



Town of Kitty Hawk

North Carolina

Beach Management Concept Assessment



Photo provided by Hilton Garden Inn Outer Banks / Kitty Hawk & VFM Leonardo Inc.

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TOWN OF KITTY HAWK, NC
BEACH MANAGEMENT CONCEPT ASSESSMENT

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (USACE) completed a feasibility report and environmental impact statement on a hurricane protection and beach erosion control project for Dare County beaches in September of 2000. The study recommended that as part of the “North Project” a beach fill project be constructed along the southern 8,070 ft. of the Town of Kitty Hawk, which included a 3,000-foot tapered section on the north end. Public infrastructure, including portions of NC 12, U.S. Highway 158, Town roads between NC 12 and U.S. Highway 158, and public utilities, as well as multiple oceanfront single family homes are located along the portion of the Town not included in the federal project. With well over half of the Town’s shoreline not included in the federal project, and little hope that the federal project will ever be funded, the Town of Kitty Hawk commissioned this study to determine the feasibility of a locally constructed beach nourishment program.

The purpose for implementing a beach nourishment project at Kitty Hawk is threefold. First, is to reduce the vulnerability of public infrastructure including NC 12, Town roads between NC 12 and U.S. Highway 158, and utilities to storm-induced erosion. Secondly, is to reduce flooding experienced in many non-oceanfront areas throughout the Town during ocean over wash conditions, including portions of highway NC 12 and U.S. Highway 158. This flooding, which at times can render routes impassable, greatly limits the ability for emergency personnel to respond. Thirdly, is to reduce the vulnerability of homes within the Town that front the Atlantic Ocean and are exposed to wave events during nor’easters and other large storm events as well as natural erosional trends.

Constructing a beach fill project that would completely eliminate damage due to coastal storms is not practical. There will always be a risk that a storm greater than the design storm will impact the area. Therefore, given limited financial resources, it is prudent for a community to make a determination as to what level of storm damage reduction it can afford and likewise let property owners know the risks involved in any plan. The most feasible project is usually one that balances financial resources and the risk a community is willing to accept.

Based on initial analysis of the published erosion rates along the Town of Kitty Hawk and the design work conducted by the USACE associated with the federal project, a beach nourishment project constructed along the entire length of the Town of Kitty Hawk may require between 1.4 million and 2.8 million cubic yards of sand. Permitting and design phase work is estimated to range between \$550,000 and \$1,120,000. Construction phase costs are highly dependent on the volume of material placed and the location of the borrow area in relation to the fill area. Two different offshore sand sources have been identified as potential borrow sites. Given the fact that extensive analyses are still required to determine the dimensions of the beach fill project and which sand source will be used, initial estimates suggest that the cost for a project constructed along the entire shoreline of Kitty Hawk could range between \$15.2 Million and \$32.8 Million. Based on permitting agency and environmental resource agency responses to similar beach projects in North Carolina the permit may require environmental monitoring. Although it is difficult to anticipate the nature and the level of environmental monitoring at this time, monitoring costs associated with a beach fill project for the Town of Kitty Hawk could range between \$100,000 and \$500,000.

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If the Town decides to pursue a beach nourishment program, significant savings could be realized through cost-sharing with the Towns of Duck and Kill Devil Hills. Initial estimates suggest that cost sharing for the engineering and design phase could result in savings ranging from \$35,000 to well over \$100,000. In order to maximize savings through cost-sharing, the Town must move forward with the engineering and design phase within the next 2 – 4 months. This would allow sufficient time to synchronize their efforts with those of Duck and Kill Devil Hills. Based on the available information, construction of the beach nourishment project could commence any time after December 2015 if the Town were to initiate engineering and design efforts by the end of September 2013.

Additional savings are possible through combining construction of multiple projects. Initial estimates of potential cost savings associated with the construction phase could exceed \$1,000,000 for the Town of Kitty Hawk. Extensive engineering, geotechnical, geophysical, and environmental analyses are required to further refine the scope, cost, and schedule for a beach nourishment project for the Town of Kitty Hawk.

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LIST OF ACRONYMS

BA	Biological Assessment
BO	Biological Opinion
BOEM	Bureau of Ocean Energy Management
CAMA	Coastal Area Management Act
CPE-NC	Coastal Planning & Engineering of North Carolina, Inc.
CY	Cubic Yards
DCM	North Carolina Division of Coastal Management
DMF	North Carolina Division of Marine Fisheries
DOA	Department of the Army
DWQ	North Carolina Division of Water Quality
EA	Environmental Assessment
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
FMC	Fishery Management Council
FONSI	Finding of No Significant Impact
MP	Mile Post
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
NAVD	North American Vertical Datum
NC SSRWQ	North Carolina Shellfish Sanitation/Recreational Water Quality
NED	National Economic Development
NEPA	National Environmental Protection Act
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
NOS	National Ocean Services
SHPO	State Historic Preservation Office
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WRC	North Carolina Wildlife Resource Commission

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INTRODUCTION

The Town of Kitty Hawk is evaluating the shoreline condition within their jurisdictional limits. The assessment will assist in making planning decisions to manage shoreline erosion and reduce storm damage vulnerability within the Town limits. As part of the assessment, the Town contracted with Coastal Planning & Engineering of North Carolina, Inc. (CPE-NC) to complete a conceptual analysis of management solutions. Part of the analysis entails reviewing the scope of the federal Dare County hurricane protection and beach erosion control project authorized by Congress in 2001. In addition, the analysis examines the conceptual scope and estimated cost of a shore protection project to include the entire shoreline within the Town limits. Two (2) types of conceptual shoreline projects are evaluated; an erosion mitigation project and a storm damage reduction project. The scope of the erosion mitigation project is derived from the updated erosion trends published by the NC Department of Coastal Management (DCM). The storm damage reduction project is based on the federal project authorized for Dare County in 2001.

Discussion is also provided on potential benefits the Town may realize by partnering with neighboring municipalities to construct a regional project. The Town of Kill Devil Hills and the Town of Duck are currently pursuing shoreline restoration projects and this report provides details as to the economic efficiencies that may exist by combining planning and construction efforts. Finally, for planning purposes, the type, anticipated schedule, and preliminary cost estimate of the potential management alternatives are provided.

What is Beach Nourishment?

Beach nourishment and dune restoration were identified as the preferred method to address the erosion problems along Kitty Hawk by the U.S. Army Corps of Engineers (USACE). Beach nourishment is an engineered shore protection alternative that directly places sand on a beach. The National Research Council (National Research Council, 1995) defines a beach nourishment project as:

The placement of sand on a beach to form a designed structure in which an appropriate level of protection from storms is provided and an additional amount of sand (advanced fill) is installed to provide for erosion of the shore prior to the anticipated initiation of a subsequent project. The project may include dunes and/or hard structures as part of its design.

Dunes provide protection from storm waves and inundation. The sandy beach in front of the dunes acts as a buffer during storms and provides recreation areas for tourists as well as habitat needed for sea turtle nesting and shorebirds. Without a wide healthy beach, dunes can be impacted by nominal storm conditions resulting in reduced recreation area and habitat, overwash, dune breaching and inundation.

A beach nourishment program typically involves the initial construction of a project, annual beach monitoring surveys, analysis of the monitoring data to determine if or when renourishment is required, and renourishment events. Initial construction involves the construction of both the designed beach profile and placement of advanced fill. Advanced fill is a sacrificial quantity of

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sand that is expected to wash away during the course of the interval between initial construction and the renourishment event. Placement of this sacrificial sand in front of the designed beach is intended to allow for the design beach to stay in place so that the designed level of protection is maintained. Beach monitoring surveys are accomplished by collecting topographic and hydrographic measurements along beach profiles from the dune out to the depth of closure (typically between 20 and 30 ft. of water). Data collected along the same profile is compared over time to determine how well the beach is performing. This performance dictates when the next renourishment event will occur. Renourishment typically involves replacing only the portion of the sacrificial sand that has washed away in front of the design beach. For this reason, the cost of a renourishment event is typically significantly less than initial construction.

FEDERAL PROJECT DESCRIPTION

The USACE completed a feasibility report and environmental impact statement on a hurricane protection and beach erosion control project for Dare County beaches in September 2000. The study recommended two components referred to as the North Project Area and South Project Area. The North Project Area covered approximately 21,900 ft. (4.1 miles) along the shoreline of Kitty Hawk and Kill Devil Hills (USACE, 2000). Figure 1 shows the North Dare County project limits including the segment within the Town of Kitty Hawk. The main fill portion of the project within the Town of Kitty Hawk extends from Mile Post (MP) 4.3 at Kitty Hawk Road to the southern Town limits. This encompasses 5,070 feet within the Town limits. In addition, the plan calls for a 3,000 ft. taper on the north end of the main fill which extends from Kitty Hawk Road north to approximately 500 ft. south of Historic Street. The resulting project length is 8,070 ft. (approximately 1.5 miles) of shoreline within the Town of Kitty Hawk. The USACE established a baseline along the Dare County coast with reference stations to designate the location and distance along the shoreline. The northern limits of the Kitty Hawk segment begin at reference station 138+30 and extend to station 189+00, exclusive of the 3,000 ft. taper on the north side of the project (Figure 1).

