

**TOWN OF DUCK, SOUTHERN SHORES,
KITTY HAWK, AND KILL DEVIL HILLS, NORTH CAROLINA
BORROW AREA INVESTIGATION AND SEDIMENT COMPATIBILITY ANALYSIS
ADDENDUM A – LARGE SEDIMENT AND SHELL ASSESSMENT**

This document is an addendum to the *Borrow Area Investigation and Sediment Compatibility Analysis Report: Town of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills, North Carolina*, prepared by Coastal Protection Engineering of North Carolina, Inc. (CPE). The original report was prepared for the four (4) northern Dare County Towns and submitted on April 26, 2021. An updated assessment of the amount of large sediments (≥ 1 inch in diameter) and shell (≥ 3 inches in diameter) was requested by the North Carolina Division of Coastal Management due to amendments to the State's Technical Standards for Beach Fill Projects (15A NCAC 07H .0312). The amended rules, which are included as Appendix 1, were adopted by the North Carolina Coastal Resources Commission (CRC) in February 2021.

In May 2021, the Towns of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills, authorized CPE to conduct the necessary field data collection and assessment to adhere to the amended Technical Standards for Beach Fill Projects.

This addendum is meant to update the information provided in Sections 2.1 and 2.2 of the *Borrow Area Investigation and Sediment Compatibility Analysis Report: Town of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills, North Carolina*. This Addendum includes the following appendices:

- Appendix 1 --- Proposed Amendments for North Carolina Technical Standards for Beach Fill Projects (15A NCAC 07H .0312)
- Appendix 2 --- Dare County Sampling Transects
- Appendix 3 --- Dare County Large Sediment and Shell Survey Results
- Appendix 4 --- Digital Files

Introduction:

Between June 11 and June 13, 2020, CPE conducted large clast surveys for the Towns of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills. CPE based the methodology of those surveys on proposed amended rule changes to the State's Technical Standards for Beach Fill Projects, that were being considered in the Summer of 2020. In February 2021, the North Carolina Coastal Resources Commission (CRC) adopted amendments to the Technical Standards (Appendix 1), which differed from those that were being proposed in summer 2020. Specifically, the proposed amendments modify Section (1)(h), which governs the sampling protocols for large sediments and shell material on a native or recipient beach. Under the proposed amendments, the number of large sediments greater than or equal to one inch in diameter and shell material greater than

or equal to three inches in diameter on the recipient beach shall be counted by a visual observation survey. Surveys must be conducted along a minimum of five (5) shore-perpendicular transects evenly spaced throughout the entire project area with spacing between transects not exceeding 5,000 feet in the shore-parallel direction. At each transect, a 10,000 square foot area between the toe of dune and mean tide level shall be surveyed for large sediments and shells by visual observation. Finally, an arithmetic mean shall be computed for both sediments and shells by summing the totals for each across all transects and dividing by the number of transects.

Methodology:

CPE conducted visual observation surveys in the Towns of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills in April 2021. Twenty-one (21) sampling transects were established across the four Towns: five (5) in Duck, six (6) in Southern Shores, five (5) in Kitty Hawk, and five (5) in Kill Devil Hills. Sampling transects were generally evenly spaced along the project areas, with spacing not exceeding 5,000 feet in the shore-parallel direction between consecutive transects. Coordinates of the transects surveyed are provided in Appendix 2.

At each transect, a 10,000 square foot area was staked out between the toe of dune and the mean tide level. The mean tide level (NAVD88 ft) is -0.44 ft. for all four towns. The coordinates of the four (4) corners of each survey area were measured using a Real Time Kinematic (RTK) Global Positioning System (GPS) and are provided in Appendix 3. Horizontal data were collected in the North Carolina State Plane Coordinate System, North American Datum of 1983 (NAD83). Vertical data were collected in the North American Vertical Datum of 1988 (NAVD88). After the survey area was delineated, sediments greater than or equal to one inch and shell material greater than or equal to three inches in diameter were counted by a visual observation survey. Upon completion of the surveys, an arithmetic mean was computed for both sediments and shells in each town.

A summary of the survey dates and list of sampling transects for the Towns of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills are provided below.

