 cy of beach fill were placed in 2022, which equates to an average fill density of 60.7 cy/lf. The 2022/2023 project achieved the design goals of constructing the design berm to provide a reasonable level of storm damage reduction and placement of material to mitigate anticipated erosion and diffusion over a 5-year maintenance cycle.

North of 4th Avenue, approximately 65,900 cy of beach fill were placed in November 2022, which equates to an average fill density of 13.6 cy/lf. The goal of the beach fill north of 4th Avenue was to re-establish a usable beach of 84 ft. as defined by the linear distance between the +12 ft. NAVD88 and +4 ft. NAVD88 contour. The design was based on beach conditions measured in May 2021. At that time, the design called for 22 cy/ft. to achieve the desired width. Between May 2021 and August 2022 surveys showed that the area north of 4th Avenue gained approximately 9 cy/ft. on average. When combined with the 13.6 cy/ft. placed north of 4th Avenue in November 2022, the target fill volume of 22 cy/ft. was achieved. However, the distribution of the fill north of 4th Avenue in November 2022 was not uniform.

In May 2023, an additional volume of approximately 58,100 cy of beach compatible sand was placed between Sta. -169+00 and -199+00 to complete the 2022/2023 project. This equates to an average fill density of approximately 19.0 cy/lf. This additional sand was placed to augment the width of the usable beach within this section of the overall project. The location of the sand placed in May 2023 is shown in Figure 4.