Project Design

The vertical dimensions of the federal project were referenced to the National Geodetic Vertical Datum established in 1929 (NGVD29). Today, a more widely used vertical datum is the North American Vertical Datum of 1988 (NAVD88). The average conversion from the NGVD29 datum to the NAVD88 datum along the project shorefront is -0.97 ft. (For simplicity, a conversion factor of -1.00 ft. was used for this report). The following description of the authorized federal project is referenced to the NAVD88 datum.

The primary purpose in designing the federal project was the reduction of damages associated with storm events and beach erosion. The recommended plan of improvement is the National Economic Development Plan (NED). The NED plan is the plan among those alternatives considered that produces the maximum net economic benefits. The NED plan for the Dare County federal project included a 25 ft. wide dune at elevation +12 ft. NAVD88 fronted by a 50 ft. wide berm at elevation +6 ft. NAVD88 (USACE, 2000). On the backside, the dune would

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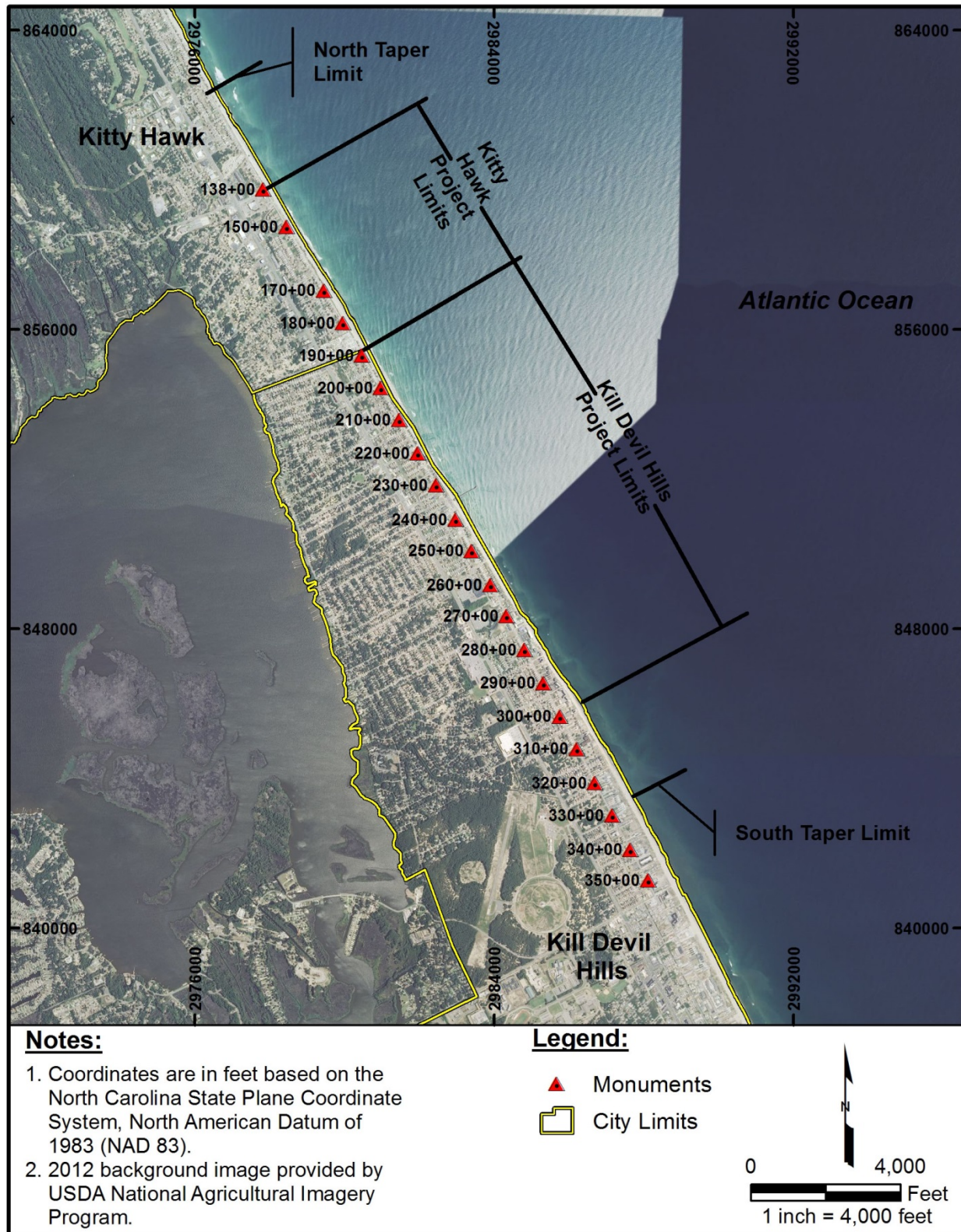


Figure 1. Location map showing the extent of the north project area associated with the federal hurricane protection and beach erosion control project for Dare County beaches, which includes portions of the Towns of Kitty Hawk and Kill Devil Hills.

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slope 1V:5H from the dune crest to the existing ground. On the seaward side, the slope of the dune would be 1V:10H from +12 ft. NAVD88 to +6 ft. NAVD88. From the seaward edge of the 50 foot berm, the design template would mimic the existing profile out to the depth of closure (-28 NAVD88). Figure 2 shows the profile view of the design section for the federal project (USACE, 2000).

The calculated benefit-cost ratio for the north project area of the federal project was 1.3; that is for every \$1 spent constructing the project there would be a return of \$1.30 in benefits from storm damage reduction, recreation, and reduced emergency costs.

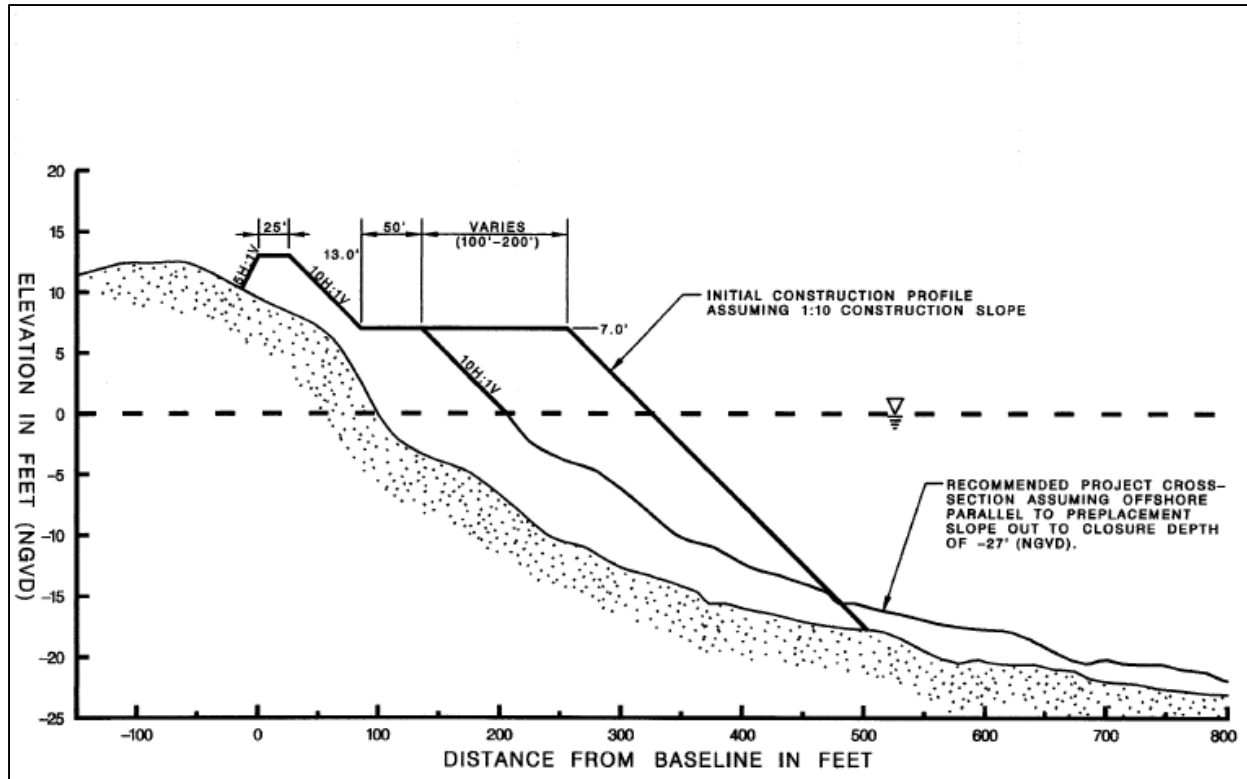


Figure 2. Typical cross section profile of the Federally Authorized North Dare County Project showing both the construction and design templates (Modified from USACE, 2000).