- On April 26th, 2021, CPE conducted a survey of five 10,000 square foot areas in Duck (D-11, D-13, D-15, D-17, D-18) (Figure 1).
- On April 26th, 2021, CPE conducted a survey of six 10,000 square foot areas in Southern Shores (-197+12, -170+56, -130+00, -90+00, -50+00, -10+00) (Figure 2).
- On April 26th, 2021, CPE conducted a survey of five 10,000 square foot areas in Kitty Hawk (9+99, 50+28, 75+00, 109+99, 159+99) (Figure 3).
- On April 28th, 2021, CPE conducted a survey of five 10,000 square foot areas in Kill Devil Hills (209+74, 235+00, 260+17, 289+99, 320+05) (Figure 4).

To ensure the accuracy of the RTK GPS equipment, horizontal and vertical positioning checks were conducted at the beginning and end of the day using two 2nd order monuments from the National Geodetic Survey (NGS). The RTK GPS was used within a virtual reference station (VRS) network to locate and confirm survey control for this project. The control check shots were acquired using a minimum of five (5) epochs which results in high accuracy location. The horizontal and vertical accuracy of control data meets the accuracy requirements as set forth in the Engineering and Design Hydrographic Surveying Manual (EM 1110-2-1003).

Results:

A summary of the results for the Towns of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills are provided below and in Tables 1, 2, 3, and 4. Results for individual transects are provided in Appendix 3.

- Five transects in Duck were surveyed (D-11, D-13, D-15, D-17, D-18) (See Figure 1). A total of 15 sediments greater than or equal to one inch and 54 shells greater than or equal to three inches were counted across all five transects surveyed along the Town of Duck shoreline. The arithmetic means for large sediments and shell material within the project area is 3.0 and 10.8, respectively. Table 1 includes a summary of the results for Duck. Appendix 3 includes detailed information for each transect sampled.

Table 1. Duck Data Summary

Stations	Arithmetic Mean		Total	
	Sediment ≥ 1 Inch	Shell ≥ 3 Inch	Sediment ≥ 1 Inch	Shell ≥ 3 Inch
All Transects (D-11, D-13, D-15, D-17, D-18)	3.0	10.8	15.0	54.0

