

National Aeronautics and
Space Administration

Final Environmental Assessment

Wallops Island Post-Hurricane Sandy Shoreline Repair

June 2013

In Cooperation with:
Bureau of Ocean Energy Management
U.S. Army Corps of Engineers



Cover images: (from top left down)
Wallops Island in August 2012 following completion of initial beach fill – Photo Credit: Patrick Hendrickson
Beach fill activities adjacent to launch Pad 0-A – Photo Credit: Patrick Hendrickson
Hopper dredge and booster station offshore of Wallops Island – Photo Credit: Patrick Hendrickson
Hurricane Sandy beach damage east of launch Pad 0-A – Photo Credit: Josh Bundick
Beach construction east of launch pad 0-B – Photo Credit: NASA Optics Lab

(front cover, bottom right and back cover)
Hurricane Sandy taken from earth observing satellite – Image Credit: NASA GOES Project

National Aeronautics and
Space Administration

Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337

Reply to Attn of: 250.W June 2013

Dear Reader:

This is the Final Environmental Assessment (FEA) for NASA's proposed Post-Hurricane Sandy Shoreline Repair project at Wallops Flight Facility (WFF), Wallops Island, Virginia.

Prepared in accordance with the National Environmental Policy Act (NEPA), the FEA evaluates the environmental consequences of 1) the repair of the Wallops Island rock seawall; and 2) the placement of approximately 800,000 cubic yards of sand along the southern two-thirds of the Wallops Island shoreline. In addition to the Proposed Action, the FEA evaluates the No Action Alternative.

NASA considered all comments received on the Draft EA (DEA) in preparing the FEA. Comments received on the DEA and NASA's responses to those comments are included as Appendix B.

An electronic version of the FEA is available on the project website at: **http://sites.wff.nasa.gov/code250/Tiered_Shoreline_Renourishment_EA.html**.

The FEA is also available for review at the Eastern Shore Public Library, Accomac, Virginia; the Chincoteague Island Library, Chincoteague Island, Virginia; and the NASA WFF Visitor's Center, Wallops Island, Virginia. A limited number of hard copies of the FEA are available on a first request basis.

Please direct all requests for copies and questions regarding the FEA to Mr. Joshua Bundick of the WFF Environmental Office. He can be reached at one of the following:

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Thank you for your participation in this process!

FINAL ENVIRONMENTAL ASSESSMENT
WALLOPS ISLAND POST-HURRICANE SANDY SHORELINE REPAIR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
WALLOPS FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA 23337

Lead Agency:	National Aeronautics and Space Administration
Cooperating Agencies:	Bureau of Ocean Energy Management U.S. Army Corps of Engineers
Proposed Action:	Wallops Island Post-Hurricane Sandy Shoreline Repair
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Date:	June 2013

ABSTRACT

This Environmental Assessment (EA) addresses the proposed repair of the Wallops Island shoreline owned by the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center's Wallops Flight Facility, located in Accomack County, Virginia. Under the Proposed Action, NASA would fund the placement of up to approximately 800,000 cubic yards of sand dredged from an offshore shoal. Additionally, should funds permit, NASA would repair a portion of its rock seawall. The project would restore the Wallops Island shoreline to its condition prior to Hurricane Sandy, a coastal storm that occurred in late October 2012.

This EA analyzes the potential direct, indirect, and cumulative environmental effects of two alternatives: the Proposed Action and the No Action Alternative. Resources evaluated in detail include coastal processes; water quality; the coastal zone; air quality; noise; benthos; wildlife; finfish and habitat; marine mammals; threatened and endangered species; and cultural resources.

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1 Introduction and Purpose and Need for Action

1.1 Background

The National Aeronautics and Space Administration (NASA) has prepared this Environmental Assessment (EA) to evaluate the potential environmental impacts of its proposed post-Hurricane Sandy shoreline repair project at Wallops Flight Facility (WFF). This EA has been prepared in accordance with the National Environmental Policy Act (NEPA), as amended (Title 42 of the United States Code [U.S.C.] 4321–4347), the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500–1508), NASA's regulations for implementing NEPA (14 CFR Subpart 1216.3), and the *NASA Procedural Requirement (NPR) for Implementing NEPA and Executive Order (EO) 12114* (NPR 8580.1).

On December 13, 2010, NASA issued a *Record of Decision (ROD)*[1] for its *Final Programmatic Environmental Impact Statement Wallops Flight Facility Shoreline Restoration and Infrastructure Protection Program (Final PEIS).*[2] In its *ROD*, NASA selected for implementation Alternative 1, Seawall Extension and Beach Fill, and adopted a suite of mitigation and monitoring protocols to both reduce potential environmental impacts and track project performance.

As identified in the *Final PEIS* and *ROD*, the initial phase of Alternative 1 entailed the placement along the Wallops Island shoreline of approximately 3.2 million cubic yards (CY) of sand dredged from an offshore shoal in the Atlantic Ocean. Additionally, Alternative 1 included an initial 1,415-foot (ft) southerly extension of the Wallops Island rock seawall, with future extensions completed on a funds-available basis to a maximum length of 4,600 ft. Alternative 1 also accounted for an estimated nine beach renourishment cycles at approximately five-year intervals.

Since issuing its *ROD*, NASA and the U.S. Army Corps of Engineers (USACE), Norfolk District, oversaw the initial seawall extension between August 2011 and March 2012, with beach nourishment occurring between April and August 2012. Both during and after completing the initial phase of the project, the agencies have sponsored multiple topographic and hydrographic surveys of the project site. The most recent monitoring effort, conducted in November 2012 following Hurricane Sandy (which made landfall in late October 2012), identified the need to repair the southern two-thirds of the recently nourished beach and a section of the seawall.

Subsequent to NASA identifying this need, Public Law 113-2, *Disaster Relief Appropriations Act, 2013*, was signed into law on January 29, 2013. Within the bill is a provision for NASA to repair its facilities that sustained damages during Hurricane Sandy. Accordingly, NASA has prepared this EA to assist in the decision-making process.

[1] The *ROD* is available online at http://sites.wff.nasa.gov/code250/docs/SRIPP_ROD_SIGNED.pdf.
[2] The *Final PEIS* is available online at http://sites.wff.nasa.gov/code250/final_sripp_peis_document.html.

1.1.1 Relationship to Final PEIS

Both CEQ and NASA NEPA regulations allow for the preparation of NEPA documents for broad actions, such as agency programs and sets of related or similar actions. These NEPA documents are referred to as "programmatic," and are often broad in scope, and may be followed by more site- or action-specific documents as appropriate. This approach, referred to as "tiering," can be compared to a funnel, with the broader, programmatic NEPA document at the top, with the more focused documents below it.

In descending the funnel, the NEPA documents for the individual actions within the interrelated program have a narrower, project-specific focus. The impacts of common issues are addressed in the programmatic EIS, then a series of more narrowly focused individual project-specific EAs or EISs are tiered, addressing project-specific issues. The more narrowly focused EISs and EAs do not repeat the impact analyses of common issues from the broad EIS, rather they summarize those analyses and incorporate them by reference while focusing on the unique project-specific issues at hand.

The *Final PEIS* was prepared as a programmatic document to assess the environmental consequences from a 50-year design life storm damage reduction program at WFF. The document describes an initial beach fill cycle followed by an estimated 9 renourishment cycles to maintain a target level of storm damage reduction. The *Final PEIS* estimates the volume of sand needed for each renourishment cycle and considers multiple material sources, both onshore and offshore, for obtaining beach-quality sand. The document also considers the effects of either repairing or extending the Wallops Island rock seawall south up to a maximum of 4,600 ft from its calendar year 2010 terminus.

Consistent with the NEPA approach outlined for the *Final PEIS*, NASA has prepared this EA as a tiered document focusing specifically on the proposed renourishment and seawall repair. As such, much of the *Final PEIS* is incorporated by reference with new information and analysis provided as appropriate.

1.1.2 Cooperating Agencies

NASA, as the WFF property owner and project proponent, is the Lead Agency in preparing this EA. The U.S. Department of the Interior's Bureau of Ocean Energy Management (BOEM) and the USACE have served as Cooperating Agencies because they each possess both regulatory authority and specialized expertise regarding the Proposed Action.

NASA would require authorizations from both the BOEM and the USACE to undertake the proposed project. The BOEM has jurisdiction over mineral resources on the Federal Outer Continental Shelf (OCS). A Memorandum of Agreement (MOA) pursuant to section 8(k)(2)(d) of the OCS Lands Act, 43 U.S.C. § 1337(k)(2), would be negotiated among BOEM, USACE, and NASA to allow the dredging of sand from the OCS.

Under Section 404 of the Clean Water Act (CWA), the USACE Regulatory Program has jurisdiction over the disposal of dredged and fill material in waters of the U.S. Similarly, under Section 10 of the Rivers and Harbors of Act of 1899 (RHA), the USACE has jurisdiction over the placement of structures and work conducted in navigable waters of the U.S. Finally, in addition to its regulatory role in the project, the USACE Norfolk District is overseeing project design, construction, and monitoring on NASA’s behalf.

1.2 Hurricane Sandy

1.2.1 Overall Storm Description

Hurricane Sandy began as Tropical Depression 18 and reached hurricane strength on Oct. 23, 2012. Though it behaved much like a tropical cyclone while in the lower latitudes, as the storm moved northward, it merged with a weather system arriving from the west and transitioned into an extra-tropical cyclone.

In contrast to tropical cyclones, which draw their energy from warm ocean waters, extra-tropical cyclones are driven by sharp temperature contrasts between masses of warm and cool air. A key result of this difference is that when tropical cyclones become extra-tropical, their wind and cloud fields expand dramatically. Their strongest winds generally weaken during this process, but occasionally a storm retains hurricane force winds, as was the case with Sandy.

As Hurricane Sandy arrived in the mid-Atlantic region, it became wedged between a stationary cold front over the Appalachians and a static high-pressure air mass over maritime Canada. The air masses blocked the storm from moving north or east, as would normally occur. Instead, this interaction amplified Sandy and drove it ashore. As it moved ashore, Sandy became a very strong Nor’easter, causing substantial damage to areas of the northeast U.S., particularly coastal New Jersey and New York on the evening of October 29. By the early morning hours of Wednesday, October 31, Sandy had weakened to an area of low pressure over western Pennsylvania.

1.2.2 Conditions Experienced at WFF

By the afternoon of Sunday, October 28, Sandy was a marginal Category 1 hurricane several hundred miles east of Cape Hatteras, North Carolina. Winds at WFF steadily intensified during the afternoon and evening hours on Sunday, gusting up to tropical storm force levels (39 miles per hour [mph]). On the morning of Monday, October 29, winds continued to increase, frequently gusting in the mid-40s (mph). The highest winds were experienced during the late afternoon on October 29, with a maximum recorded wind gust of 68 mph occurring at 4:52 p.m. Winds remained strong during the evening and slowly subsided during the overnight hours into Tuesday morning. Total rainfall at WFF was measured was just under 8.5 inches (in) with most of the rain (more than 6.5 in) occurring on October 29.