Fill Volume Requirements

Dredge quantities for the Dare County North Project Area were estimated at approximately 4,300,000 cubic yards. This accounted for a material overfill ratio of 1.5 calculated by the USACE based on the assumption that Borrow Area N1 would be used (USACE, 2000). Borrow Area N1 is a borrow site located approximately 1 – 2 miles offshore Kitty Hawk (Figure 3). The overfill factor is based on the difference in grain size, silt content, and sorting distribution between the native or existing beach and the borrow source. Based on these factors, approximately 1.5 times more material would be needed from the borrow source, which following sorting and winnowing by wave action, would provide essentially the same grain size

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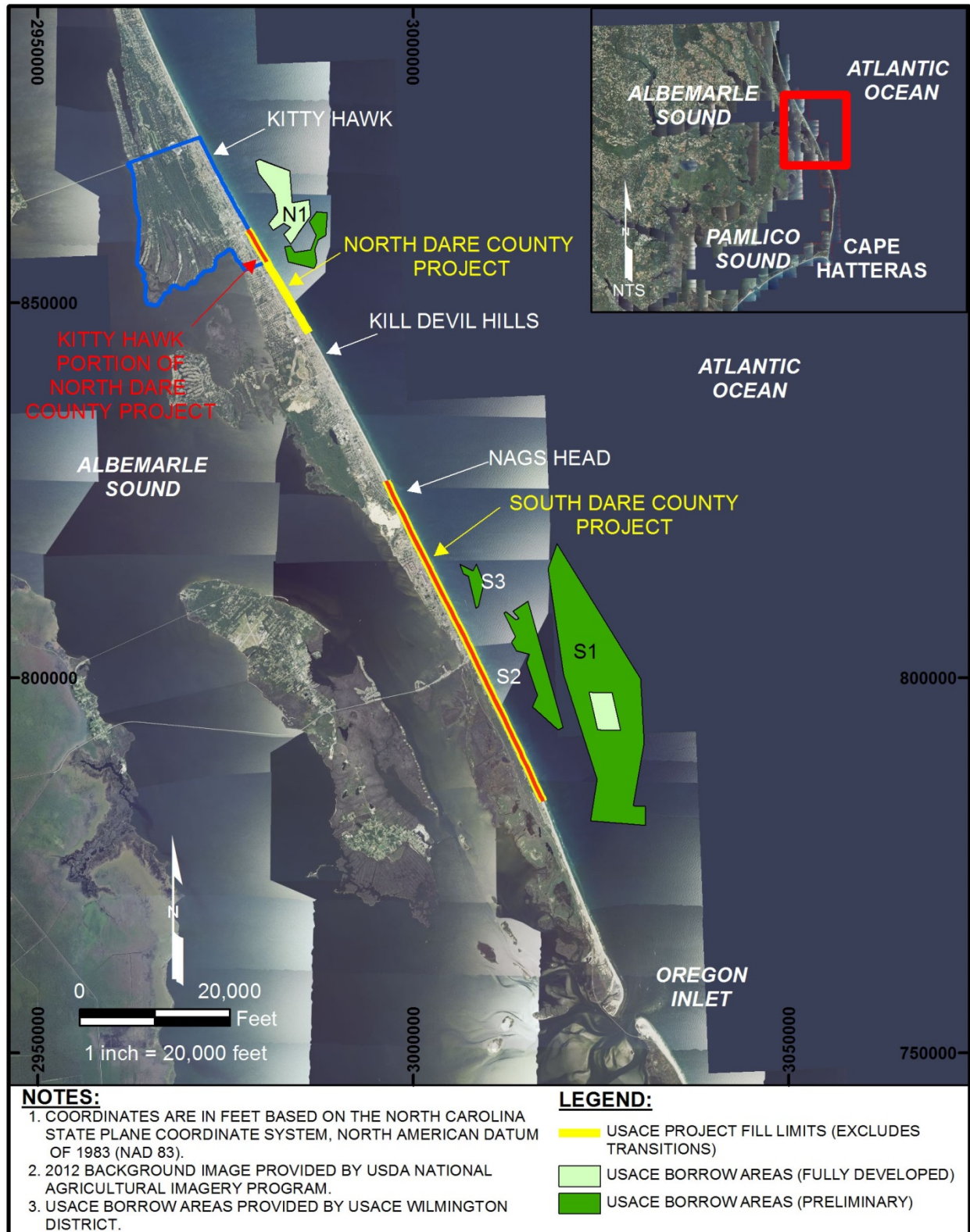


Figure 3. Location map showing the extent of the north and south project areas and proposed borrow areas associated with the federal hurricane protection and beach erosion control project for Dare County beaches.

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characteristics as the native material. Based on the dredge quantity of 4,300,000 cubic yards and 1.5 overfill factor, the effective or in place volume required to construct the North Project Area was calculated at approximately 2,870,000 cubic yards (4,300,000 cy / 1.5 overfill factor).

The average in place fill density for the Kitty Hawk section is estimated at 151.9 cubic yards / linear foot based on an even distribution of fill along the 15,900 ft. main fill area (Kitty Hawk and Kill Devil Hills portions) and the two 3,000-foot tapers on either end of the project. The periodic nourishment schedule for the North Project Area was reported as every three (3) years by USACE. The material proposed by the USACE for use in periodic nourishment operations was Borrow Area S1 located seaward of South Nags Head (Figure 3) (USACE, 2000). The volume requirement to be dredged for the periodic nourishment was estimated at 1,055,000 cubic yards. The overfill factor calculated based on using Borrow Area S1 was 1.1. Therefore, the net in place 3-year periodic nourishment volume is calculated as 959,000 cubic yards (1,055,000 cy / 1.1 overfill factor). This is equivalent to an average fill density of 50.7 cubic yards / linear foot for the North Project Area. The volume needed to periodically nourish the 8,070 foot long Kitty Hawk segment every three years totals approximately 333,000 cubic yards.

Sand Sources

One of the major keys to the success of a beach nourishment project is the quality of the sand. In choosing a borrow area, both the quality of the material and the proximity of the material to the beach fill area are of primary consideration. As previously mentioned, the USACE developed two (2) offshore borrow areas designated as S1 and N1 to fulfill the complete project requirements (Figure 3). The borrow area designated as N1 was proposed for the initial construction of the North Project Area and is estimated to contain approximately 5,192,000 cubic yards. The estimated dredge quantity of 4,300,000 cubic yards is required for the initial construction. Approximately 17% of the total volume could remain within the borrow area after the initial construction. However, the borrow area was not projected to be available for future periodic nourishment events due to the anticipated sediment losses expected in the dredging process.

The borrow area designated as S1 was proposed for all of the 17 periodic nourishments expected through the project's 50-year lifespan. As discussed above, the placement volume required for the Kitty Hawk section equates to 333,000 cubic yards for each periodic nourishment event. Therefore, the total volume of material that would be required from Borrow Area S1 for all of the periodic nourishments for the Kitty Hawk segment is 5,663,000 cubic yards. The site was estimated to contain 104,454,000 cubic yards (USACE, 2000) and would be capable of supplying the necessary volume.

Using Borrow Area N1 as proposed in the NED plan, requires a larger volume of sand to be dredged from the offshore borrow area based on the fact that the material in the borrow area is significantly finer than the native beach. The mean grain size of Borrow Area N1 is 0.22 mm, whereas the mean grain size for the North Project Area is 0.31 mm. An analysis conducted for the Town of Kill Devil Hills suggested that using Borrow Area S1 would be more cost

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effective due to the reduction in volume needed by using the coarser sand (0.34 mm) contained in S1, despite a greater distance from borrow area to project area (CPE-NC, 2012).

LOCAL PROJECT ALTERNATIVES

The main fill of the federal project only extends to reference station 138+30 on the USACE baseline, or approximately Kitty Hawk Road. The Town of Kitty Hawk's jurisdictional limits extend approximately 2.6 miles north of Kitty Hawk Road and reach just north of the Kitty Hawk Pier. Public infrastructure, including portions of NC 12, Town roads between NC 12 and U.S. Highway 158, and public utilities, as well as multiple oceanfront single family homes are located along the portion of the Town not included in the federal project. This public and private development, which front the Atlantic Ocean and are exposed to wave events during nor'easters and other large storm events, would not be adequately protected if fill placement stops at Kitty Hawk Road as proposed by the federal project.