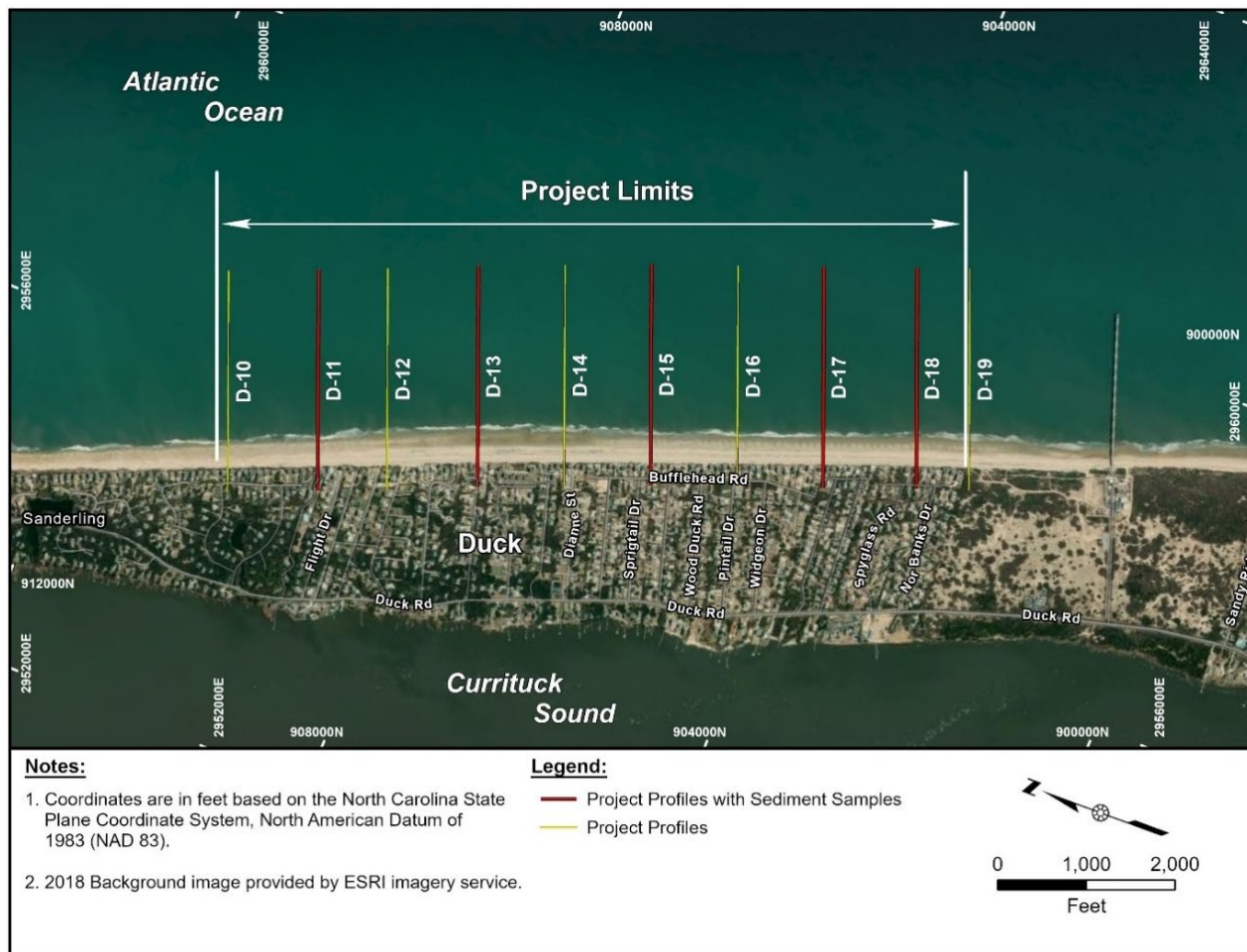


Figure 1. Map showing locations of the survey transects in the Town of Duck

- Six transects in Southern Shores were surveyed (-197+12, -170+56, -130+00, -90+00, -50+00, -10+00) (See Figure 2). A total of 123 sediments greater than or equal to one inch and 30 shell material greater than or equal to three inches were counted across all six transects. The arithmetic means for large sediments and shell material within the project area is 20.5 and 5.0, respectively. Table 2 includes a summary of results for Southern Shores. Appendix 3 includes detailed information for each transect sampled.

Table 2. Southern Shores Data Summary

Stations	Arithmetic Mean		Total	
	Sediment ≥ 1 Inch	Shell ≥ 3 Inch	Sediment ≥ 1 Inch	Shell ≥ 3 Inch
All Transects (-197+12, -170+56, -130+00, -90+00, -50+00, -10+00)	20.5	5.0	123.0	30.0