Though WFF does not have its own tide station, the storm surge experienced during Sandy can be estimated from the tidal station at Wachapreague, Virginia, approximately 20 mi to the south. During the high tide cycle on the morning of Monday, October 29, the storm surge at Wachapreague reached nearly 4 ft above normal, which also corresponds to the general time when Wallops Island experienced its highest water levels of about the same magnitude. During the previous low tide cycle (early morning of October 29), the area experienced its largest surge of nearly 5 ft. However, given the point in the tidal cycle, overall water levels were not as high as later that day.

In comparison to other recent storms, the conditions (e.g., winds, storm surge) experienced at WFF were comparable to those during Hurricane Irene in August 2011. Figure 1-1 depicts the extent of damage reduction afforded by the recently constructed beach. Both photographs were taken from the same vantage point (mid-Island) at approximately 1 hour before high tide.

Figure 1-1: Wallops Island during Hurricanes Sandy (top) and Irene (bottom)

1.3 Purpose and Need for the Proposed Action

1.3.1 Purpose

The purpose of NASA's Proposed Action is to restore the Wallops Island shoreline to its pre-Hurricane Sandy condition.

1.3.2 Need

The Proposed Action is needed because the existing beach cannot provide the level of storm damage reduction for which it was originally designed. Although the Wallops Island beach served its intended purpose of reducing damage to the Island's infrastructure during the storm, it was at its own expense (Figures 1-2 and 1-3). A substantial volume of sub-aerial (above water) sand was relocated to sub-aqueous (under water) areas, especially in the cross-shore direction (Figure 1-4).

Based upon post-storm assessments of the beach, it is evident that the area which sustained the greatest damage is the southern two-thirds of the recently nourished beach, behind which are located some of NASA and the Commonwealth of Virginia's most critical launch assets, including Launch Complex 0 and multiple sounding rocket pads. Of particular concern is the fact that the seaward half of the dune has been lost in most places and the beach berm has been lowered by at least several feet (also shown in Figure 1-4). Although it can be expected that some of the sand moved offshore will eventually move back into the intertidal zone on the beach, those areas of highest elevation (i.e., dune and berm) would require renourishment to regain their full functionality.

The rock seawall on Wallops Island sustained minimal damage during Hurricane Sandy with the exception of the revetment east of camera stand Z-100 at the southernmost terminus of the project site. While the structure likely afforded some damage reduction to the infrastructure behind it, due to its less-robust design (which pre-dated the design described in King et al. [2011] and the *Final PEIS),* the structure was notably damaged (Figure 1-3).

1.3.3 Cooperating Agency Purpose and Need

The BOEM and the USACE, as cooperating Federal agencies, would each undertake a "connected action" (40 CFR 1508.25) that is related to, but unique from NASA's proposed action, the funding of the project. The purpose of BOEM's proposed action is to consider NASA's request for the use of OCS sand resources in renourishing the Wallops Island beach.

The purpose of USACE's proposed action is to consider NASA's request for authorization to: 1) discharge fill material into waters of the U.S. under Section 404 of the CWA; and 2) conduct work in navigable waters of the U.S. under Section 10 of the RHA.

The BOEM and USACE proposed actions are needed to fulfill each agency's jurisdictional responsibilities under the OCS Lands Act and the CWA and RHA, respectively.

Figure 1-2: Hurricane Sandy Beach Damage on South Wallops Island, Looking South

Figure 1-3: Hurricane Sandy Seawall Damage at Z-100 Camera Stand, Looking North

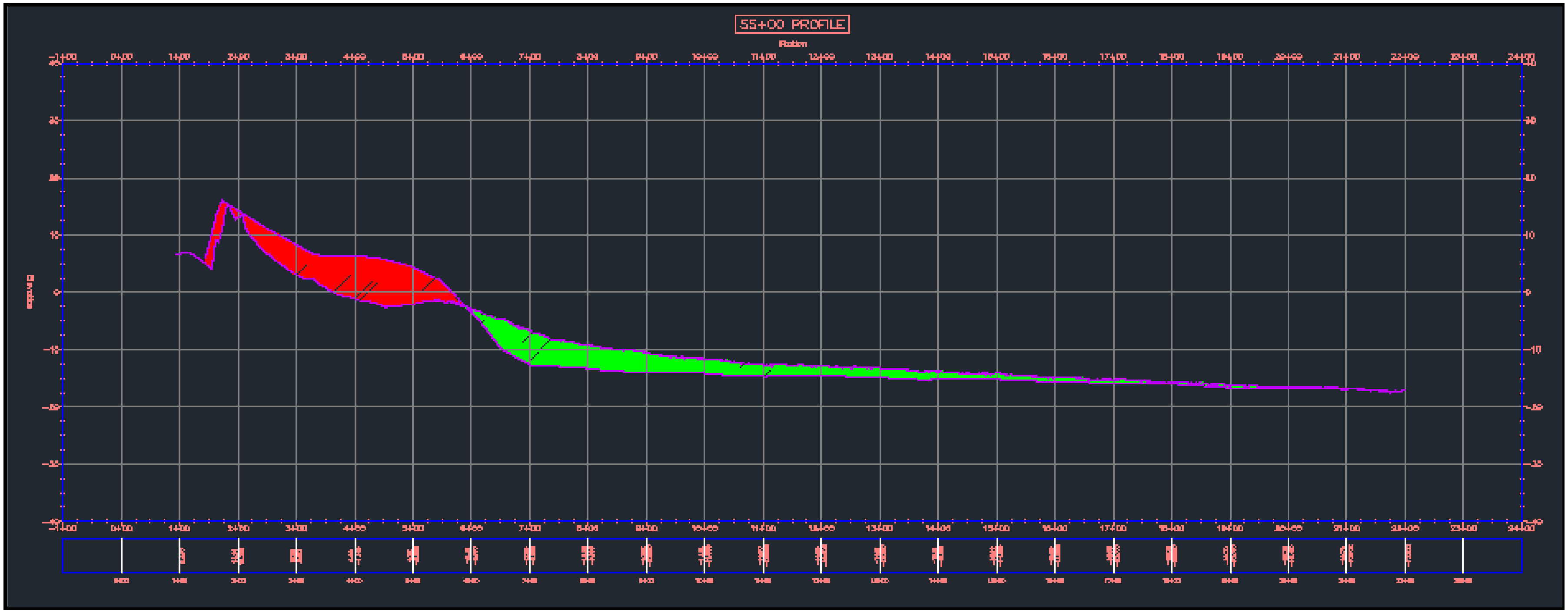

Figure 1-4: Cross Section Showing Hurricane Sandy-Induced Shoreline Change at Pad 0-A

Red shading indicates erosion; green shading indicates deposition

1.4 Changes Between Draft and Final EA

Based upon comments received on the Draft EA, consultations with resource agencies, and its own internal review, NASA made the following substantive changes to the document which are reflected in this Final EA:

- A discussion of a proposed modification to the beach berm elevation has been added to Sections 2.3.3, 3.1.2.3, and 3.1.3.3;
- A summary of the Coastal Zone Management Act consultation has been added to Section 3.1.3.3;
- A summary of the Essential Fish Habitat consultation has been added to Section 3.2.3.3;
- A discussion of seabeach amaranth has been added to Section 3.2.5;
- A reasonably foreseeable future action, the U.S. Navy powder gun and railgun project, has been added to the cumulative effects analysis in Section 3.4.2.4;
- Correspondence with resource agencies has been added to Appendix A; and
- Comments received on the Draft EA and NASA's responses to those comments have been included as Appendix B.

2 Proposed Action and Alternatives

2.1 Introduction

This section provides a discussion of the alternatives under consideration for the repair of the Wallops Island shoreline. The *Final PEIS* considered in detail a range of potential storm damage reduction alternatives, including structural and non-structural options, varying beach berm widths, and multiple sources of fill material. Based upon a combination of economic, engineering, and environmental factors, in its *ROD* NASA selected for implementation the alternative (Alternative 1) that would best meet its needs. Therefore, the focus of this EA is returning the Wallops Island shoreline to the condition described and analyzed for Alternative 1 in the *Final PEIS*. Accordingly, the No Action Alternative and the Proposed Action are evaluated in this EA.

2.2 No Action Alternative

CEQ regulations require that an agency "include the alternative of no action" as one of the alternatives it considers (40 CFR 1502.14[d]). The No Action Alternative serves as a baseline against which the impacts of the Proposed Action are compared. Under the No Action Alternative for this EA, NASA would not renourish the Wallops Island beach or repair the rock seawall to return them to their pre-Hurricane Sandy condition.

2.3 Proposed Action

Consistent with the renourishment component of Alternative 1 described in detail in the *Final PEIS*, NASA's Proposed Action is to dredge sand from an offshore shoal and place it within the area of the Wallops Island beach that sustained the greatest level of storm damage (Figure 2-1). The subject area is generally defined as the 2.3 miles of shoreline starting at the Z-100 camera stand at the south and ending north of the Horizontal Integration Facility (HIF) located mid-Island (Figure 2-2). Additionally, although beach fill is the primary impetus for the project, should funds be available, NASA would also repair its existing rock seawall at the south end of the project site (also shown in Figures 2-1 and 2-2).

2.3.1 Seawall Repair

Consistent with the description in the *Final PEIS*, seawall repair would occur prior to beach nourishment such that the fill material could be used to cover the rock structure. Based upon experience gained during the initial seawall extension, it is expected that some rock could be "recycled" from the existing structure with other materials hauled to Wallops Island from an off-site location, staged at a nearby upland site on WFF property, and then moved from the stockpile to the placement site by dump trucks. At the placement site, one or more excavators would have already moved the existing dune and rock material to a nearby stockpile and excavated additional material from below grade to install "marine mattresses" as a base (Figure 2-3). These same excavators would also position all rocks into place.