In addition to the public and private development that is vulnerable to storm damage and beach erosion, many areas throughout the Town experience heavy flooding during ocean over wash conditions. This includes portions of highway NC 12 and U.S. highway 158 within Kitty Hawk. When flooding occurs, vehicular movement along both routes can become impassable and greatly limit the ability for emergency personnel to respond (Albemarle and Associates, 2011).

During a February 5, 2013 meeting between representatives of CPE-NC, the Town of Kitty Hawk, and the Town of Kill Devil Hills, the representatives of the Town of Kitty Hawk expressed interest in assessing a project to provide erosion and storm damage reduction along the entire 3.5 miles of oceanfront shoreline. Alternatives for a local project to provide protection to the infrastructure and residential structures along the entire Town limits are discussed below. The alternative projects would extend from approximately Kitty Hawk Pier to 150 ft. south of E. Sibbern Street for an approximate distance of 3.5 miles.

Constructing a beach fill project that would completely eliminate damage due to coastal storms is not practical. There will always be a risk that a storm greater than the design storm will impact the area. Therefore, given limited financial resources, it is prudent for a community to make a determination as to what level of storm damage reduction it can afford and likewise let property owners know the risks involved in any plan. The most feasible project is usually one that balances financial resources and the risk a community is willing to accept.

Given the nature of this desktop study, two types of shoreline restoration projects are discussed herein, an erosion mitigation project and storm damage reduction project. The purpose of an erosion mitigation project is primarily to maintain a particular shoreline position for the duration of the projects design life. Some storm damage reduction is gained by constructing an erosion mitigation project; however, the primary focus is to stem the normal effects of beach erosion. Beach placement volumes for such a project are calculated based on long term erosion and volumetric change rates. Storm damage reduction projects provide a dune and/or berm specifically designed to absorb the anticipated wave energy generated by a theoretical storm or suite of storms. The design storm is estimated based on historical events that have occurred within the project area. The storm is generally based on the percent of occurrence for a given

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wave energy level during any given year. Examples include a 5 year and 25 year event, which have a 20% and 4% chance of occurrence in any given year, respectively.

A discussion regarding applicability of each type of project to the Town of Kitty Hawk is provided in the following sections.

Erosion Mitigation Project

Shoreline change within the Town of Kitty Hawk was evaluated using the 1940 to 2009 migration rates provided by the North Carolina Division of Coastal Management (DCM, 2011). The rates reported by the DCM (2011) were averaged for 2,000-foot segments to provide a representative migration value applicable for planning purposes. The average migration rate along the Town of Kitty Hawk shoreline was calculated as -1.8 ft./yr (landward), with a maximum rate calculated at -2.7 ft./yr (landward). Given the current oceanfront conditions along the Town of Kitty Hawk, a starting point for a proposed beach fill project would extend the existing shoreline 40 ft. seaward of its current position. Advanced fill would then be placed in front of the newly established shoreline to act as a sacrificial fill expected to be washed away over time. Approximately 1,400,000 cy of material would be required to extend the shoreline 40 ft. seaward and provide sufficient advanced fill to last 5 years based on the analysis of long term erosion rates reported by DCM (2011). While the 40 foot berm width is less than the width proposed by USACE (2000), the value is consistent with the design goals for a similar erosion mitigation project proposed to the Town of Duck (CPE-NC, 2013b).

The fill density for the erosion mitigation project described herein for the Town of Kitty Hawk is estimated at 74.9 cubic yards per linear foot (cy/lf). This value is consistent with projects recently constructed on North Topsail Beach and in Nags Head. The respective fill densities for those projects were 73.2 cy/lf (CPE-NC, 2013a) and 80.6 cy/lf (Coastal Science & Engineering, 2013).

Storm Damage Reduction Project

The USACE study, completed in 2000, provided a design for a storm damage reduction project along the south portion of Kitty Hawk with a fill density calculated at 151.9 cy/lf. To construct a project with this fill density along the entire shoreline of Kitty Hawk would require approximately 2,800,000 cy. Based on the USACE 2000 study, the volume is sufficient for a 25 foot wide dune feature at +12 ft. NAVD88 fronted by a 50 foot wide berm at elevation +6 ft. NAVD88. The volume density does not account for advance nourishment requirements. This scale of a project is presented herein for comparison purposes only. The scale of such a project may not be financially feasible for the Town of Kitty Hawk, even with County and State cost sharing. Cost estimates are discussed in greater detail in subsequent sections.

Additional analyses of the current shoreline condition, proximity of development to the shoreline, and storm frequency, should be conducted in order to design a project that can provide the most storm damage reduction at a cost that meets the financial constraints of the Town. A similar approach was recently conducted for the Town of Duck, in which a range of costs were

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developed to build a project that provided storm damage reduction from the 5, 10, 20, 25, and 50-year return interval storm (CPE-NC, 2013b).

Summary

The volumes presented herein for a conceptual erosion mitigation and storm damage reduction project are preliminary estimates based on available data. Beach fill parameters were based on the design parameters for similar projects in the vicinity of the Town of Kitty Hawk and the Dare County federal project authorized in 2000. If the Town elects to pursue a beach project, further analysis should be conducted to assess what level of protection could be achieved given logistical, environmental, and financial constraints. A more detailed shoreline change and volume change analysis should be conducted to verify erosion/accretion rates. Likewise, further storm damage vulnerability analyses should be conducted to better define the vulnerability of public and private infrastructure as well as to determine the potential cost to mitigate against varying degrees of vulnerability.

ALTERNATIVE SAND SOURCES

Borrow Area S1 was identified by the USACE through investigations in the 1990's associated with the hurricane protection and beach erosion control project for Dare County beaches (USACE, 2000) (Figure 3). Further investigations into various sub-sections of S1 were conducted by the Town of Nags Head in an effort to permit a borrow area to be used as the source of sand for the local beach fill project (USACE, 2010). Both of these investigations concluded that the material contained in Borrow Area S1 was beach compatible material. The successful construction of the Nags Head local project in 2011, verified that the portion of S1 used for the project was in fact beach compatible.

In 2001, Boss and Hoffman prepared a report that described investigations to identify sand resources offshore Dare County. This study was commissioned by the U.S. Minerals Management Service (currently known as the Bureau of Ocean Energy Management or BOEM) in response to a perceived increase in the demand for offshore sand located beyond State Waters. Figure 4 shows the extent of the study area.

The Boss and Hoffman study identified four target areas with potential for sand resources (2001). These four sites, which may contain up to 77 million cubic yards of sand, are located outside State Waters (beyond the 3-mile limit). The sites are located generally offshore of the Town of Kill Devil Hills and the Town of Nags Head and are labeled as areas 1 – 4 on Figure 5. (Boss and Hoffman, 2001). Additional data obtained from the National Ocean Services (NOS) was obtained and processed to create a shaded relief bathymetric chart, which is provided as Figure 5. The figure shows the presence of a number of offshore topographic features.

Several vibracores were collected in the areas labeled 1 – 5 in Figure 5 (Boss and Hoffman, 2001). Data from these vibracores suggest material is a mix of beach sand and silty sand. However, further analysis of the location of these vibracores suggests that some vibracores were not taken directly on top of the topographic high features as seen in Figure 5. Furthermore, those vibracores collected in the vicinity of the topographic highs show mostly beach quality sand.

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The Town of Kill Devil Hills has contracted with CPE-NC to conduct a reconnaissance survey to better assess the quality of the material in Areas 1 and 5.