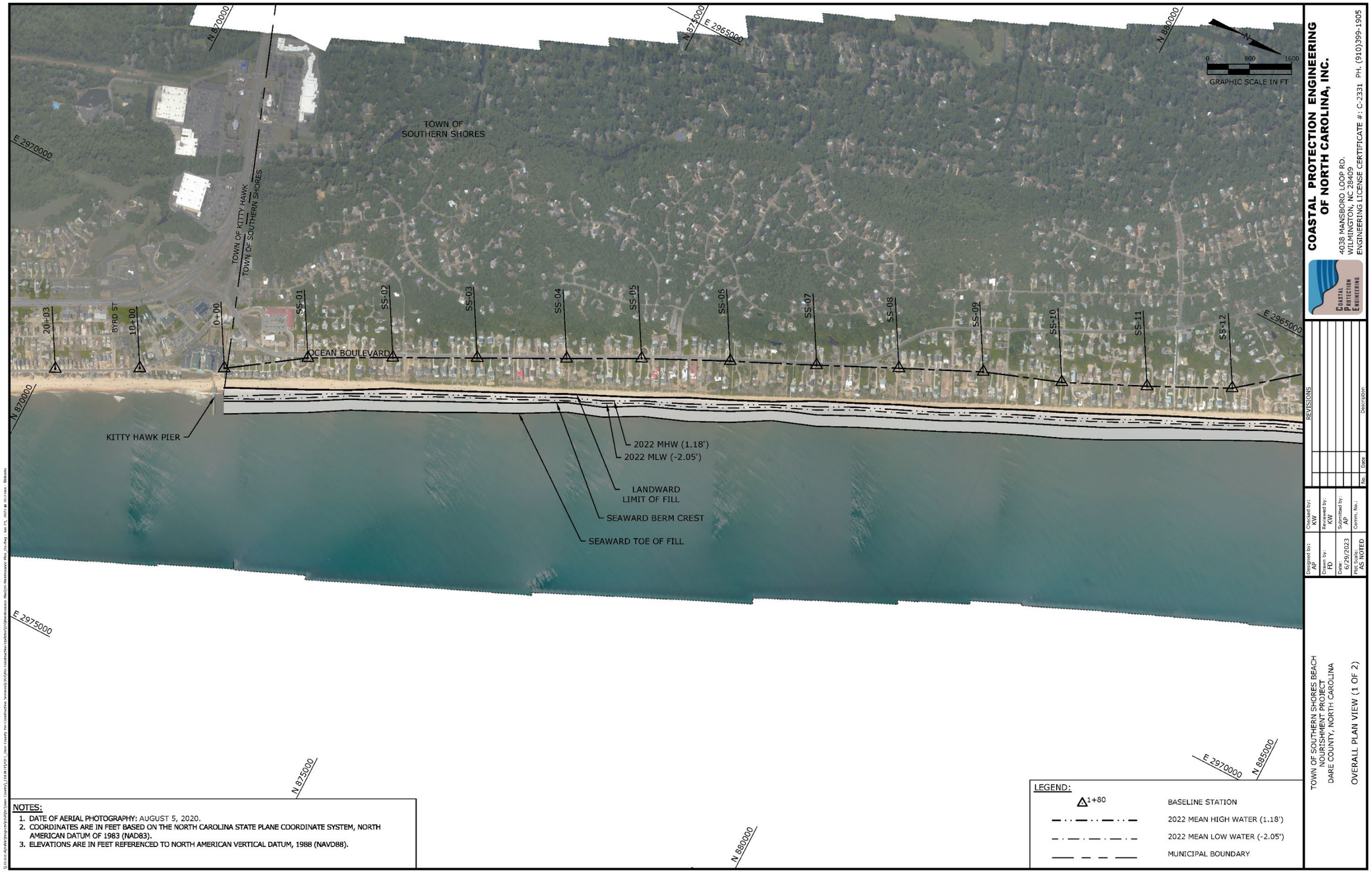

Figure 3. Map showing the extent of the 2022/2023 project including the main fill construction template and the construction baseline (1/2).

Figure 4. Map showing the extent of the 2022/2023 project including the main fill construction template and the construction baseline (2/2).

Sand Fencing
As part of the 2022 project, approximately 1,985 sections of sand fence were installed along the entire project area as needed to replace damaged fencing and to help control landward sand migration by catching wind-blown sand on the seaward face of the dune. One (1) row of angled 10-foot sand fencing sections was installed, staggered along the dune and oriented at 45-degree angles from the shoreline.

Dune Vegetation
NEED INFORMATION FROM THE TOWN

Funding
The initial construction was funded through revenue derived from the Dare County Beach Nourishment Fund and the Town of Southern Shores. The Town of Southern Shores portion of the project was raised through a combination of General Fund appropriation and Municipal Service Districts (MSDs). In essence, the Town of Southern Shores portion of the cost of the project was funded by a contribution from all of the taxpayers in Southern Shores with additional funding provided by property owners in two (2) municipal service districts (MSDs).

MAINTENANCE REQUIREMENTS

Sand Volume
During the design of the 2022/2023 Southern Shores Beach Nourishment Project, Coastal Protection Engineering of North Carolina, Inc. (CPE) conducted an analysis of background erosion losses and diffusion losses to determine the volume of advanced fill to include in the project design. Advanced fill refers to the volume of sand anticipated to be lost over a maintenance cycle that is placed in addition to the design volume needed to achieve an established project goal. The 2022/2023 project was designed using an assumed rate of loss of 3.0 cy/ft/yr. (CPE, 2021C). The design also called for an additional 39,200 cy to be placed along the central portion of the Town between Sta. -70+00 and -110+00 to mitigate hot spot erosion (CPE, 2021C). The portion of the project constructed north of 4th Avenue, had exhibited a long-term positive volumetric change rate, and thus no advanced fill was included in the beach fill design for that section. Assuming a 5-year nourishment cycle and other variables, the Southern Shores project is anticipated to require approximately 375,000 cy of sand in 2027.

Cost
CPE has estimated that the cost to conduct maintenance of the Southern Shores Beach Nourishment project in 2027 would be $6,734,900. This cost estimate accounts for the construction cost to place 375,000 cy of sand, design and permitting, construction soft costs, environmental monitoring, and a 5% contingency. The cost estimate assumes renourishment of the Southern Shores Project would occur simultaneously with the Kill Devil Hills, Kitty Hawk, and Duck renourishment projects and that the mobilization and demobilization costs were allocated based on the percentage of the total renourishment volumes.

For planning purposes, CPE has also estimated costs to conduct maintenance of the Southern Shores Beach Nourishment project in 2027 assuming the 2027 maintenance project would be

designed for a 6-year and 7-year maintenance cycle. These estimates assume that the 2027 project would place the equivalent volume to last 6 years or 7 years, respectively. Initial estimates suggest increasing the maintenance cycle from 5-years to 6-years, for the 2027 project, could save approximately $141,200 per year in future maintenance costs, starting in 2027. Furthermore, increasing the maintenance cycle from 5-years to 7-years could save approximately $240,500 per year in future maintenance costs. These estimates are based on transitioning all four northern Dare County Town projects (Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills) to 6-year and 7-year maintenance cycles in 2027. However, it has not yet been determined whether all four projects could be extended to a 6-year or 7-year maintenance cycle. In the event that the 2027 project could be designed to include a 7-year maintenance cycle, the estimated cost would be $7,745,300. Constructing a project in 2027, assuming a 6-year maintenance cycle, is estimated to cost $7,234,400. These estimated costs are provided as preliminary planning numbers for comparison to the previously stated cost of $6,734,900, which reflects a volume that assumes a 5-year nourishment cycle.