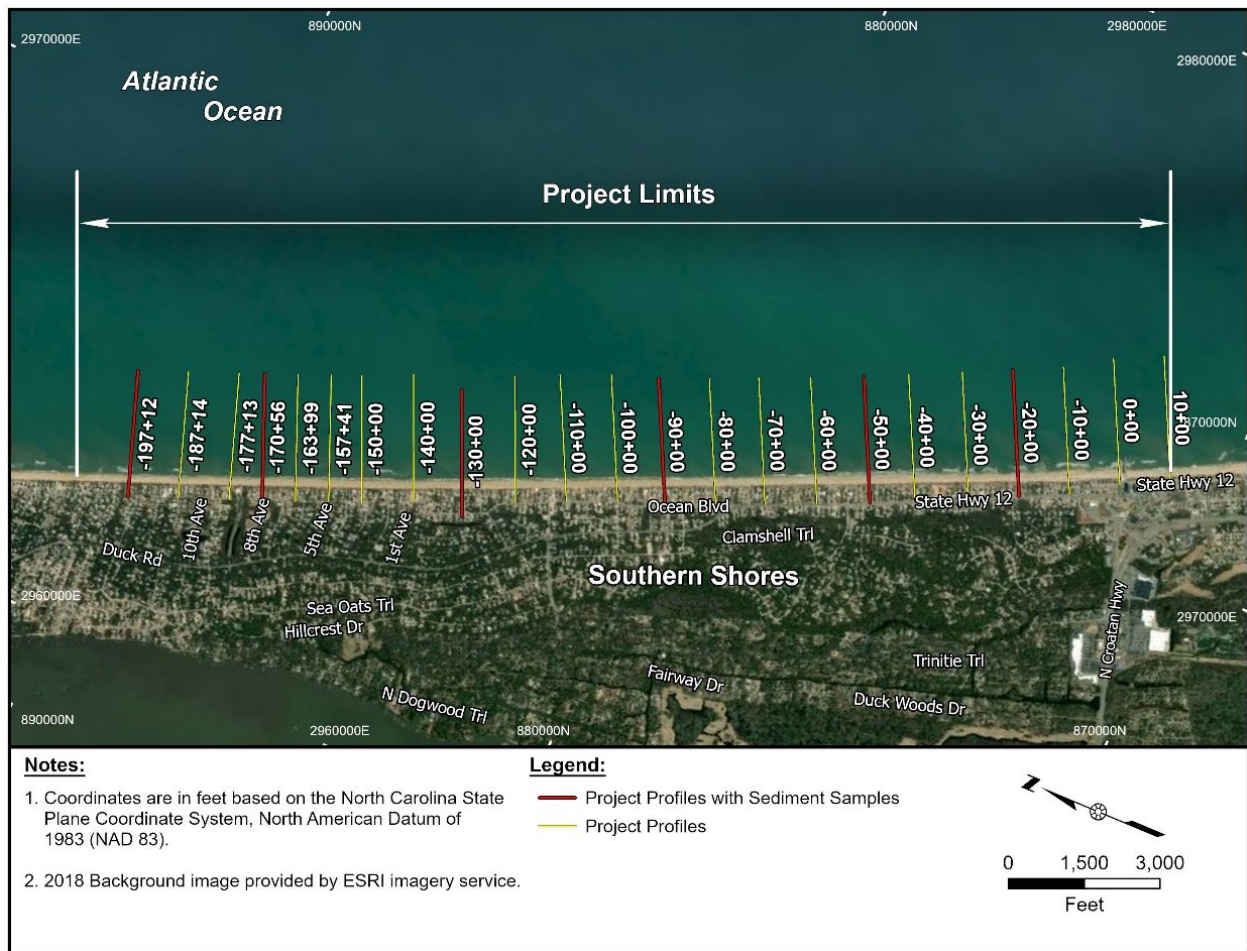


Figure 2. Map showing locations of the survey transects in the Town of Southern Shores

- Five transects in Kitty Hawk were surveyed (9+99, 50+28, 75+00, 109+99, 159+99) (See Figure 3). A total of 9 sediments greater than or equal to one inch and 49 shells greater than or equal to three inches were counted across all five transects. The arithmetic means for large sediments and shell material within the project area is 1.8 and 9.8, respectively. Table 3 includes a summary of results for Kitty Hawk. Appendix 3 includes detailed information for each transect sampled.

Table 3. Kitty Hawk Data Summary

Stations	Arithmetic Mean		Total	
	Sediment ≥ 1 Inch	Shell ≥ 3 Inch	Sediment ≥ 1 Inch	Shell ≥ 3 Inch
All Transects (9+99, 50+28, 75+00, 109+99, 159+99)	1.8	9.8	9.0	49.0