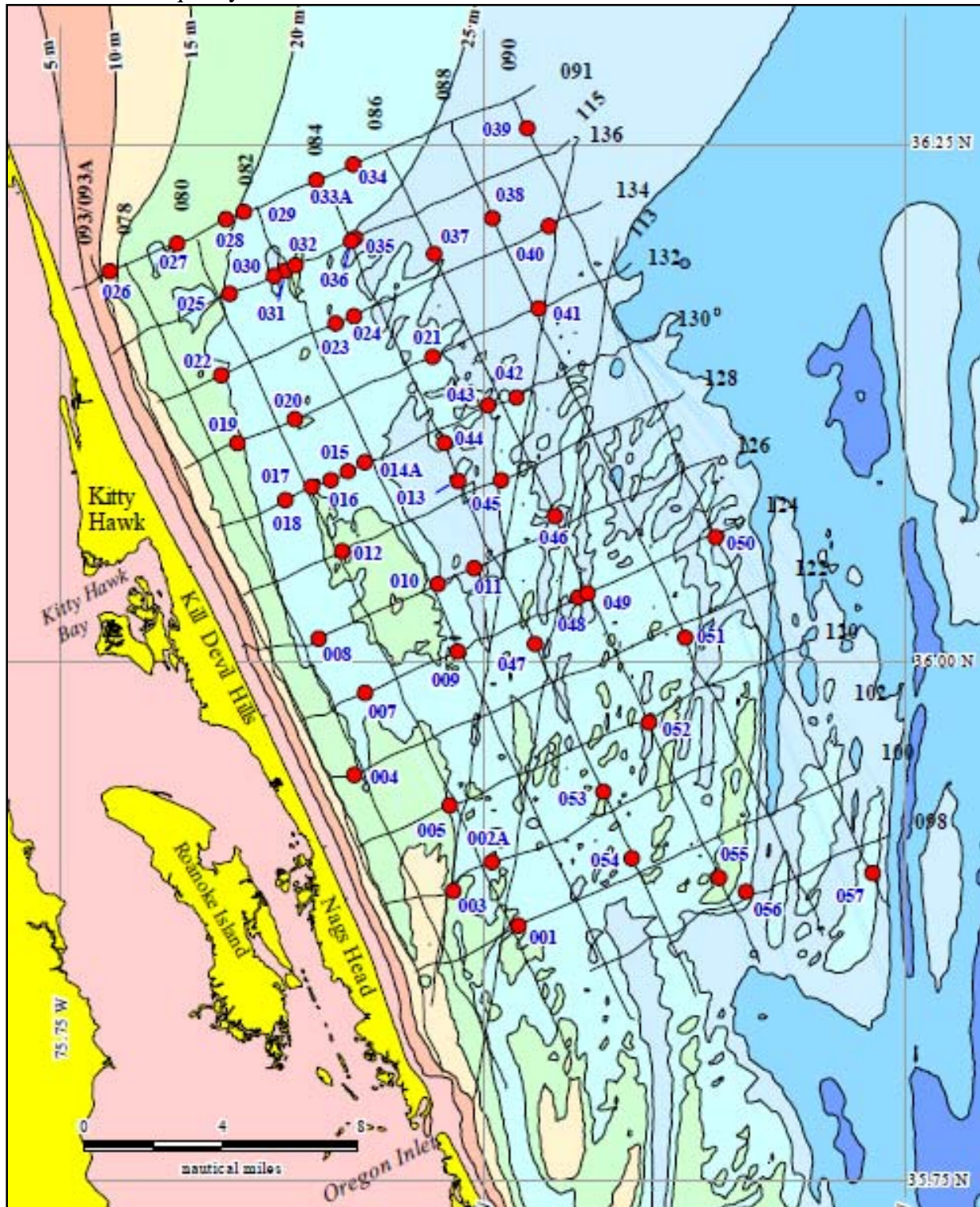


Figure 4. Location of Geophysical and Geotechnical Data Collected Offshore of Dare County (Boss & Hoffman, 2001)

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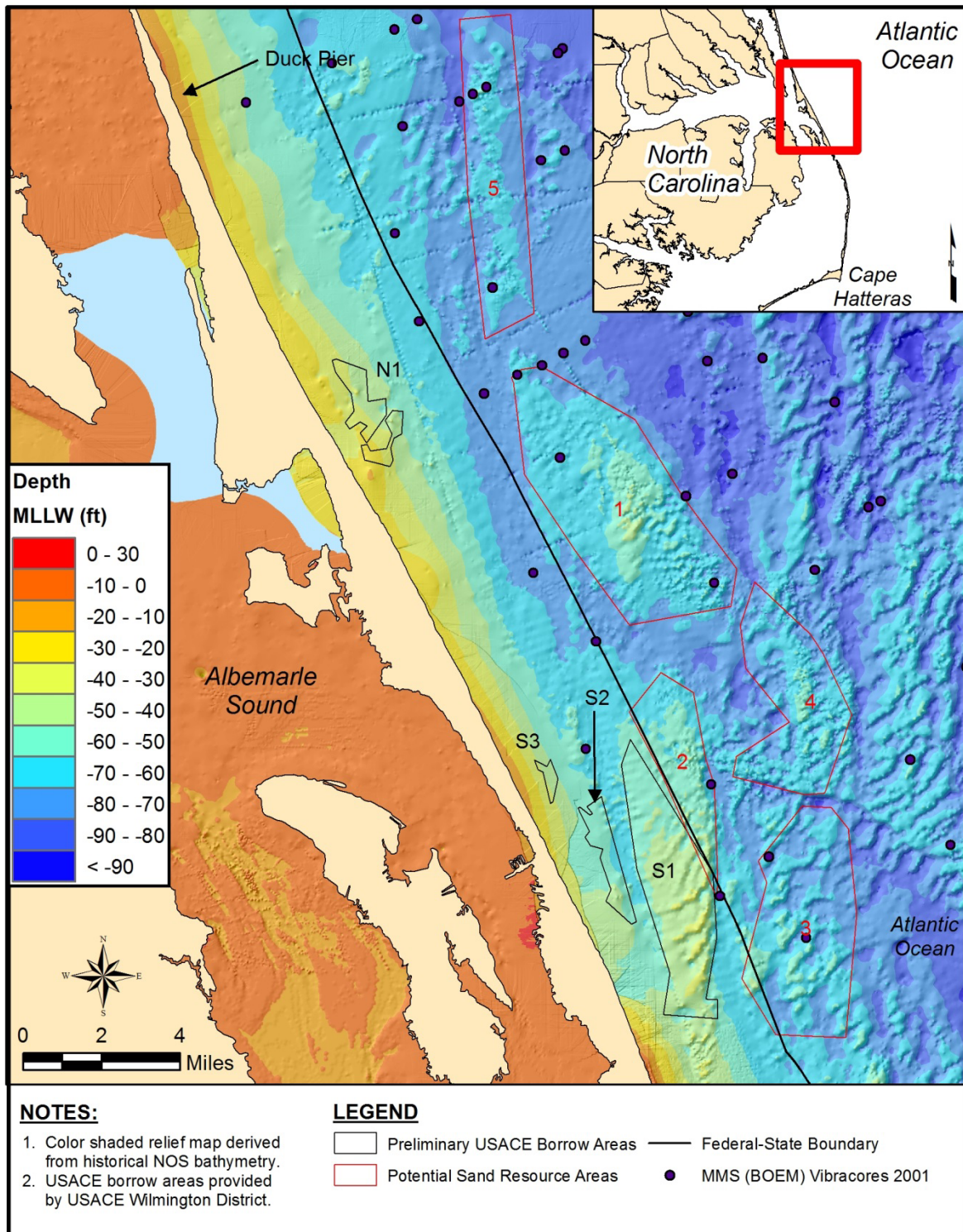


Figure 5. Offshore Sand Resource Areas Identified by USACE and BOEM.

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Summary

Based on available data, sand resources do exist in sufficient quantity and quality to support beach nourishment efforts for the Town of Kitty Hawk. However, significant efforts remain to define these sand resources to the extent needed to permit a borrow area. The State of North Carolina has adopted specific Technical Standards for Beach Fill Projects (15A NCAC 07H.0312) that must be met prior to the issuance of a Major Coastal Area Management Act (CAMA) permit. These standards include characterization of both the existing beach through sediment sampling and beach profile surveys as well as characterization of the borrow source through geophysical and geotechnical surveys.

PERMITTING AND ENVIRONMENTAL DOCUMENTATION

An interagency meeting was held in Washington, NC on June 19, 2013 to discuss proposed permitting and environmental documentation approaches for a beach nourishment project along the oceanfront shoreline at Kitty Hawk. Recognizing the fact that Kill Devil Hills and Duck, both in proximity to Kitty Hawk, are proceeding with similar beach nourishment projects, the meeting also focused on approaches to permit and develop supporting environmental documentation for these three projects in tandem. Attendees included representatives from the Town of Kitty Hawk, Town of Duck, Town of Kill Devil Hills, Dare County, and federal and state resource agencies including the USACE, US Fish and Wildlife Service (USFWS), National Marine Fisheries (NMFS), BOEM, North Carolina Division of Marine Fisheries (DMF), North Carolina Division of Water Quality (DWQ), North Carolina DCM, North Carolina Shellfish Sanitation/Recreational Water Quality (NC SSRWQ), and the North Carolina Wildlife Resource Commission (WRC). A complete list of attendees as well as minutes from the inter-agency meeting are included as Appendix A.

Permitting

The construction of a beach nourishment project along the Town of Kitty Hawk's shoreline using offshore dredged material will require permits from the Department of the Army (DOA) (USACE) in order to satisfy the National Environmental Policy Act (NEPA). In addition, a CAMA Major Permit will be required by the State of North Carolina. Major permits are necessary for activities that require other state or federal permits, for projects that cover more than 20 acres, or for construction covering more than 60,000 square feet. Applications for major permits are reviewed by ten (10) state and four (4) federal agencies before a decision is made.