Borrow Areas

In 2014/2015, CPE conducted a comprehensive marine sand search and borrow area design (CPE-NC, 2015B). Two borrow sites, referred to as Borrow Areas A and C, were designed during the investigation. Borrow Area A, shown in Figure 2, is located on the Outer Continental Shelf (OCS) between 5.0 and 6.5 miles offshore of the Towns of Kill Devil Hills and Nags Head in water depths between 50 and 60 ft. (NAVD88). The borrow area covers 1,173 acres and initially contained approximately 16,335,000 cy of sand. The mean grain size of the sand was found to be 0.36 mm with a sorting value of 0.90. The sand in the borrow area was characterized as fine to medium grained quartz sand with trace silt, shell hash, and shell fragments. The average wet Munsell color value was determined to be 5 and dry color value 6. The borrow area was broken up into 6 different cuts with cut depths ranging from -58.5 to -68.0 ft. NAVD88. Multi-beam survey data collected in January 2023 indicated that Borrow Area A contained approximately 10,722,500 cy of beach compatible sand; however, it should be noted that this was prior to the construction of the 2023 Duck project and the 2023 placement of sand on Southern Shores.

A marine sand search investigation was conducted in October 2020 to locate an additional source of beach compatible material other than Borrow Area A (CPE, 2021A). The investigation concluded that there was material in the reconnaissance area, however, the material was determined to have a finer grain than the material in Borrow Area A.

The Dept. of the Army (USACE) and North Carolina Division of Coastal Management issued permits for the Town of Southern Shores to use Borrow Area A for the initial construction of the Southern Shores Beach Nourishment Project. Furthermore, since the borrow area is located in Outer Continental Shelf (OCS) waters, the Town was required to obtain a lease from the Bureau of Ocean Energy Management (BOEM) to use the sand in the permitted borrow area. Individual leases were issued by BOEM for the 2022 project.

Post-construction surveys of Borrow Area A are expected to be finalized in July 2023. Based on preliminary assessments following the dredging of Borrow Area A in 2022 and 2023 to construct beach nourishment projects in Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills, a

sufficient quantity of sand is anticipated to be available for the 2027 maintenance event. That said, Dare County, in cooperation with the Towns of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills was awarded a grant to provide 50% funding to conduct a regional sand investigation survey aimed at identifying up to 30-years of sand resources to support their programs. This sand resource investigation is currently ongoing.

MONITORING PROTOCOL

A monitoring plan has been designed and implemented for the Southern Shores Beach Nourishment Project. An initial baseline post-construction survey of the 2022/2023 project was conducted in October/November 2022. Topographic and hydrographic surveys of the beach profiles are conducted to monitor project performance and potential impacts. Annual monitoring surveys are conducted along beach profiles at approximately 1,000-foot intervals along the fill area and the shoreline adjacent to the project. Figure 5 shows the location of these beach profiles.

Annual monitoring is used to assess the volume of sand in place compared to the initial beach fill design configuration. The analysis of the monitoring data also provides rates of volume change, which are used to identify erosion 'hot spots' and to estimate sediment needs for future maintenance events. Reports for each monitoring event are archived by the Town. The reports contain volumetric and shoreline change calculations to describe how the project is performing. The first annual monitoring event (Year-1) was conducted in June 2023. Supplemental beach profile surveys may also be required following significant storm events.