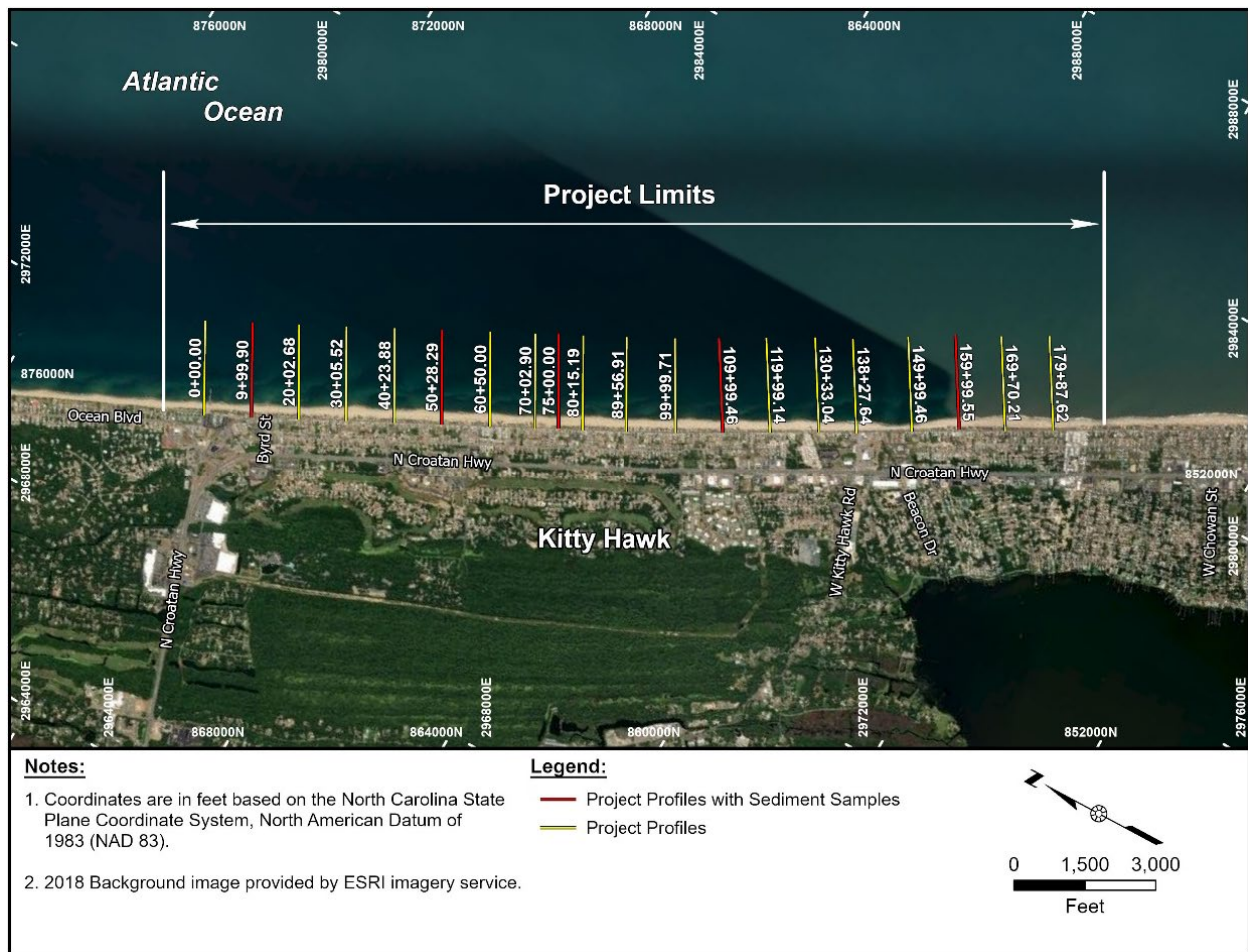


Figure 3. Map showing locations of the survey transects in the Town of Kitty Hawk

- Five transects in Kill Devil Hills were surveyed (209+74, 235+00, 260+17, 289+99, 320+05) (See Figure 4). A total of 9 sediments greater than or equal to one inch and 93 shells greater than or equal to three inches were counted across all five transects. The arithmetic means for large sediments and shell material within the project area is 1.8 and 18.6, respectively. Table 4 includes a summary of results for Kill Devil Hills. Appendix 3 includes detailed information for each transect sampled.

Table 4. Kill Devil Hills Data Summary

Stations	Arithmetic Mean		Total	
	Sediment ≥ 1 Inch	Shell ≥ 3 Inch	Sediment ≥ 1 Inch	Shell ≥ 3 Inch
All Transects (209+74, 235+00, 260+17, 289+99, 320+05)	1.8	18.6	9.0	93.0