Along with the USACE, the federal agencies involved in the project planning and formulation during the preparation of environmental documents would include (but not necessarily be limited to) the BOEM, USFWS, NMFS, and the Environmental Protection Agency (EPA). The lead State agency would be the North Carolina DCM, which is responsible for review and issuance of the major CAMA permit. Other State agencies include the North Carolina DMF, the North Carolina WRC, and the North Carolina DWQ.

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The permitting process for both the USACE and DCM, when completed, will result in the issuance of additional approvals required by federal and state agencies prior to the implementation of the beach nourishment project. These include:

- NEPA Compliance
- Coastal Area Management Act (CAMA) Major Authorization
- NCDWQ 401 Certification
- USACE Section 10/404 Permit
- U.S. Fish and Wildlife Service Biological Opinion (BO)
- National Marine Fisheries Service Concurrence
- NC State Historic Preservation Office (SHPO) Concurrence

Environmental Documentation

As previously mentioned, an inter-agency meeting was held on June 19, 2013 to bring federal and state agency representatives together to discuss permitting approaches for the Towns of Kitty Hawk, Kill Devil Hills, and Duck. Because the projects being considered may include borrow areas outside of state waters, the BOEM may carry jurisdiction over dredging activities in the event that the final proposed borrow area is located in federal waters. The USACE will carry jurisdiction of the placement of material along the oceanfront shoreline. Unlike dredge-and-fill beach nourishment projects utilizing borrow sources within state waters, this project will require coordination with two federal agencies (BOEM and USACE) as co-lead agencies.

Based on the feedback received from the inter-agency meeting as well as extensive past correspondence with agencies on similar projects, it is likely that an Environmental Assessment (EA) will suffice to support the NEPA permitting process for a beach fill project along the Kitty Hawk shoreline. An EA, under NEPA, is a concise public document that provides sufficient evidence and analysis for determining whether a federal regulatory agency should issue a Finding of No Significant Environmental Impact (FONSI) or prepare an Environmental Impact Statement (EIS). It is designed to help public officials make decisions that are based on an understanding of the human and physical environmental consequences of the proposed project and take actions, in the location and design of the project, that protect, restore and enhance the environment. The core elements of an EA in 40 CFR § 1508.9:

1. The need for the proposal,
2. Alternatives as required by NEPA § 102(2)(E),
3. The environmental impacts of your proposed action and the alternatives, and
4. The agencies and persons consulted.

Given the similarities between projects being considered for the Towns of Duck, Kitty Hawk, and Kill Devil Hills, many elements of an EA would serve as regional “baseline information”. This baseline information would be utilized in each of the individual EAs developed for a particular Town’s project. Cost sharing of the development of this “baseline information” is possible. Additional project-specific data and information would also be needed to develop the EA.

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Along with the EA, two additional environmental documents will likely be required to support the NEPA process. The first of these two documents is an Essential Fish Habitat Assessment (EFH). An EFH assessment is utilized by the NMFS to ensure that the project will identify and protect important marine and estuarine fish habitat in accordance with the amended Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). The MSFCMA was enacted by the U.S. Congress to protect marine fish stocks and their habitat, prevent and stop overfishing and minimize bycatch. Congress defined Essential Fish Habitat (EFH) as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." The MSFCMA requires that EFH be identified for all fish species federally managed by the Fishery Management Councils (FMCs) and the NMFS. An EFH assessment evaluates the potential impacts to the various essential fish habitats within the designated Permit Area.

In addition to the EFH assessment, a Biological Assessment (BA) will also likely be required to support the NEPA process. The purpose of the BA is to document potential impacts that may affect federally listed species which will serve to satisfy the USFWS and marine species under the jurisdiction of NMFS. The document is prepared for the Section 7 process to determine whether a proposed major construction activity under the authority of a federal action agency is likely to adversely affect listed species, proposed species, or designated critical habitat. The Town will likely be required to determine whether the project-related actions may affect listed or proposed species as well as designated and proposed critical habitat.

Similar to the development of the EA, cost sharing may be possible for the development of the baseline information required for these two supporting documents (EFH and BA). Unlike the process for developing an EA, which will result in one EA submitted on behalf of each Town pursuing a project, the agencies have suggested that one comprehensive EFH and one comprehensive BA could be submitted to the relevant agencies for their review to cover multiple projects in northern Dare County.

COST ESTIMATES

Design and Permitting Estimates

If the Town of Kitty Hawk decides to proceed with the implementation of a beach nourishment program, the first step will be to formulate the design and obtain permits for the project, often referred to as design and permitting phase. Specific items likely to be included in the design and permitting phase include:

- **Project Management and Coordination**
- **Engineering**
 - Shoreline Change and Volume Change Analysis
 - Storm Damage Vulnerability Analysis
 - Beach Fill Performance Analysis (Numerical Modeling)
 - Beach Fill Design
 - Development of Engineering Report
- **Beach Profile Surveys**

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- **Geotechnical/Geophysical Analysis**
 - Native Beach Sand Analysis
 - Offshore Geophysical Surveys
 - Offshore Hydrographic Surveys
 - Offshore Vibracore Surveys
 - Compatibility Analysis
 - Development of Geotechnical Report
- **Environmental Documentation**
 - Development of EA
 - Development of EFH
 - Development of BA
- **Permit Application Submittal**
 - Develop and Submit CAMA Major Permit Application
 - Develop and Submit DOA Permit Application

Based on similar projects completed in the State of North Carolina, the estimated cost for the design and permitting phase could range between \$550,000 and \$1,120,000. Cost estimates for design and permitting are presented as a range due to the uncertainty associated with the level of offshore geophysical investigations required to characterize the sand source. Likewise, although extensive coordination was conducted with permitting and resource agencies, the ultimate pathway to obtaining a permit will not be fully established until detailed information has been provided and agencies have a chance to provide comments on said information.

Construction Estimates

Preliminary construction cost estimates for beach nourishment were developed for both an erosion mitigation project and storm damage reduction project. Naturally, the cost of a beach nourishment project is highly dependent on the volume of sand placed. The cost estimates provided are based on volume estimates provided herein under the Local Project Alternatives section.

Aside from the volume of sand required for a beach nourishment project, the location of the sand source relative to the fill area also weighs heavily on the cost of a project. The two sources currently identified as potential sand sources for a beach nourishment project at Kitty Hawk are Borrow Area S1, previously identified by the USACE for the Dare County Beaches Project, and Borrow Area “1” located in federal waters offshore of Kitty Hawk (Figure 5). Transporting material from either of these two borrow sites would likely be accomplished by hopper dredges with direct pump-out capability as was the case for portions of the Nags Head project. Since the distance from Borrow Area S1 to Kitty Hawk is greater than the distance from Borrow Area “1”, the unit cost for Borrow Area S1 is greater. An initial unit cost estimate for Borrow Area S1 is approximately \$8.80 per cubic yard while the unit cost estimate for Borrow Area “1” is around \$6.90 per cubic yard.

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The mobilization and demobilization (mob & demob) cost for either borrow area would be essentially the same. These costs include moving the dredge and all of the ancillary equipment including dredge pipe, to and from the project area, setting up and moving pump-out stations approximately every 5,000 to 7,000 feet offshore of the project, and transportation for the dredge and construction crews. Based on recent experience for similar projects, mobilization and demobilization cost were estimated at approximately \$2.95 million.

In addition to services provided by the dredge contractor, there will be pre-construction and construction engineering services required. These services may include items such as pre-construction beach profile surveys, development of construction plans and specifications, assistance with bidding and contractor negotiations, as well as construction observations by the engineer while the project is being constructed. Based on recent projects and the estimated timeframe to complete the projects, pre-construction and construction engineering services are estimated at approximately \$348,000 for the erosion mitigation project and \$485,500 for the storm damage reduction project. The difference in cost is a factor of the time needed to construct each project. Based on the initial volume calculated to construct the erosion mitigation project, approximately 3.5 months may be required for construction; whereas the storm damage reduction project could take up to 6 months to complete. Cost estimates have also been provided for physical and environmental monitoring that may be required during construction such as trawling and turtle monitoring. These costs are dependent on the time needed for construction. Construction monitoring costs for the erosion mitigation and storm damage reduction projects were estimated at \$360,000 and \$610,000, respectively.

Table 1 provides a breakdown of the estimated cost for each type of project. The range of costs vary from approximately \$15.2 Million to \$32.8 Million depending on the type of project and the borrow area location. This includes construction costs, soft costs, and a 15% contingency added to the construction costs.

Environmental Monitoring Estimates

In addition to these costs, there may be pre- and post-construction environmental monitoring required. At this point, it is difficult to determine the type and level of environmental monitoring that could be required. Based on similar projects in North Carolina, including the Nags Head project, monitoring costs could range between \$100,000 and \$500,000.