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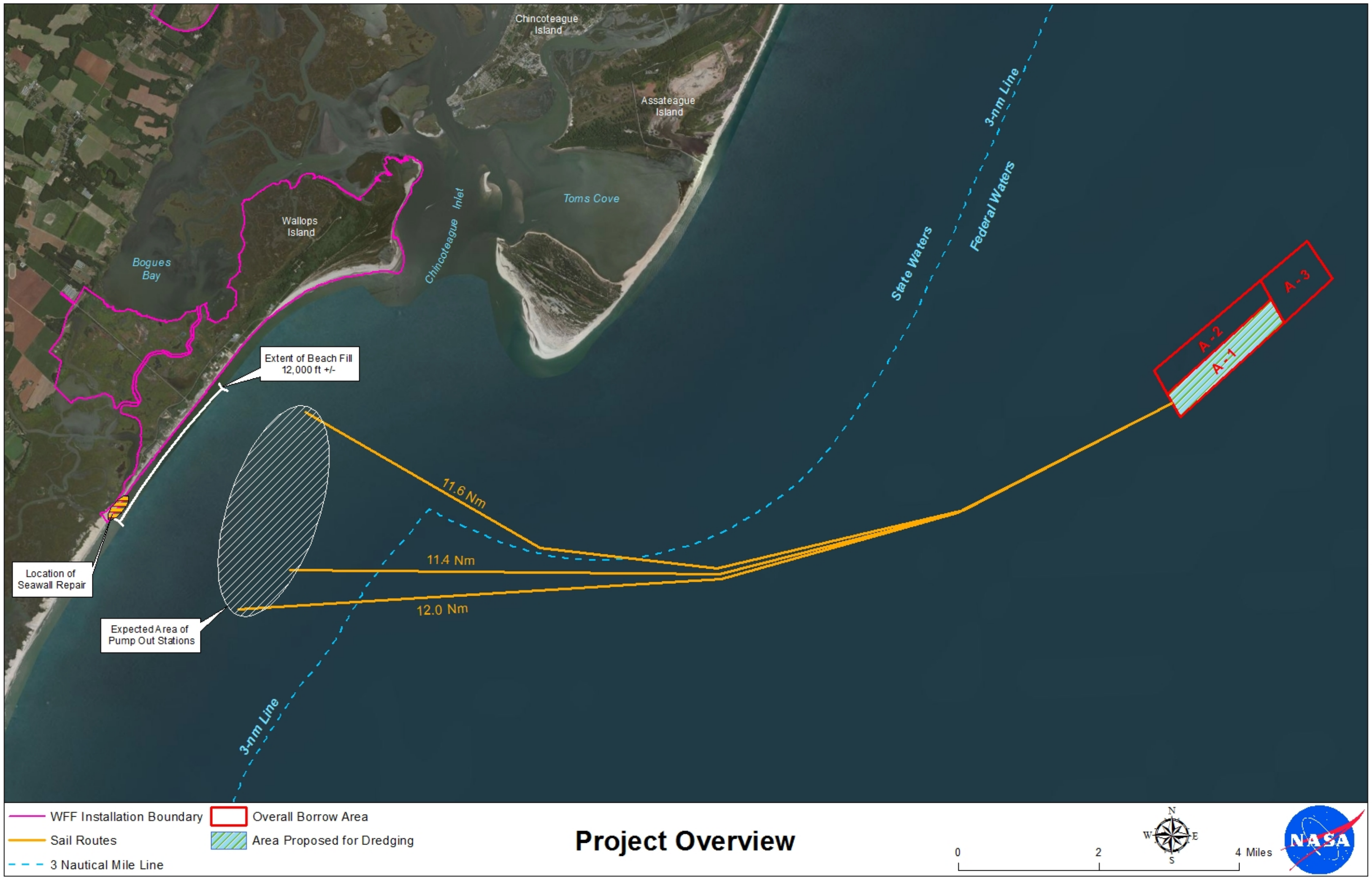

Figure 2-1: Project Overview Showing Borrow Area, Transit Routes, Pump out Areas, Beach Fill, and Seawall Repair

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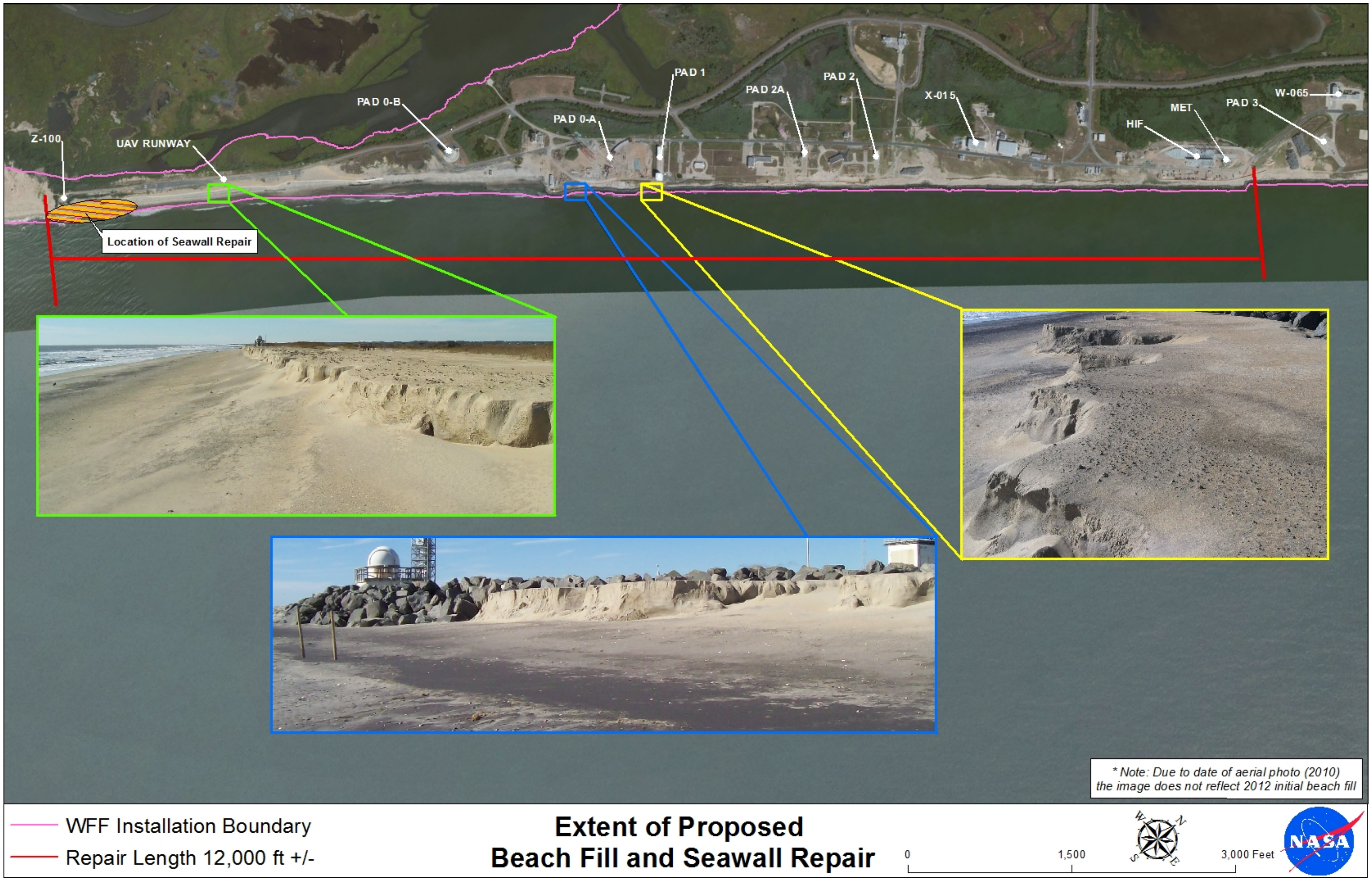

Figure 2-2: General Extent of Proposed Repairs

Figure 2-3: Installation of Marine Mattresses

Because the actual extent of seawall repair would be based upon available funds, the exact length is not known at this time. However, to provide perspective, it is expected that the actual linear distance would be on the order of hundreds of feet, and would remain within the maximum 4,600-ft maximum distance and footprint described in the *Final PEIS.*

2.3.2 Beach Fill Mobilization

The first phase of the beach fill portion of the project would focus on the dredge contractor transporting equipment and materials to the project site, with the assembly of the offshore equipment requiring the greatest amount of lead-time. Offshore equipment would include at least several miles of discharge pipe, multiple barges, tugboats, derricks, and smaller crew transportation vessels (Figure 2-4). Based upon experience gained during the initial beach fill cycle, it is expected that the discharge lines would be assembled inside the protected waters of Chincoteague Inlet, then "rafted" together, and floated to their ultimate placement site as weather conditions allow. Onshore, it is expected that sections of the discharge lines would be trucked in, staged, and placed using a front-end loader or crane (Figure 2-5). Other onshore support equipment would likely be trucked in and would include multiple bulldozers, several all-terrain vehicles (ATVs), an office trailer, mobile generators, construction site lighting, and mobile fuel tanks.

Another important component of the mobilization phase is the performance of pre-project topographic and hydrographic surveys. Offshore, the dredge contractor would employ vessels to survey the borrow area, the nearshore zone within which dredge pumpout equipment would be placed, and the shallower areas of proposed transit routes. Onshore, multiple survey crews would employ ATVs and light trucks to conduct pre-project surveys of the project site.

Figure 2-4: Offshore Equipment Including Derrick, Tugs, and Barges

Figure 2-5: Onshore Equipment Staging Area

2.3.3 Dredging and Sand Placement

Upon receipt of all necessary authorizations, the USACE (on NASA's behalf) would contract the placement of up to 800,000 CY of sand dredged from the same borrow area (Unnamed Shoal A, sub-area A-1) that was the source of material for the initial beach fill. Given the distance of the borrow area from Wallops Island (12 nautical mi +/- each way), it is expected that the contractor would again use one or more trailing suction hopper dredges to obtain the material (Figure 2-6).

The dredging process would be cyclic in nature, with the vessel transiting to the borrow area, lowering its dragarms, filling its hopper, and returning to a predetermined discharge site. At the discharge site, the dredge would connect to the floating end of the submerged line to pump the material onto the beach. Once the hopper has discharged its entire load, the dredge would return to the borrow area to remove more material.

Because of overflow from the hopper dredge at the borrow area during dredging and losses during discharge and placement, a larger volume of material would need to be dredged to meet the targeted fill volume. Based on information from other shoreline restoration projects, sediment losses during dredging and placement operations may be up to 25 percent. Assuming a conservative 25 percent loss, the dredged volume for the proposed renourishment would be approximately 1,000,000 CY.

Figure 2-6: Trailing Suction Hopper Dredge with Dragarms Raised

Similar to the initial fill cycle, dredging would be conducted in a manner generally consistent with the recommendations of two publications examining the effects of dredging of offshore shoals in the mid-Atlantic (CSA International, Inc. et al. 2009 and Dibajnia and Nairn 2011).

More specifically, NASA would:

- Target Shoal A sub-area A-1 (an accretional area) for beach fill material. Shoal A sub-area A-2 would only be used during off-nominal conditions (e.g., discovery of incompatible material, ordnance, archaeological resource, etc.);
- Dredge over a large area and not create deep pits;
- Require that cut depth not be excessive at approximately 7-10 ft; and
- Require that dredging not occur over the entire length of the shoal.

Nearshore, it is expected that the contractor would employ one or more anchored pumpout stations approximately 2 miles east of Wallops Island in 25-30 ft of water. Up to several miles of submerged steel pipeline would be temporarily placed on the seafloor and would be the conduit through which the sand/water slurry would be pumped from the dredge to the beach.

As the sand slurry is discharged onto the shoreline, bulldozers would grade the material (Figure 2-7) to the desired design template (Figure 2-8), which is proposed to include an additional foot of berm elevation (raised from +6 ft to +7 ft [referencing North American Vertical Datum of 1988]) as compared to the initial beach fill. The purpose of this design change would be to provide an additional buffer during storm conditions.

The time in the tidal cycle would factor into the location on the beach within which the equipment would work for a given dredge load. During low tide, the equipment would likely concentrate on the intertidal and subtidal zones, whereas during high tide, work would be focused on the upper beach berm and dune. After each section of beach is confirmed to meet design criteria, the process would continue in the longshore direction, with sections of discharge pipe added as it progresses.