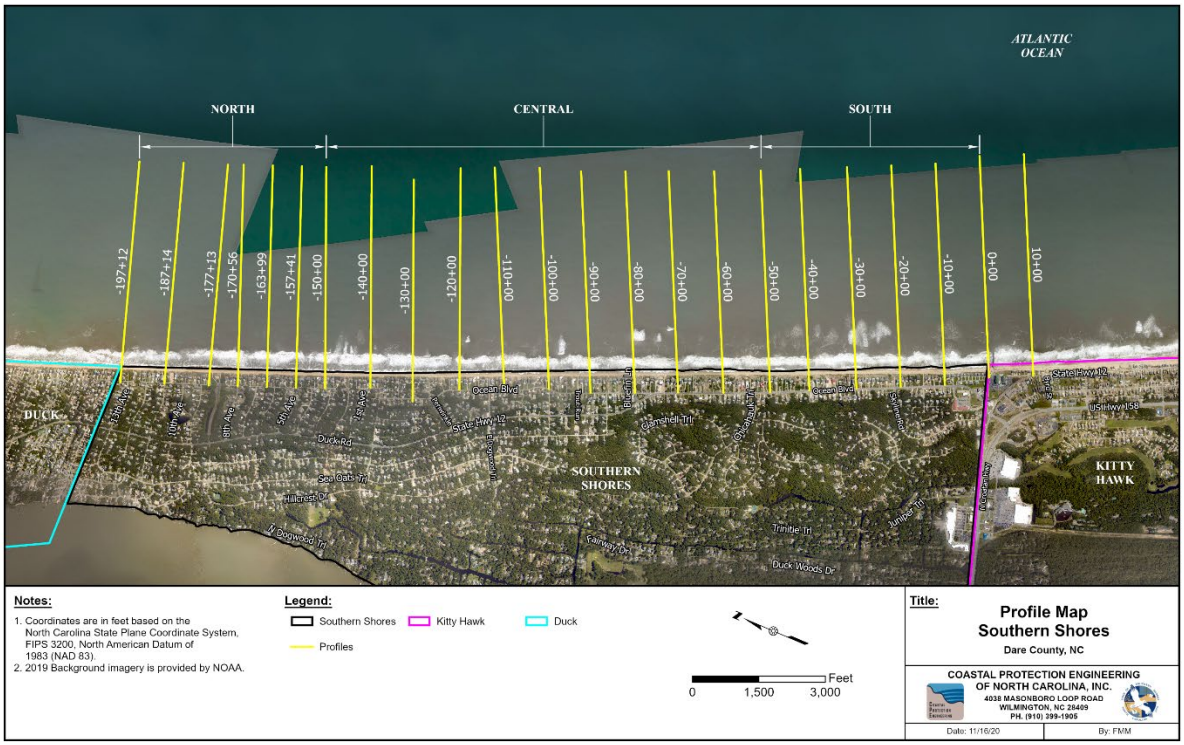

Figure 5. Map of Southern Shores Beach Nourishment Project Monitoring Beach Profiles.

CONCLUSION

The Town of Southern Shores has implemented a beach nourishment project aimed at: 1) provides a reasonable level of storm damage reduction; 2) mitigates long term erosion that could threaten public infrastructure and private property as well as recreational opportunities and biological resources, and 3) maintain a healthy beach that provides sufficient usable beach and supports valuable shorebird and sea turtle nesting habitat. Part of the project includes implementing this maintenance program to document construction achievements and project performance. Anticipated future costs have been estimated and are also included in the maintenance plan.

The Town successfully completed the initial construction of the Beach Nourishment Project in May 2023. The renourishments are expected to occur on a 5-year cycle and will involve dredging of Borrow Area A offshore Kill Devil Hills and Nags Head and/or additional offshore sand sources currently being evaluated.

Project monitoring has been implemented to track performance of the placed material and is used to update nourishment requirements. An initial baseline monitoring event was conducted in November 2022. The beach profile surveys were designed and are conducted to capture changes along the active profile of the beach both within the project area and adjacent to the project.

This Maintenance Plan serves as documentation that the Town of Southern Shores' Beach Nourishment Project meets the criteria established by 44 CFR 206.226(j)(2). The Maintenance Plan has been developed in a way consistent with FEMA's Public Assistance Program and Policy Guide (Version 4). This Maintenance Plan will be updated regularly to reflect results of monitoring, construction of additional projects, maintenance events and changes in schedules.

REFERENCES

CPE (2021 A) Coastal Protection Engineering of North Carolina, Inc. Borrow Area Investigation and Sediment Compatibility Analysis Report: Town of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills, North Carolina. Wilmington, NC.

CPE (2021 B) Coastal Protection Engineering of North Carolina, Inc. Town of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills, North Carolina Borrow Area Investigation and Sediment Compatibility Analysis Addendum B – Borrow Area Infilling Assessment, North Carolina, NC.

CPE (2021 C) Coastal Protection Engineering of North Carolina, Inc. Town of Southern Shores, North Carolina Erosion & Shoreline Management Design Report, North Carolina, NC.

CPE-NC (2015 B) Coastal Planning & Engineering of North Carolina, Inc. Comprehensive Marine Sand Search and Borrow Area Design Report. Prepared For: The Towns of Duck Kitty Hawk and Kill Devil Hills, North Carolina, 49 pgs.

CPE-NC (2018) Coastal Planning & Engineering of North Carolina, Inc. Town of Southern Shores Vulnerability Assessment & Beach Management Plan. Prepared For: The Town of Southern Shores, North Carolina, 41 pgs.

CPE-NC (2020) Coastal Planning & Engineering of North Carolina, Inc. Town of Southern Shores Beach Management Plan Addendum A. Prepared For: The Town of Southern Shores, North Carolina, 7 pgs.

FEMA (2020) Public Assistance Program and Policy Guide (PAPPG), Version 4, Effective June 1, 2020. (FP 104-009-2).