Summary

The erosion mitigation and storm damage reduction projects presented herein provide a basis for which the Town of Kitty Hawk can gauge potential costs associated with a beach fill project. Permitting and design phase work should not vary with the length of the project or fill density, and is estimated to range between \$550,000 and \$1,120,000. Construction phase costs are highly dependent on the volume of material placed and the location of the borrow area in relation to the fill area. The two beach fill alternatives outlined in this report should be viewed as the lower and upper range of what is likely to ultimately be proposed for the Town of Kitty Hawk. The erosion mitigation project as described, could range between approximately \$15.2 Million and \$18.3 Million. The storm damage reduction project covering the entire Town shoreline, built to the

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Table 1. Estimated Project Cost

Item		Borrow Area “1 ”		Borrow Area S1 (USACE Site)	
		Erosion Mitigation	Storm Damage Reduction	Erosion Mitigation	Storm Damage Reduction
Design and Permitting Costs		\$1,120,000			
Construction Costs	Mob & Demob	\$2,950,000	\$2,950,000	\$2,950,000	\$2,950,000
	Fill Placement	\$9,660,000	\$19,320,000	\$12,320,000	\$24,640,000
	Construction Subtotal	\$12,610,000	\$22,270,000	\$15,270,000	\$27,590,000
	15% Contingency	\$1,892,000	\$3,341,000	\$2,291,000	\$4,139,000
	Construction Total	\$14,502,000	\$25,611,000	\$17,561,000	\$31,729,000
	Pre-Construction and Construction Services	\$348,000	\$485,500	\$348,000	\$485,500
	Physical and Environmental Monitoring	\$360,000	\$610,000	\$360,000	\$610,000
	Construction Phase Total	\$15,210,000	\$26,707,000	\$18,269,000	\$32,825,000
Physical and Environmental Monitoring		\$500,000			
Project Totals		\$16,830,000	\$28,327,000	\$19,889,000	\$34,445,000

1. Design and Permitting costs are estimated to range between \$550,000 and \$1,120,000; however the upper range is used in the table.
2. Fill Placement costs are based on 1,400,000 cy for an erosion mitigation project and 2,800,000 cy for a storm damage reduction project.
3. 15% contingency is applied to mobilization and fill placement costs.
4. Physical and Environmental Monitoring costs are estimated to range between \$100,000 and \$500,000; however the upper range is used in the table.

same dimension as outlined for the federal beach fill project, could range between \$26.7 Million and \$32.8 Million. Construction estimates listed here include pre-construction and construction engineering services, physical and environmental monitoring, as well as a 15% contingency on construction costs. Lastly, environmental monitoring may be required as a condition of the permit for a beach fill project. Based on other recent projects in North Carolina, environmental

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monitoring may range between \$100,000 and \$500,000 for any given beach fill project for the Town of Kitty Hawk.

REGIONAL COORDINATION

Reductions in design and permitting phase, construction phase, and potentially even monitoring phases may be realized if the Town of Kitty Hawk chooses to partner with other local government entities. Specifically, opportunities to partner may exist with the Town of Duck and the Town of Kill Devil Hills. These two municipalities are both moving forward with the design and permitting phase of beach fill projects. Already, these communities have begun coordinating efforts to achieve cost savings through a reconnaissance offshore sand investigation and environmental documentation.

If the Town of Kitty Hawk were to commence the permitting and design phase prior to November 2013, significant cost savings could be realized. As previously discussed, the likely process of environmental documentation for the proposed projects for Duck, Kitty Hawk, and Kill Devil Hills would include an individual EA for each and a comprehensive EFH and BA, which would cover all three projects. The development of the baseline information needed to develop these documents could be cost shared between all three communities resulting in savings to Kitty Hawk between \$25,000 and \$40,000.

A reconnaissance offshore sand investigation is currently being conducted through a contract with the Town of Kill Devil Hills to determine which potential offshore sand resource should be targeted for a detailed investigation to develop borrow areas for the projects in northern Dare County. This survey will likely be cost shared between the Town of Duck and Kill Devil Hills. The Town of Kitty Hawk could request this data from the Town of Kill Devil Hills, which would reduce sand investigation costs even if Kitty Hawk was asked to contribute to the effort in some way. Ultimately, a geophysical and geotechnical survey of the recommended sand resource will be required. There are significant mobilization and demobilization costs associated with conducting offshore geophysical and geotechnical operations. It is reasonable to expect that these costs could be shared. Likewise, depending on the nature of the sand deposit(s) ultimately used for a beach fill project, actual survey efforts could also be cost shared. Cost savings associated with sand source investigations could range from the 10's of thousands of dollars to over \$100,000. In addition to cost sharing with local communities, the Town has also consulted with the BOEM regarding the possibility of receiving in-kind credit for work that the BOEM is looking to conduct as part of a regional reconnaissance survey of offshore sand resources. As part of this study, Mr. Jeff Waldner of the BOEM was consulted as to the likelihood of the Town receiving any in-kind credit. Mr. Waldner suggested that obtaining in-kind credit would be unlikely due to the differences in the overall goals of the two operations (Kitty Hawk offshore sand investigation and BOEM offshore regional sand source investigations). A copy of an e-mail correspondence between Mr. Waldner and CPE-NC is included as Appendix B, which summarizes Mr. Waldner's concerns and recommendations.

Additional cost sharing opportunities may exist through combining beach profile survey operations. Beach profile surveys will be required to verify current erosion rates, assess storm vulnerability, and more accurately determine the volume of sand required to construct a proposed

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project. At this point numerical modeling is not anticipated; however, if resource agencies require such modeling, it is likely that adjacent projects would also require such modeling. In that case, cost efficiencies could be realized by partnering with other communities. Depending on the environmental documentation and ultimately the permits issued for beach fill projects, if environmental monitoring is required, that too may present an additional opportunity for cost sharing.

The most significant potential for savings through cost sharing is associated with the construction phase of a beach project. During project construction, the contractor's mobilization cost could potentially be cost shared. Depending on how the bid package is formulated, this option could create some logistical issues with scheduling but the financial benefit may be worth it. Partnering also increases the size of a potential project and creates more interest in the combined effort. The Town might lose some control over where the contractor begins work in respect to the different sites. However, this may be overcome with proper coordination. The potential to reduce project cost recommends at least consideration of such coordinated efforts.

SCHEDULE

Based on coordination with permitting and resource agencies and experience with similar projects in North Carolina, the following schedule was developed (Figure 6). The schedule includes an anticipated timeline of the engineering and design phase, the pre-construction services phase, and the time at which construction of the project could begin. The schedule assumes that the Town of Kitty Hawk would be in a position to begin the permitting and design phase by mid-September 2013.

The item listed as environmental documentation is the most time consuming aspect of the process. The schedule reflects 16 months to allow for development of the draft EA, BA, and EFH documents, submittal to permitting and other resource agencies for comments, addressing comments, and re-submitting final documents. After submitting a final EA document, it is presumed that the USACE would review the document and ultimately issue a FONSI resulting in the issuance of the Department of Army permit. Simultaneous to the submittal of the final EA, a CAMA Major Permit application will be submitted to the State. Their review and subsequent issuance of the State CAMA Major permit could take up to six months. Concurrently, while environmental documents are being developed, beach profile surveys, engineering analyses, and sand search investigations would be conducted.

Following the submittal of the final EA and other environmental documentation, construction plans and specifications could be developed. This process could take up to 4 months. Final permit conditions will need to be incorporated into the construction plans and specifications documents; however, this can be timed so that the project could be advertised for construction within 30 days following the issuance of permits. The schedule then assumes 30 days to advertise for construction bids and 45 days following to review bids and make final arrangements to award the contract. If any portion of the construction is being financed, the Town will need to seek approval from the Local Government Council (LGC) between the time that bids are received and the time the contract is awarded. Once the contract is awarded, the contractor will need 30 days for mobilization. Based on these assumptions, construction could

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begin as early as December 2015. In order to achieve the most competitive construction bids, the Town may need to provide flexibility to the contractor as to when they construct the project. This may mean that construction does not occur until the spring/summer of 2016.