Figure 2-7: Bulldozers Grading Newly Discharged Sand

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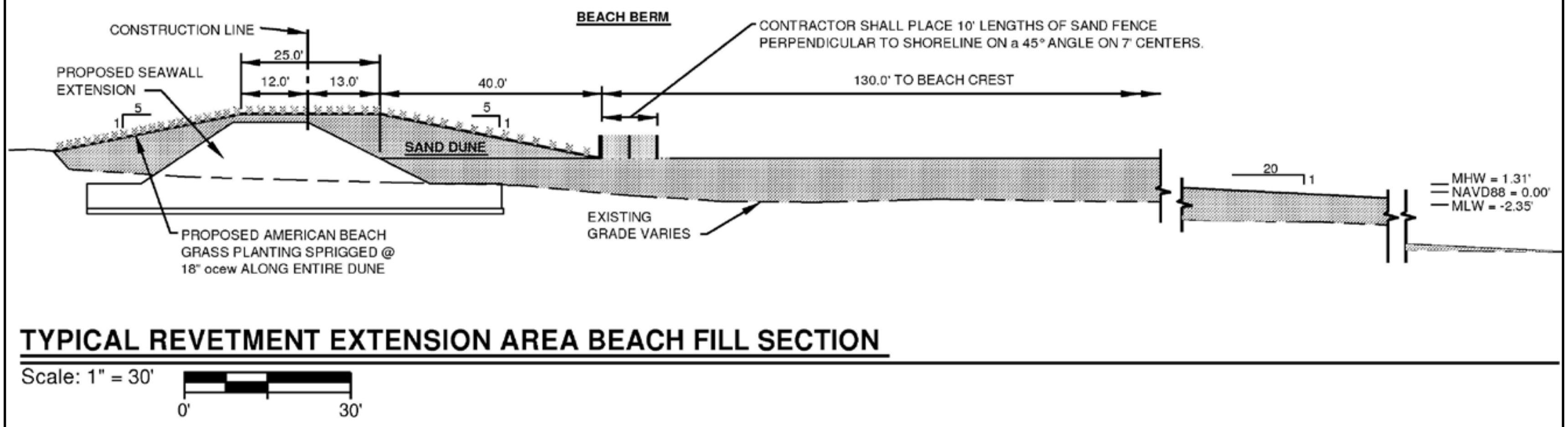

Figure 2-8: Typical Renourishment Design Template

Once the work is completed to its maximum distance in one direction, the onshore piping would be disassembled and relocated, and the work would move in the opposite direction employing the same technique. Once both directions have been completed, it is possible that the discharge line and pumpout station would be relocated along the beach to continue the work. Alternately, another dedicated discharge line and pumpout would already have been set up to be utilized immediately by the dredges to minimize down time. Similar to the mobilization phase, topographic and hydrographic surveys of the project site would continue to determine when project design requirements have been met.

It is expected that the dredging and beach fill work would take between 1.5-3 months to complete with actual duration driven by the number of hopper dredges the contractor would allocate to the project. The timing of the work would be dependent upon contractor availability, and therefore for the purposes of this EA, it should be assumed that the project could be conducted at any time of year between fall 2013 and summer 2014.

Due to the potential for avian and sea turtle use of the beach during the proposed project, if work were to be conducted between the months of April and September, NASA would ensure that the work site and adjacent areas are surveyed for nesting activity by a biological monitor on a daily basis. Survey protocols would be the same as those developed for the initial beach fill and seawall extension (NASA 2011a). The biological monitor would coordinate directly with onsite project employees to ensure that all parties are made aware of potential nesting status and any need to suspend or relocate work activities until nesting activities have ceased.

2.3.4 Post-Dredging Activities

At the conclusion of dredging and beach fill, the construction contractor would begin the demobilization phase of the project, the largest task of which would be the disassembly, staging, and loading of discharge piping for transport offsite. Additional remaining activities would include installation of sand fencing and planting dune grasses (Figure 2-9). It is NASA's intent to re-use as much of the existing sand fencing as possible. Therefore, the proposed project would include removing the existing sand fencing, stockpiling it until the beach fill is complete, and then re-installing it as needed. It is expected that a majority of the existing dune grass within the work site would be covered with sand, therefore requiring re-planting.

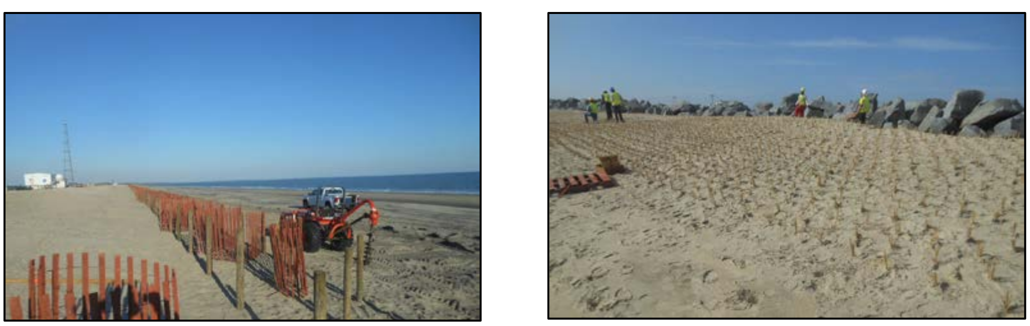

Figure 2-9: Installing Sand Fencing (left) and Planting Dune Grasses (right)

As described in detail in the *Final PEIS*, NASA and USACE would also resume the regular beach profile monitoring of the project site and immediately adjacent properties (i.e., Assateague Island, Assawoman Island) once beach fill activities have ceased.

2.3.5 Consideration of Sea Level Rise

Based upon the analysis presented in King et al. (2011), each renourishment cycle would include an additional volume of fill to compensate for sea level rise (SLR), estimated at project initiation to be approximately 11 mm per year based upon 85 percent of Curve 3 from NRC (1987) as adapted by Knuuti (2002). While SLR does not demonstrate linear growth, assuming a generally fixed increase can ease planning for future renourishment cycles. For example, in earlier years of the project (such as this proposed renourishment), the volume would outpace SLR, while in later years the volume would at least equal the expected SLR at year 50. In recognition of the variability in actual SLR rates over time, the volume can be adjusted accordingly in the future.

Since completing the *Final PEIS*, NASA has prepared additional estimates of climate change (and resultant sea level rise) for the WFF area using different methods (described in Horton et al. [2011]) than those employed by King et al. (2011). Based on local sea level records, scientists from NASA's Goddard Institute for Space Studies (GISS) developed two sets of SLR projections for WFF. The first, shown in light blue in Figure 2-10 below, regionalized the methods employed by the International Panel on Climate Change (IPCC) in 2007, relying heavily on Global Climate Models (GCMs). Because the models employed in the IPCC 2007-based approach may not fully capture land-based ice melt, a second rapid ice-melt (RIM) scenario (shown in darker blue) was also developed. Figure 2-10 indicates that the SLR estimates for WFF developed by King et al. (2011) are generally consistent with those prepared by GISS, ranging from approximately the 50th percentile of the RIM scenario earlier in the project, and ending at approximately the 25th percentile of RIM at year 50.

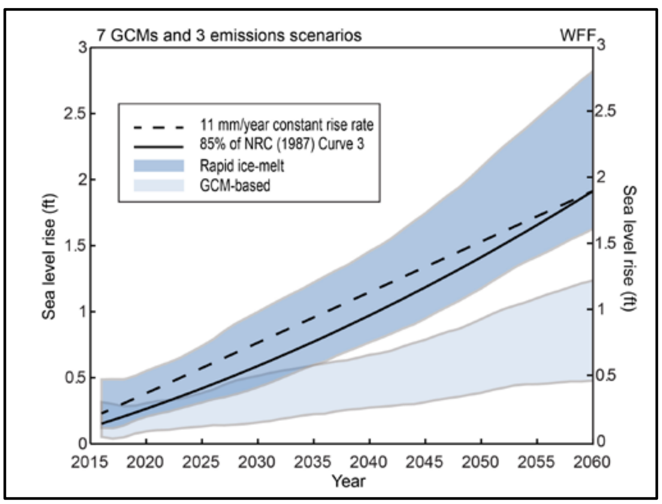

Figure 2-10: Comparison of SLR Estimates from King et al. (2011) (dashed black line) and GISS (2012) (blue shading)

It should be noted that the main usefulness of the SLR planning estimate initially developed for this project is to provide one of the component values needed to calculate the total volume of beach nourishment material needed over the project lifetime. It is not intended that this value actually be used at the time each renourishment occurs. Rather, the volumes needed at renourishment would be primarily based upon an analysis of the data collected from the on-site project monitoring program.

2.4 Summary of Proposed Action

In summary, with the exception of a shortened time (i.e., 2 years +/-) between initial fill and the first renourishment cycle, the Proposed Action is essentially equivalent to both the seawall extension/repair component and the renourishment component described in the *Final PEIS*, which estimated that approximately 806,000 CY of material would be needed approximately every 5 years.

The table below provides a summary of key information regarding the Proposed Action.

Table 2-1: Summary of Proposed Action

Key Information Regarding Proposed Action	
Cubic Yards of Material Placed	700,000 – 800,000
Cubic Yards of Material Dredged[1]	875,000 – 1,000,000
Mobilization Duration	30 - 45 days
Dredging and Beach Fill Duration	1.5 - 3 months
Demobilization and Post-Fill Activities	2 – 3 months
Source of Beach Fill Material	Unnamed Shoal A; Sub-Area A-1

[1]Assumes 25 percent difference between dredged volume and placed volume

3 Affected Environment and Environmental Consequences

NEPA requires a focused analysis of the resources potentially affected by an action or alternative. The results of the analysis should be presented in a comparative fashion that allows decision makers and the public to differentiate among the alternatives.

CEQ regulations for implementing NEPA also require the discussion of impacts in proportion to their significance, with only enough discussion of non-significant issues to show why more study is not warranted. The analysis in this EA considers the current conditions of the affected environment and compares those to conditions that might occur should NASA implement either of the alternatives.

Affected Environment

The affected environment for this EA includes the Wallops Island beach, the nearshore zone within which project related activities (i.e., dredge discharge) would occur, and the offshore shoal identified as the source of beach fill material.

Given that there is a complete description of all project-related resource areas in the 2010 *Final PEIS*, only those environmental resources that have measurably changed or would be notably affected are discussed in this EA; otherwise they are incorporated by reference.

Resources Carried Forward for Detailed Analysis

Table 3-1 presents the results of the process of identifying resources to be analyzed in this EA. The general organization of resource areas is consistent with the *Final PEIS*, however some have been grouped and/or renamed for clarity. For example, while the *Final PEIS* identified three separate resource areas of *Bathymetry, Geology and Geomorphology*, and *Physical Oceanography and Coastal Processes*, this EA combines them into a single resource entitled *Coastal Geology and Processes*.

Resources Considered but Eliminated from Detailed Analysis

Numerous resources were considered in the *Final PEIS*, but warrant no further examination in this EA because the *Final PEIS* concluded they would be negligibly affected. Those resources not warranting further discussion are also presented in Table 3-1.