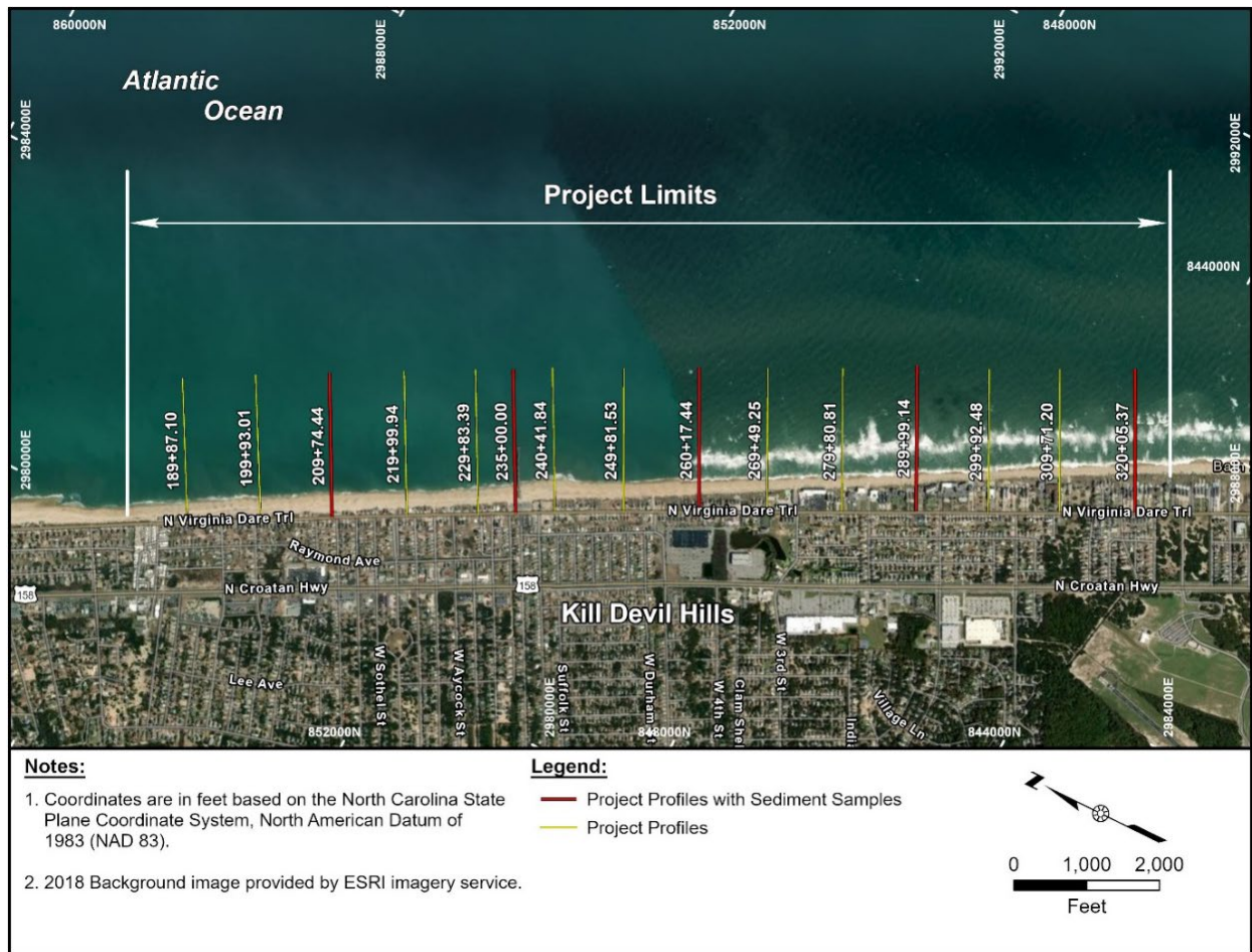


Figure 4. Map showing locations of the survey transects in the Town of Kill Devil Hills

Conclusions:

In April 2021, CPE conducted visual observation surveys for large sediments and shell material along 21 transects in the Towns of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills. The surveys were conducted in accordance with the CRC’s amended Rule 15A NCAC 07H .0312 – Technical Standards for Beach Fill Projects, adopted in February 2021. Sediments greater than or equal to one inch in diameter and shell material greater than or equal to three inches in diameter were counted during the survey. Following the survey, an arithmetic mean was computed for both sediments and shell material in each town. A summary of the results is presented below in Table 5.

Table 5. Summary results of the visual observation surveys conducted in April 2021 for beach nourishment projects in northern Dare County, North Carolina

	Duck	Southern Shores	Kitty Hawk	Kill Devil Hills
Mean Number of Sediments (≥ 1 inch)	3.0	20.5	1.8	1.8
Mean Number of Shells (≥ 3 inches)	10.8	5.0	9.8	18.6