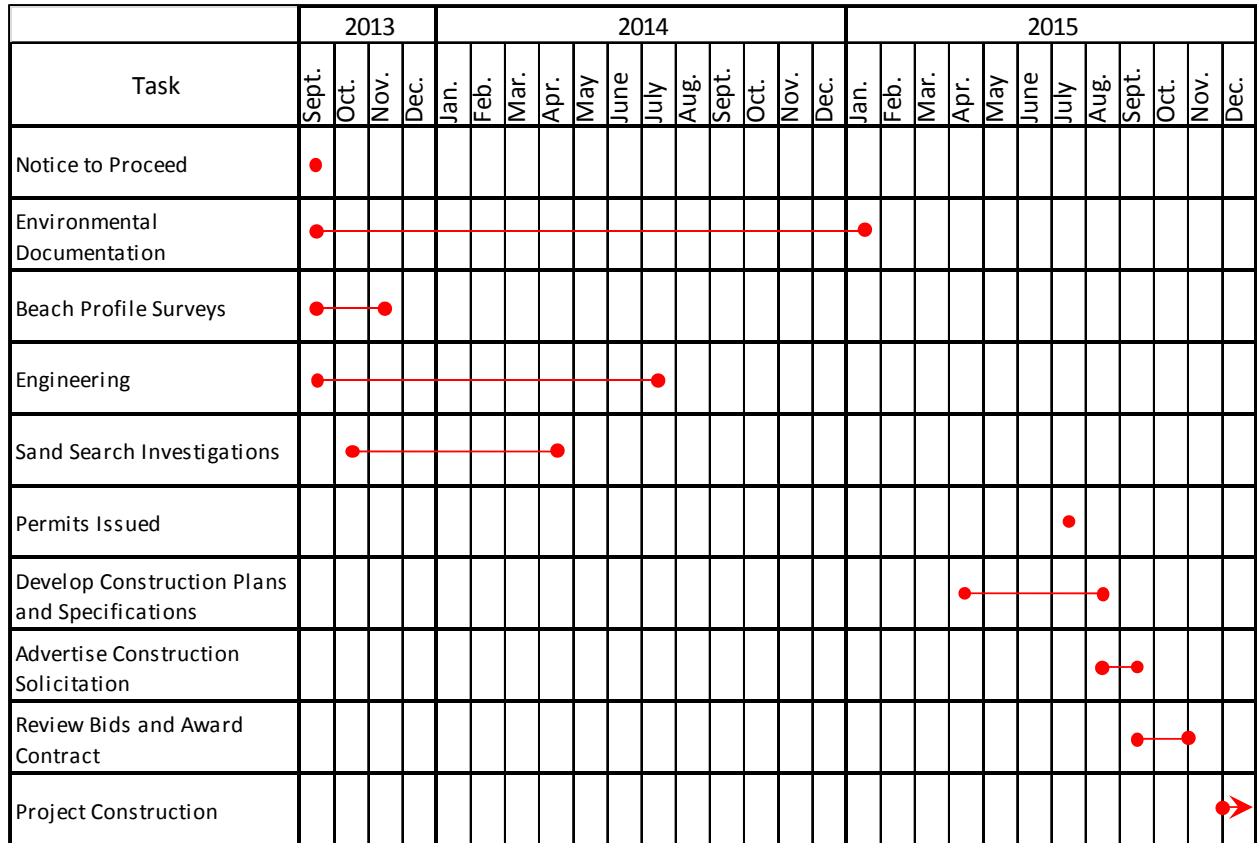


Figure 6. Graphical Schedule for the Implementation of a Beach Nourishment Project at Kitty Hawk.

CONCLUSION

This beach management concept assessment resulted in the following conclusions:

- An initial beach nourishment project constructed along the entire length of the Town of Kitty Hawk may range between 1.4 million cy and 2.8 cy. The upper limit would be in line with the design parameters of the federal project.
- Additional analyses of the current shoreline condition, proximity of development to the shoreline, and storm frequency, should be conducted in order to design a project that can provide the most storm damage reduction at a cost that meets the financial constraints of the Town.
- Based on available data, sand resources do exist in sufficient quantity and quality to support beach nourishment efforts for the Town of Kitty Hawk. However, significant efforts remain to define these sand resources to the extent needed to permit a borrow area.
- The construction of a beach nourishment project along the Town of Kitty Hawk's shoreline using offshore dredged material will require permits from the Department of the

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Army (USACE) in order to satisfy the National Environmental Policy Act (NEPA), and a CAMA Major Permit issued by the State of North Carolina.

- An Environmental Assessment (EA) is likely to be sufficient to satisfy environmental documentation required by NEPA. In addition, it is likely that one comprehensive Essential Fish Habitat (EFH) assessment and one comprehensive Biological Assessment (BA) would satisfy additional environmental documentation requirements.
- Design and permitting services for a beach fill project may range between \$550,000 and \$1,120,000. The lower range reflects the efforts to develop the environmental documentation discussed in the previous bullet and maximum cost-sharing by synchronizing the Town's efforts with similar efforts being undertaken by the Towns of Duck and Kill Devil Hills. The upper limit reflects a change in the environmental documentation requirements and minimal cost sharing.
- An initial beach nourishment project constructed along the entire length of the Town of Kitty Hawk could range in cost between \$15.2 Million and 32.8 Million.
- Environmental monitoring for a beach nourishment project could range between \$100,000 and \$500,000.
- A high potential for cost savings exists through cost-sharing with the Towns of Duck and Kill Devil Hills. Cost sharing for the engineering and design phase could result in savings ranging from \$35,000 to well over \$100,000. Likewise cost sharing associated with the construction phase could exceed \$1,000,000.
- Based on the available information, if the Town was to initiate engineering and design efforts by the middle of September 2013, construction of the beach nourishment could commence any time after December 2015.
- Extensive engineering, geotechnical, geophysical, and environmental analyses are required to further refine the scope, cost, and schedule for a beach nourishment project for the Town of Kitty Hawk.

SUMMARY

The U.S. Army Corps of Engineers (USACE) completed a feasibility report and environmental impact statement on a hurricane protection and beach erosion control project for Dare County beaches in September 2000. The study recommended that as part of the "North Project" a beach fill project be constructed along the southern 8,070 ft. of the Town of Kitty Hawk, which included a 3,000-foot tapered section on the north end. Multiple oceanfront single family homes are located along the portion of the Town not included in the federal project. With well over half of the Town's shoreline not included in the federal project and little hope that the federal project will ever be funded, the Town of Kitty Hawk commissioned this study to determine the feasibility of a locally constructed beach nourishment program.

The purpose for implementing a beach nourishment project at Kitty Hawk is threefold. First, is to reduce the vulnerability of public infrastructure including NC 12, Town roads between NC 12 and U.S. Highway 158, and utilities to storm-induced erosion. Second, is to reduce flooding experienced in many non-oceanfront areas throughout the Town during ocean over wash conditions, including portions of highway NC 12 and U.S. Highway 158. This flooding, which at times can render routes impassable, greatly limits the ability for emergency personnel to

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respond. Third, is to reduce the vulnerability of homes within the Town that front the Atlantic Ocean and are exposed to wave events during nor'easters and other large storm events as well as natural erosional trends.

Constructing a beach fill project that would completely eliminate damage due to coastal storms is not practical. There will always be a risk that a storm greater than the design storm will impact the area. Therefore, given limited financial resources, it is prudent for a community to make a determination as to what level of storm damage reduction it can afford and likewise let property owners know the risks involved in any plan. The most feasible project is usually one that balances financial resources and the risk a community is willing to accept.

Based on initial analysis of the published erosion rates along the Town of Kitty Hawk and the design work conducted by the USACE associated with the federal project, a beach nourishment project constructed along the entire length of the Town of Kitty Hawk may require between 1.4 million and 2.8 million cubic yards of sand. Permitting and design phase work is estimated to range between \$550,000 and \$1,120,000. Construction phase costs are highly dependent on the volume of material placed and the location of the borrow area in relation to the fill area. Two different offshore sand sources have been identified as potential borrow sites. Given the fact that extensive analyses are still required to determine the dimensions of the beach fill project and which sand source will be used initial estimates suggest that the cost for a project constructed along the entire shoreline of Kitty Hawk could range between \$15.2 Million and \$32.8 Million. Based on permitting agency and environmental resource agency responses to similar beach projects in North Carolina permits may require environmental monitoring. Although it is difficult to anticipate the nature and the level of environmental monitoring at this time, monitoring costs associated with a beach fill project for the Town of Kitty Hawk could range between \$100,000 and \$500,000.

If the Town decides to pursue a beach nourishment program, significant savings could be realized through cost-sharing with the Towns of Duck and Kill Devil Hills. Initial estimates suggest that cost sharing for the engineering and design phase could result in savings ranging from \$35,000 to well over \$100,000. In order to maximize savings through cost-sharing the Town must move forward with the engineering and design phase within the next 2 – 4 months in order to synchronize their efforts with those of Duck and Kill Devil Hills. Based on the available information, construction of the beach nourishment project could commence any time after December 2015 if the Town were to initiate engineering and design efforts by the end of September 2013.

Additional savings are possible through combining construction of multiple projects. Initial estimates of potential cost savings associated with the construction phase could exceed \$1,000,000 for the Town of Kitty Hawk. Extensive engineering, geotechnical, geophysical, and environmental analyses are required to further refine the scope, cost, and schedule for a beach nourishment project for the Town of Kitty Hawk.

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