Table 3-1: Resources Considered for Analysis in this EA

Resource	Analyzed in Detail in this EA?	If *Yes*, EA Section If *No*, Rationale for Elimination
Physical Environment: Section 3.1		
Coastal Geology & Processes	Yes	Section 3.1.1
Water Quality	Yes	Section 3.1.2
Floodplains	No	Negligible impacts identified in *Final PEIS*
Coastal Zone Management	Yes	Section 3.1.3
Air Quality & Climate Change	Yes	Section 3.1.4
Noise	Yes	Section 3.1.5
Hazardous Materials & Waste	No	Negligible impacts identified in *Final PEIS*
Biological Environment: Section 3.2		
Vegetation	No	Negligible impacts identified in *Final PEIS*
Benthos	Yes	Section 3.2.1
Wildlife	Yes	Section 3.2.2
Plankton	No	Negligible impacts identified in *Final PEIS*
Invertebrate Nekton	No	Negligible impacts identified in *Final PEIS*
Fisheries & Essential Fish Habitat	Yes	3.2.3
Marine Mammals	Yes	3.2.4
Threatened & Endangered Species	Yes	3.2.5
Social Environment: Section 3.3		
Land Use	No	Negligible impacts identified in *Final PEIS*
Infrastructure & Facilities	No	Negligible impacts identified in *Final PEIS*
Recreation	No	Negligible impacts identified in *Final PEIS*
Fisheries	No	Negligible impacts identified in *Final PEIS*
Population & Employment	No	Negligible impacts identified in *Final PEIS*
Health & Safety	No	Negligible impacts identified in *Final PEIS*
Environmental Justice	No	Negligible impacts identified in *Final PEIS*
Cultural Resources	Yes	Section 3.3.1

3.1 Physical Environment

3.1.1 Coastal Geology and Processes

3.1.1.1 Affected Environment

Sections 3.1.4 and 3.1.5 of the *Final PEIS* describe in detail the coastal processes influencing the project area. This section provides both a summary and updated information obtained since the *Final PEIS*.

Onshore and Nearshore

Wallops Island is one of the twelve Virginia barrier islands fronting the Atlantic Ocean. Though it displays generally similar morphologic features as neighboring islands shaped by mixed-energy conditions (i.e., sedimentary processes driven by the interplay of waves and tide), localized processes occurring over both the short- and long-term have led to Wallops Island being distinct from others in the Virginia barrier island chain.

In general, the net sediment transport along the Virginia barrier islands is from north to south. However, along much of Wallops Island, the direction of net longshore sediment transport is toward the north, due in most part to the growth (and resulting wave sheltering effects) of Fishing Point at the south end of Assateaugue Island (King et al. 2011). In addition to the northerly sediment transport, the westward drift of Chincoteague Inlet ebb shoals in the cross-shore direction is contributing to the rapid growth of north Wallops Island. This sediment accumulation is changing the existing north-south shoreline orientation to one that is much more east-west.

Of the Virginia barrier islands, Wallops Island is the only one that has been nourished. With the exception of Federally sponsored recreational beach parking area repairs on south Assateague Island, the others are managed for conservation purposes and are driven by natural forces. Prior to the initial beach nourishment in the spring and summer of 2012, sediment samples collected on Wallops Island in 2007 and 2009 indicated native median grain sizes ranging from approximately 0.18 millimeter (mm) to 0.27 mm, corresponding to fine sand per the American Society for Testing and Materials (ASTM) unified classification system.

Samples collected during the initial beach fill indicate that the sediment within the nourished portion of the beach is coarser, with median grain sizes between approximately 0.28 mm and 0.54 mm, corresponding to fine to medium sand per ASTM. With the recent introduction of the coarser material, the intertidal and subaqueous portions of the Wallops Island shoreface are now steeper than they were pre-nourishment, especially in the area between 300-600 ft offshore of the rock seawall. However, due to the effects of Hurricane Sandy, the shoreface is now more gently sloped that it was immediately post-nourishment (Figure 3-1).

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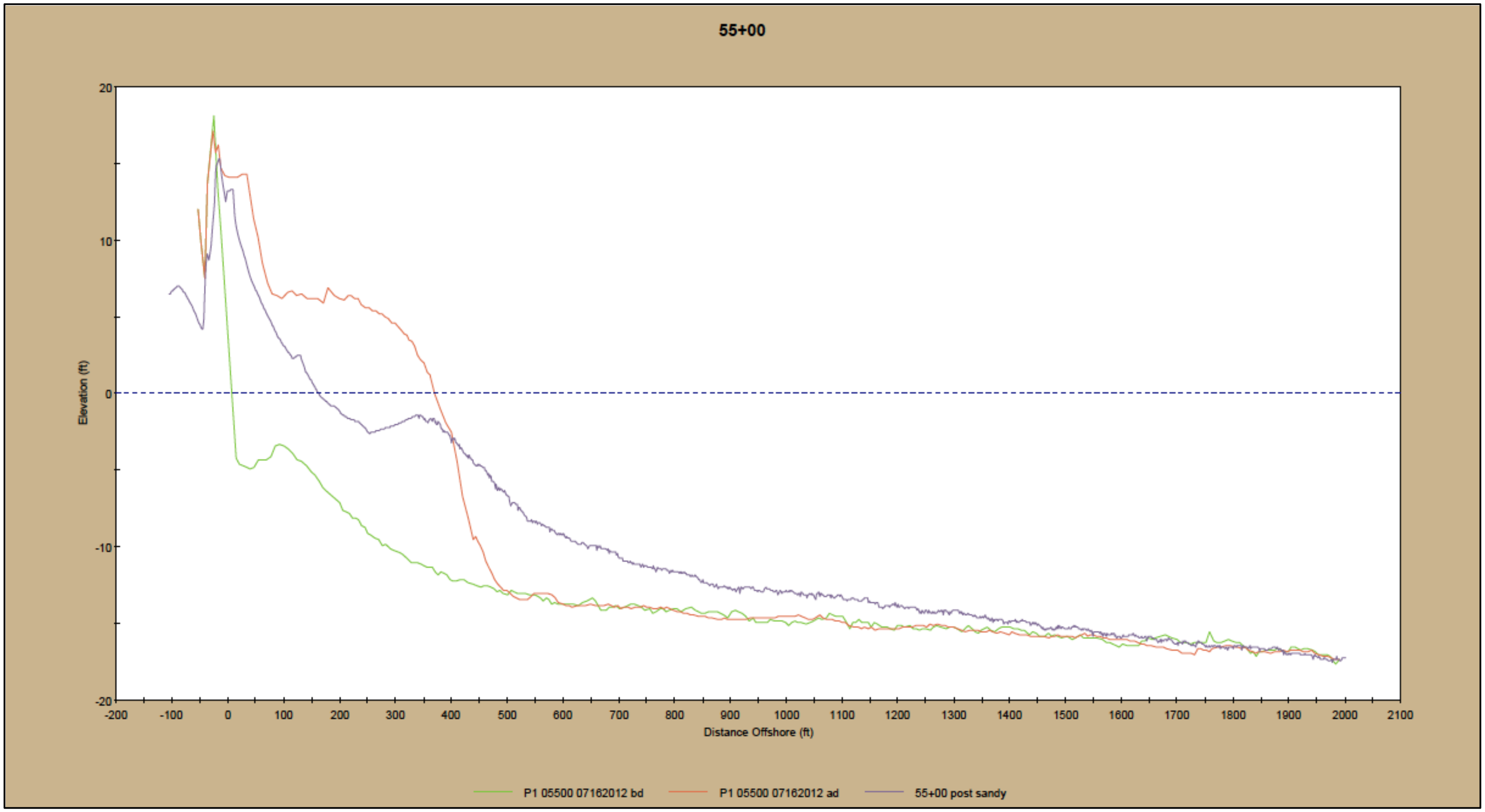

Figure 3-1: Beach Profile Changes at Pad 0-A; Vertical Exaggeration Approximately 28:1

Green line is before initial fill; brown line is after initial fill; purple line is Post-Sandy

Offshore

Unnamed Shoal A is an unvegetated offshore sand ridge located at the southern end of the Assateague ridge field. Of its approximately 1,800 acre (ac) surface area, up to approximately 515 ac of the shoal (sub-area A-1) were recently dredged for the initial beach fill cycle (Figure 3-2). In summary, the majority of the borrow area experienced changes in shoal elevation of less than 6 ft, and the material was removed in a generally uniform manner. As shown in Figure 3-3, the dredged area of the shoal now contains steeper, more pronounced areas of micro-topography than the relatively gently sloped area found prior to dredging.

A study by Dibajnia and Nairn (2011) identified 181 shoals between Delaware and Chesapeake Bays that were between the 33 ft and 130 ft depth contours and greater than 1.2 mi in length, all of which fit the general characteristics of Unnamed Shoal A. Assuming that these shoals are rectangular in shape, their surface area is estimated to be in excess of 590,000 ac. It should be noted, however, that this is only a first-order approximation; the referenced study only focuses on shoals deemed to be economically viable for dredging and excludes shoreface attached shoals, shorter shoals, and those in deeper waters. Accordingly, while Shoal A is an important geomorphic feature, it is only one of many shoals within a larger regional context of the Mid-Atlantic coast.

The limited sediment sampling effort conducted at the borrow area prior to the initial beach fill indicated that mean grain size was approximately 0.29 mm. However, as discussed above, additional sampling of the material indicates that it is generally coarser than originally expected.

3.1.1.2 Environmental Consequences

Sections 4.2.1 - 4.2.3 of the *Final PEIS* describe in detail the expected effects of dredging and beach renourishment on coastal processes. This section provides a summary.

No Action Alternative

Under the No Action Alternative, renourishment of the Wallops Island beach would not occur. It is expected that the northernmost area of the beach would continue to grow, with the remaining areas of the beach eroding at a level directly related to the frequency and intensity of future storm events. It is expected that some of the sediment moved offshore during Hurricane Sandy would return to the beach during times of calmer wave conditions (i.e., summer), however those areas of highest elevation (dune and berm) would not regain their pre-storm profiles. In the longer term, with the narrowing of most of the beach, it would be more likely for storm-driven overwash events to occur, moving sediment west of the beach.

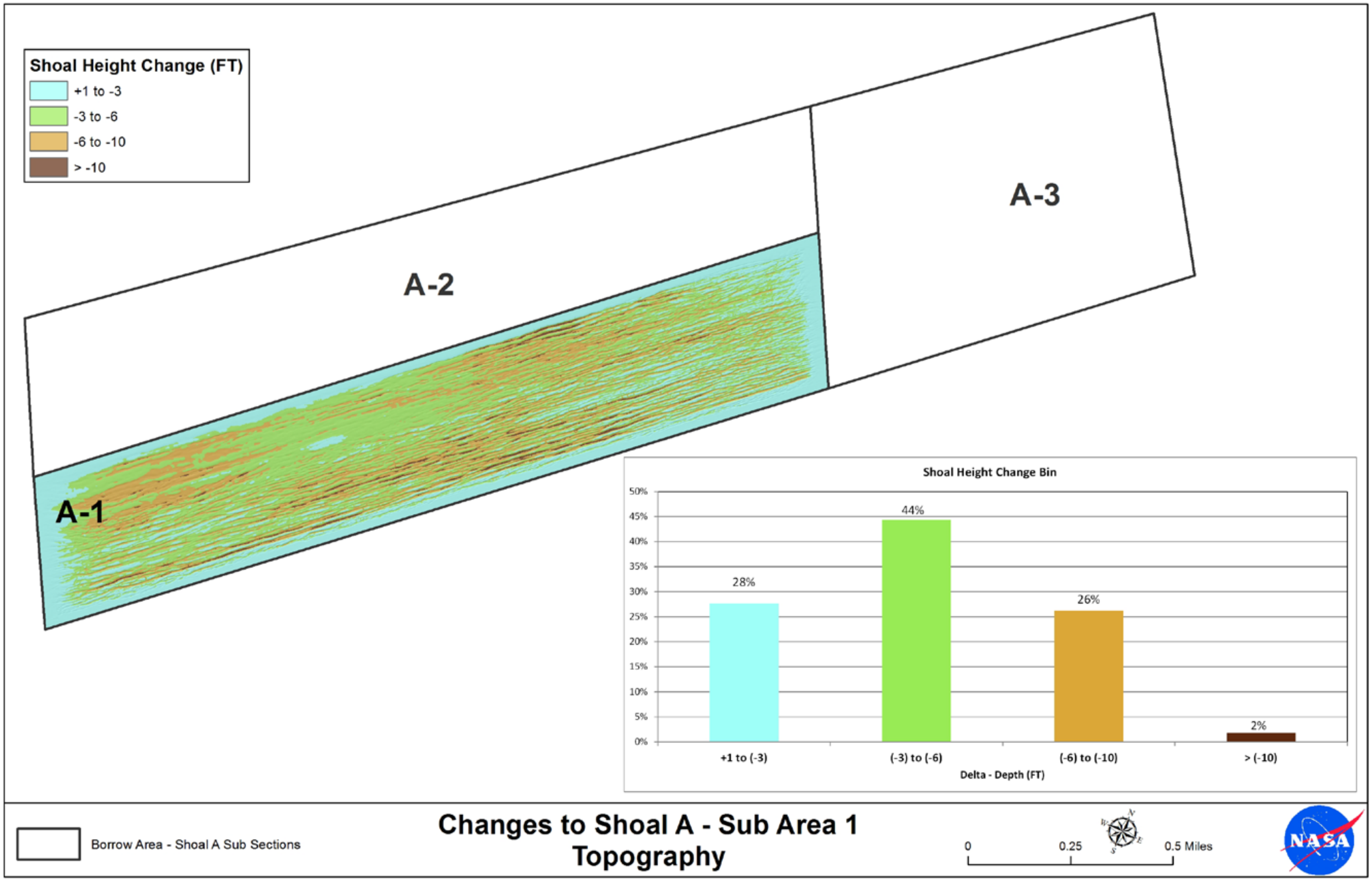

Figure 3-2: Summary of Changes to Borrow Area from Initial Beach Fill

Note that vertical error of each hydrographic survey (n=2) can be in excess of +/- 6 in

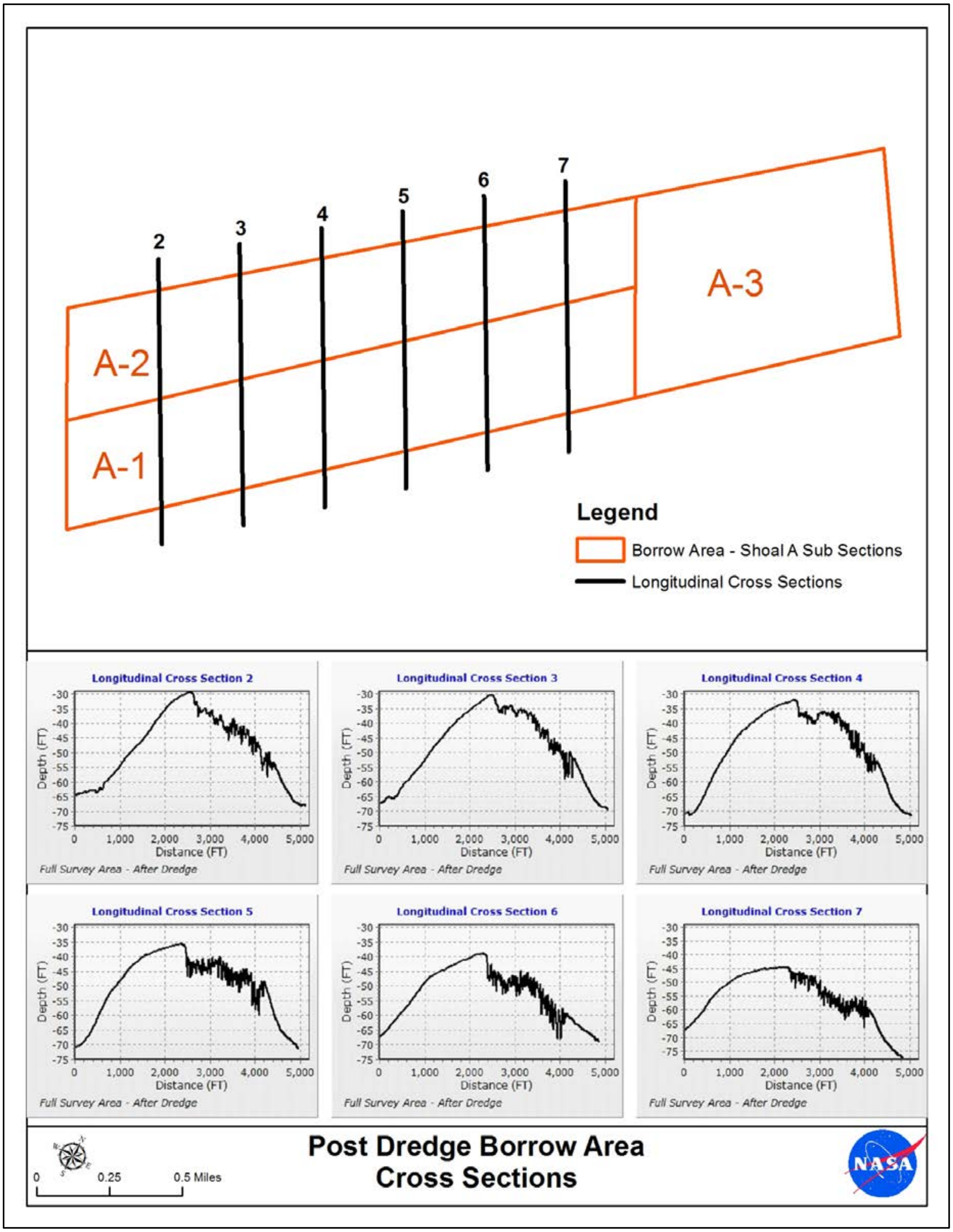

Figure 3-3: Selected Cross-Sections Depicting Changes to Borrow Area from Initial Fill Approximately 61x Vertical Exaggeration

At the borrow area, it is expected that on the decadal scale, wave and tidal energy would re-work the areas of micro-topography created by the initial dredging cycle, resulting in a more consistent, uniform elevation over time (Hitchcock et al. 1999). Changes in shoal volume and profile geometry would likely persist. While the accretional flank of the shoal crest is not expected to regain its pre-dredge elevation, it is expected that over time, the borrow area would equilibrate to the same general morphology, albeit at different profile and in places lower elevation (Dibajnia and Nairn 2011).

Proposed Action

Nearshore

Placement of the additional sediment along the Wallops Island shoreline would benefit the nearshore transport system because more material would be available for transport to either north Wallops Island or south to the adjacent Assawoman Island. It is expected that both areas would expand in size as a result. In the cross-shore direction, the presence of the elevated, more steeply sloped beach would limit the possibility of overwash events to only major storms, which would restrict Wallops Island from migrating to the west. In the easterly direction, the presence of additional sand within the nearshore system would likely lead to the formation of offshore sand bars, which would effectively dissipate wave energy.

Offshore

NASA would ensure to the extent practicable that material removal at the Shoal A borrow area would be done so in a uniform manner across the areal extent of sub-area A-1. As such, approximately two thirds of the southern half of the shoal's elevation would be lowered by an additional 1.5-3 ft on average, with some areas approaching an additional 10 ft below the current profile. While cut depths on the order of 5-10 ft would not be necessary over the entire borrow area to obtain the targeted fill volume, they could occur in some places due to the inherent limitations in precision associated with operating a dredge in the open ocean.

As proposed, the elevation of the northern portion of the shoal (sub-area A-2) would remain the same unless an unexpected condition (discussed in Section 2.3.3) required its use. The conservative model-based analysis performed for the *Final PEIS* indicated that even when a 2 square-mi area of the shoal was "planed" to an elevation necessary to obtain 10 million CY of material, the induced effects on the Assateague Island shoreline could not be distinguished from those changes occurring as a result of natural variation in sediment transport. Therefore, it is not expected that the additional lowering of the shoal would cause any measurable reduction in wave sheltering effects on properties to the west of the borrow area.

Dredging the borrow area would again create steeply sloped areas of micro-topography, which would be re-worked by tidal and wave energy in the years following the dredge event. Similar to the discussion under the No Action Alternative, the lowering of the shoal's topography would be a longer-term effect, with the shoal maintaining the same general morphology but at a lower elevation and different profile.

3.1.2 Water Quality

3.1.2.1 Regulatory Context

Section 404 of the CWA established a permit program to regulate the discharge of fill material into waters of the U.S. Managed jointly by the USACE and the U.S. Environmental Protection Agency (EPA), the primary intent of the program is to minimize adverse effects to the aquatic environment. USACE is responsible for day-to-day administration and permit review while EPA provides program oversight. On March 10, 2011 USACE issued permit *NAO-1992-1455* for the initial fill cycle and 4,600-ft seawall extension. The permit's expiration date is February 28, 2016.

3.1.2.2 Affected Environment

Section 3.1.6 of the *Final PEIS* describes in detail the water resources within and adjacent to the project area. A summary is provided below.

Surface waters in the vicinity of Wallops Island are saline to brackish and are influenced by the tides. Marine waters in the project area maintain a fairly uniform salinity range (32 to 36 parts per thousand [ppt]) throughout the year, with pockets of high salinity water (38 ppt) found near the Gulf Stream in the fall (NASA 2003).

In the project area in winter, the water column is vertically well-mixed, whereas in the summer months, the offshore waters are vertically stratified, with notable differences in temperature between surface waters and those at greater depths. A 2009 benthic video survey of the borrow area showed bedforms on the shoal's surface, which is evidence that wave energy reaches the seafloor and mixing occurs throughout the water column.

3.1.2.3 Environmental Consequences

No Action Alternative

Under the No Action Alternative, the proposed beach and seawall repairs would not occur. Therefore, there would be no project related impacts to water quality.

Proposed Action

Offshore

Dredging operations would cause sediment to be suspended in the water column. Studies of past projects indicate that the extent of the sediment plume is generally limited to between 1,640 – 4,000 ft from the dredge and that elevated turbidity levels are generally short-lived, on the order of an hour or less. (USACE 1983; Hitchcock et al. 1999; MMS 1999; Anchor Environmental 2003; Wilber et al. 2006).

The length and shape of the plume depend on the hydrodynamics of the water column and the sediment grain size. Given that the dominant substrate at the borrow sites is sand, it is expected to settle rapidly and cause less turbidity and oxygen demand than finer-grained sediments. No appreciable effects on dissolved oxygen, pH, or temperature are anticipated because the dredged material has low levels of organics and low biological oxygen demand. Additionally, dredging activities would occur within the open ocean where the hydrodynamics of the water column are subject to mixing and exchange with oxygen rich surface waters. Any resultant water column turbidity would be short term (i.e., present for approximately an hour) and would not be expected to extend more than several thousand feet from the dredging operation. Accordingly, it is anticipated that the project would have only minor impacts on marine waters at the offshore borrow area.

Nearshore

Multiple studies have been conducted on past beach nourishment projects to determine the extent and duration of elevated suspended solids levels downcurrent of a dredge's discharge pipe. In general, elevated concentrations were limited to within an area 1,310-1,640 ft of the discharge pipe in the swash zone (Schubel et al. 1978; Burlas et al. 2001; Wilber et al. 2006).

Given that the beach fill material proposed for the Wallops Island shoreline has a low amount of fine-grained sediment, it is expected that the turbidity plume generated at the placement site would be comparable to those reported in similar projects: concentrated within the swash zone, dissipating between 1,000-2,000 ft alongshore; and short term, only lasting several hours.

Both onshore and offshore construction equipment would use petroleum-based fuels and lubricants. Inadvertent spills or leaks of these substances would have the potential to adversely affect water quality. As such, NASA would require its contractors to implement Best Management Practices (BMPs) for vehicle and equipment fueling and maintenance as well as spill prevention and control measures.

Applicable Permit

NASA consulted with USACE to determine the applicability of its existing permit to the Proposed Action. On March 18, 2013, USACE responded that the Proposed Action would be permissible within the scope of the existing permit (see Appendix A). Subsequent to this correspondence, in a May 28, 2013 letter, NASA requested that USACE authorize an additional 1 ft of berm elevation for the proposed project design (see Appendix A). USACE's response is pending. NASA would only implement the proposed elevation change upon authorization from USACE.

3.1.3 Coastal Zone Management

3.1.3.1 Regulatory Context

The Virginia Department of Environmental Quality (VDEQ) is the lead agency for the Virginia Coastal Zone Management (CZM) Program. Any Federal agency development in Virginia's Coastal Management Area (CMA) must be consistent with the enforceable policies of the CZM Program. Although Federal lands are excluded from Virginia's CMA, any activity on Federal land that has reasonably foreseeable coastal effects must be consistent with the CZM Program. Because portions of the project are within Virginia's Coastal Zone and/or would have likely coastal effects, the Federal Consistency requirement applies.

Three enforceable policies of Virginia's CZM Program are particularly relevant to the Proposed Action. *Subaqueous Lands Management* and *Dunes Management*, both overseen by the Virginia Marine Resources Commission (VMRC), required NASA to obtain a permit from the agency prior to conducting the initial beach fill and seawall extension. Permit *10-2003*, issued on February 22, 2011, authorized the work with an expiration date of February 22, 2016. A third policy, *Wetlands Management*, administered by VDEQ, applied to the initial beach fill, however given that USACE and VMRC had already issued permits for the project, VDEQ waived its authority in a March 16, 2011 letter and no permit was issued.

3.1.3.2 Affected Environment

Section 3.1.8 of the *Final PEIS* describes in detail Virginia's CZM Program and its nine enforceable policies. NASA prepared a Federal Consistency Determination (FCD) in conjunction with the *Draft PEIS*; VDEQ concurred with NASA's determination in an April 14, 2010 letter. However, subsequent discussions with VDEQ indicate that a new FCD would be required for each beach renourishment cycle, including the Proposed Action.

3.1.3.3 Environmental Consequences

No Action Alternative

Under the No Action Alternative, the proposed repairs to the beach and seawall would not occur. Therefore, there would be no impacts to the coastal zone.

Proposed Action

NASA determined that the Proposed Action would be consistent to the maximum extent practicable with the enforceable policies of the CZM Program. NASA submitted its FCD to VDEQ on March 8, 2013 (NASA 2013a). In a May 6, 2013 letter, VDEQ concurred with NASA's determination (see Appendix B).

Applicable Permits

NASA consulted with VMRC to determine the applicability of its existing permit to the Proposed Action. On January 13, 2013, VMRC responded that the Proposed Action would be permissible within the scope of the existing permit provided that the footprint or heights (elevations) of the project would not change (Appendix A). NASA also consulted with VDEQ regarding the applicability of its permitting waiver to the Proposed Action. In a May 20, 2013 email, VDEQ confirmed that the waiver would apply to the project (see Appendix A). Subsequent to these correspondences, in a May 28, 2013 letter, NASA requested that VMRC authorize an additional 1 ft of berm elevation for the proposed project design (see Appendix A). In a June 11, 2013 letter, VMRC authorized the requested design modification (see Appendix A).

3.1.4 Air Quality

3.1.4.1 Affected Environment

Section 3.1.9 of the *Final PEIS* describes in detail the regulatory context and types and quantities of air pollutants emitted from NASA's activities on Wallops Island. Below provides a summary.

Criteria Pollutants

Air quality in a given location is described by the concentration of various pollutants in the atmosphere. The significance of the pollutant concentration is determined by comparing it to the Federal and State ambient air quality standards. The Clean Air Act (CAA), and its subsequent amendments, established the National Ambient Air Quality Standards (NAAQS) for seven "criteria" pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than 10 (PM_{10}) and 2.5 ($PM_{2.5}$) microns in diameter, and lead (Pb). These standards represent the maximum allowable atmospheric concentrations that may occur while ensuring protection of public health and welfare, with a reasonable margin of safety.

Areas that exceed a Federal air quality standard are designated as non-attainment areas. Wallops Island is located in Accomack County, an attainment area for all criteria pollutants; therefore, a General Conformity Review (under Section 176(c) of the CAA) does not apply to this project.

Greenhouse Gases

Greenhouse Gases (GHGs) include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), O_3, and several hydro- and chlorofluorocarbons. Each GHG is assigned a global warming potential (GWP), which is the ability to trap heat, and is standardized to CO_2, which has a GWP value of 1. For example, N_2O has a GWP of 310, meaning it has a global warming effect 310 times greater than CO_2 on an equal-mass basis. For simplification, total GHG emissions are often expressed as a CO_2e.

As GHGs are relatively stable in the atmosphere and are essentially uniformly mixed throughout the troposphere and stratosphere, the climatic impact of GHG emissions does not depend upon the source location. Therefore, regional climate impacts are likely a function of global emissions.

Until recently, GHGs have not been regulated under the CAA. Recent (2010) draft guidance from CEQ indicates that projects having estimated CO_2e emissions greater than 25,000 tonnes (27,500 tons) warrant further consideration.

3.1.4.2 Environmental Consequences

The primary emissions from the Proposed Action would result from the burning of fossil fuels in mobile sources (e.g., dredges, earth moving equipment, etc.). For the purposes of evaluating air quality impacts in this EA, emissions are considered to be minor if the Proposed Action would result in an increase of 250 tons per year or less for any criteria pollutant. The 250 tons per year value is used by the EPA in its New Source Review standards as an indicator for impact analysis for listed new major stationary sources in attainment areas. No similar regulatory thresholds are available for mobile source emissions. Lacking any mobile source emission regulatory thresholds, this threshold is used to equitably assess and compare mobile source emissions. For the assessment of greenhouse gases, the CEQ-recommended 25,000 tonnes (27,500 tons) threshold is applied.

No Action Alternative

Under the No Action Alternative, the proposed repairs to the beach and seawall would not occur. Therefore, there would be no project related air emissions.

Proposed Action

In the *Final PEIS*, NASA estimated the potential criteria pollutant and GHG emissions from an 806,000 CY beach renourishment project that used Shoal A as the source of sand. As summarized in Table 3-2, while fossil fuel powered construction equipment would generate emissions; it is not anticipated to cause measurable long-term adverse impacts on air quality or climate change.

Table 3-2: Renourishment Cycle Criteria Pollutant and Greenhouse Gas Emissions

Source of Sand:	Tons per year					Metric tonnes per year			
Unnamed Shoal A	CO	NO_x	VOC	PM	SO_x	CO_2	N_2O	CH_4	CO_2e
TOTAL	**23.4**	**170.6**	**6.4**	**5.6**	**4.2**	**7,731**	**0.2**	**0.1**	**7,449**

3.1.5 Noise

Noise is defined as unwanted sound. Section 3.1.10 of the *Final PEIS* describes in detail the noise fundamentals and standards that are relevant to the Proposed Action. It is important to note that because air and water are two different media with different densities, different reference sound pressure levels are used for each. The most commonly used reference for air is 20 microPascals (µPa) and the most commonly used reference for underwater is 1 µPa. Unless otherwise noted, all noise levels will be presented as such. Furthermore, under the Marine Mammal Protection Act (MMPA, discussed in Section 3.3.3 of this EA), root-mean-square (rms) levels are used to determine harassment, therefore all underwater sound levels will be reported in rms.

3.1.5.1 Affected Environment

This section focuses on new information obtained since the *Final PEIS*.

In-Air Sounds

NASA sponsored a study to characterize the ambient in-air sound levels on Wallops Island (BRRC 2011). Two of the study sites were on the Wallops Island beach; the northernmost site approximately 600 ft west of the surf zone in the Recreational beach area; the southernmost site was just south of the existing Unmanned Aerial Systems airstrip, approximately 300 ft from the surf zone.

The average daily background levels for the northernmost site ranged from 30 to almost 50 A-weighted decibels (dBA), with a constant level of low-frequency sound likely caused by the wind and surf. The site demonstrated an increase in sound levels during the daylight hours likely due to increased wind. The southern site also had the same general characteristics, however sound levels were higher, between 40 and 50 dBA, which was likely related to the closer proximity to the surf zone.

In-Water Sounds

During the initial beach fill in summer 2012, NASA partnered with BOEM and USACE to record background in-water sound levels at the both offshore borrow area and the nearshore pumpout area. Data were collected at two listening depths at each site; approximately 10 ft and 30 ft depths at the offshore shoal and 10 ft and 20 ft at the nearshore sites. During the study, the majority of data collected when winds were at least 4-7 miles per hour and wave heights were at least 1-2 feet. Therefore, the data do not reflect “calm” sea conditions.

Background sound pressure levels (SPLs) averaged 117 dB across all sampling days, sites, water depths and weather conditions. Minimum measured sound levels ranged from 91 dB to 107 dB depending on sampling location and water depth; maximum levels ranged from approximately 128 dB to just under 148 dB (Reine et al. *in prep*). Highest SPLs were found at frequencies of less than 200 hertz. The authors note that sea state and the associated sounds generated by waves interacting with the survey vessel likely contributed to the elevated readings.

3.1.5.2 Environmental Consequences

The primary focus of this section is to employ the new information summarized above to characterize the noise generated by the alternatives rather than to assess the effects on particular receptors. Given the distance of the borrow area from land, and that all placement activities would be conducted along the access-restricted Wallops Island shoreline (in contrast to a publicly-used beach), the sensitive receptors of concern would be wildlife, the potential noise-induced effects on which are discussed in this EA under *Wildlife*, *Marine Mammals*, and *Threatened and Endangered Species*.

No Action Alternative

Under the No Action Alternative, there would be no project related sources of noise. As such, the project site would continue to be dominated primarily by the sounds of wind and waves.

Proposed Action

In-Air Sounds

The operation of heavy equipment on the Wallops Island beach would be the most pronounced source of project-related sounds, including engine/radiator fans, back-up alarms, and connecting and moving onshore piping. Given the expected around-the-clock work schedule, it would be nearly constant for the 2-3 month duration of the project.

In general, construction noise levels at a particular receptor can be difficult to predict. Heavy construction vehicles, the major source of noise during construction projects, are constantly moving in unpredictable patterns, therefore no one receptor is expected to be exposed to construction noise of long duration. However, in the case of beach nourishment, it is expected that most of the noise-producing equipment would be located in approximately the same area on the beach (e.g., near the current location of the discharge pipe) and would move together in the same general direction.

Therefore, conservative estimates of “point source” sound levels can be determined using construction equipment sound level data collected by the Federal Highway Administration (FWHA) (2006). Assuming the immediate work site would include four bulldozers, a front-end loader, and two generators (one for office power, one for nighttime lighting), the total received sound level at 50 ft from the site would be approximately 90 dBA. Typically, sound drops off at a rate of 6 dB for each doubling of the distance from a point source (FHWA 2007). Employing this methodology, noise levels would fall within the upper range of background levels (50 dBA) at approximately 0.9 mi from the work site.

However, it should be noted that wind and surf conditions would play a major role in dictating the distances at which the construction related sounds could be heard by nearby receivers. Studies have shown that the effects of wind on sound propagation can be substantial, with upwind attenuation approaching 25-30 dB more than downwind at the same distance from the source (Wiener and Keast 1959). Therefore, received construction-related noise levels would vary, however they would not be expected to be substantial.

In-Water Sounds

It is expected that in-water sound levels generated by the Proposed Action would be similar to those reported by Reine et al. (*in prep.)*, which summarizes recorded sound levels from hopper dredges operating in the nearshore waters off Wallops Island. Though the referenced study presents sound levels from three individual dredges, the sound levels presented for this analysis were logarithmically averaged into a single SPL for each activity in the dredging cycle.

Based upon data collected by Reine et al. (*in prep.*), sediment removal and the transition from transit to pump-out would be expected to produce the highest sound levels at an estimated source level (SL) of 172 dB at 3 ft. The two quietest dredging activities would be expected to be seawater pump-out (flushing pipes) and transiting (unloaded) to the borrow site, with expected SLs of approximately 159 and 163 dB at 3 ft, respectively.

These expected sound levels generally correlate with those presented in the *Final PEIS*, which were based upon levels recorded by Clarke et al. (2003). However the new information does suggest that SLs and the region of elevated sound around the dredges could be higher than originally anticipated, however not substantially different (discussed in more detail in Section 3.2.4 of this EA).

Based upon attenuation rates observed by Reine et al. (*in prep.)*, it would be expected that at distances approximately 1.6-1.9 mi from the source, underwater sounds generated by the dredges would attenuate to background levels. However, similar to in-air sounds, wind (and corresponding sea state) would play a major role in dictating the distance to which project-related underwater sounds would be above ambient levels and potentially audible to nearby receptors.

3.2 Biological Environment

3.2.1 Benthos

3.2.1.1 Affected Environment

Section 3.2.5 of the *Final PEIS* describes in detail the benthic (bottom dwelling) organisms that inhabit the project site. This section provides a summary.

Onshore

Air-breathing crustaceans such as ghost crabs dominate the uppermost zone of the Wallops Island beach, while the swash zone is dominated by isopods, amphipods, polychaetes, and mole crabs (*Emerita talpoida*). Below the mid-tide line is the surf zone where coquina clams (*Donax* *variabilis*) and a variety of amphipods are prevalent. All such organisms are important prey species for a variety of waterbirds and fish.

Studies reviewed in preparing the *Final PEIS* indicated that filled beaches can be devoid of living benthos for up to a year following project completion. Given that the initial beach fill occurred less than one year ago, it is likely that the beach is still in a biologically suppressed state as compared to a natural beach. As the primary mechanism for recolonization of benthic organisms is transport from adjacent areas, it is expected that the northern and southern ends of the project site will recover first.

Offshore

Several recent studies conducted off the coasts of Delaware, Maryland, and Virginia have characterized nearby sand shoal habitats, finding that they are generally dominated by annelid worms, mollusks, and crustaceans.

Similar to the discussion regarding onshore benthic resources, it is not expected that the dredged area has fully recovered to pre-dredge conditions, however with a spring/summer recruitment pending, it is expected that the affected area will continue its biological recovery.

3.2.1.2 Environmental Consequences

Section 4.3.5 of the *Final PEIS* describes in detail the expected effects of dredging and beach nourishment on benthic organisms. This section provides both a summary and updated information obtained since the *Final PEIS*.

No Action Alternative

Under the No Action Alternative, the proposed repairs to the beach and seawall would not occur. Therefore, there would be no adverse impacts to benthos. It is expected that an absence of newly placed sand would allow upper beach and swash zone benthic organisms to continue their recolonization of the areas affected by the prior year's initial fill cycle. Similarly, at the offshore borrow area; in the absence of additional dredging, the site would continue its biological recovery following the initial dredge event.

Proposed Action

Offshore

Within the borrow area, bottom dwelling organisms would be entrained in the dredge. Based upon reports by biological monitors onboard the dredges during the initial beach fill cycle, the most commonly encountered macrobenthos included horseshoe crab (*Limulus polyphemus*), whelk (*Busycon canaliculatum*), and blue crabs (*Callinectes sapidus*).

Because of the dynamic nature of benthic communities on the nearshore continental shelf and their variability over time, the recolonization and recovery of the dredged area can proceed at various rates. A summary of post-dredge faunal recovery rates from 19 different projects in Europe and the U.S. compiled by Newell and Seiderer (2003) show a range from several weeks to more than ten years. The most rapid recovery rates were observed for muds and sands (i.e., several months up to two years); whereas the longest recovery periods (i.e., more than two years) were associated with gravel and reef habitats. Given that Unnamed Shoal A consists of fine to medium sand (per the ASTM unified classification), it can be estimated that the required benthic recovery time would be on the order of one year following cessation of dredging.

Nearshore and Onshore

Due to the handling and pumping activities, the dredged sand would likely be devoid of live benthos. As a result, the recovery of benthos at the placement area would rely on immigration of adult organisms from adjacent undisturbed areas, as well as larval colonization from the water column. However, raising the elevation of the existing beach from intertidal to upper beach would effectively limit the landward extent of water driven organismal transport. In the longer term, the re-establishment of an elevated beach berm would reduce the extent of the more biologically diverse intertidal zone.

Recovery time of benthos within the surf zone is expected to be more rapid than the offshore borrow area given the dynamic conditions within the nearshore and surf zones. Burlas et al. (2001) estimated that the recovery time for benthos in a New Jersey study ranged from approximately 2 to 6 months when there is a good match between the fill material and the natural beach sediment. In the case of the Proposed Action, the fill material would not be substantially different (though slightly coarser) than native material, therefore it is expected that recovery time would be similar to that reported in the referenced study.

Placement of beach fill and construction would also bury existing benthic communities and inhibit the ongoing recovery of the existing beach; however, the extent of the affected area would be limited and organisms from adjacent areas would recolonize the new beach in relatively short time (i.e., on the order of 6-12 months post-project).

3.2.2 Wildlife

3.2.2.1 Affected Environment

Section 3.2.2 of the *Final PEIS* describes in detail the terrestrial fauna that inhabit the project site. This section provides both a summary and updated information regarding wildlife activity on the Wallops Island beach since the *Final PEIS*. Those species listed for protection under the Federal Endangered Species Act (ESA) are discussed in Section 3.2.4 of this EA.

Onshore

Avifauna: The Wallops Island beach provides important nesting and foraging habitat for a number of migratory waterbirds, including gulls, terns, and sandpipers. Waterbird numbers on the beach peak during the fall and spring migrations, during which the beach provides stopover habitat for resting and feeding as the birds transit between breeding and wintering grounds. Important food sources include fish and a wide variety of invertebrates, including mollusks, insects, worms, and crustaceans.

Given that the recently filled beach is expected to be mostly devoid of food sources, its habitat value is likely limited. However, with a spring/summer recruitment in the near future, it is expected that habitat value will continue to increase. Also noteworthy is that following the initial fill cycle, the northern end of the project site (which would be unaffected by the Proposed Action) has developed an expansive area of tidal pools, which are expected to be important sources of forage for avian species.

In accordance with its Protected Species Monitoring Program, NASA conducted regular monitoring of the Wallops Island beach between March and September 2012 to determine the level of avian nesting activity within and adjacent to the project area. During the monitoring period, one American oystercatcher (*Haematopus palliatus*) nest was identified outside the project area on north Wallops Island, however it was predated shortly after its discovery. In 2011, seven oystercatcher nests were found on Wallops Island. Of the seven nests, six were on the north end and one on the south end, west of the beach. At least five of the nests were unsuccessful due to either predation or storm overwash, with the remaining two enduring until the hatch window with unknown end results. No colonial waterbird nesting activity has been observed on the Wallops Island beach since NASA began its regular beach nesting bird surveys in spring 2010 (NASA 2012a).

Herpetofauna: Though Wallops Island is home to a number of amphibians and reptiles, the species most likely affected by activities on or adjacent to the beach is the diamondback terrapin (*Malaclemys terrapin*), which in the past has regularly nested on the north beach and locations west of the beach. However now that portions of the rock seawall have sand overtopping them, the species has easier access to the beach for its late spring to early summer nesting. During the recent beach fill, the species was observed frequently within the project site during the late May to early June timeframe.

Offshore

Seabirds including scoters, loons, and gannets utilize the offshore portion of the project area as foraging grounds during winter months. Similar to the discussion above regarding the nearshore environment, given that dredging occurred within the borrow area on Shoal A during spring and summer 2012, it is expected that the forage value of the affected area has not yet returned to pre-dredge conditions.

3.2.2.2 Environmental Consequences

Section 4.3.2 of the *Final PEIS* describes in detail the expected effects of dredging and beach nourishment on wildlife. This section provides both a summary and updated information obtained since the *Final PEIS*.

No Action Alternative

Under the No Action Alternative, the proposed repairs to the beach and seawall would not occur. Within both the recently filled area of the Wallops Island beach and at the offshore borrow area, the biological recovery of these areas would continue, to the benefit of foraging avifauna.

In the absence of additional beach fill, the project site would continue to erode, resulting in a loss of suitable foraging and nesting habitat along most of the shoreline. As the beach narrows, it would increase the potential for the inundation of nests. It is expected that the north end of Wallops Island would continue to grow, to the benefit of beach nesting and foraging species.

Proposed Action

Onshore

Avifauna: Temporary noise and visual disturbances from construction equipment and personnel could adversely affect beach foraging and nesting birds. Direct effects could include eliciting a startle or flee response, which for foraging birds could temporarily interrupt feeding activities or cause individuals to relocate to other areas of the beach. If nesting birds were to flush from nests, it could lead to an elevated risk of egg overheating or predation. It would also be possible for equipment to inadvertently crush or bury nests or chicks if the nests were undetected. Adverse effects would also occur from a reduction in available food sources during and following the placement of sand on the Wallops Island shoreline. Due to the nesting cycle of potentially affected species, the possibility of adverse effects would be greatest should the work occur between the months of April and September.

However, onshore construction would occur well south of the areas of the beach that have historically hosted the greatest level of nesting activity. It is unknown to what extent the newly created Wallops Island beach will be used by waterbirds, as the beach has not yet been in place for a full nesting season. The actual usage patterns will play a large role in dictating potential impacts. For example, if nesting occurs well outside the areas of greatest human activity as it has in the past, species would be exposed to far fewer construction related stressors that could adversely affect their nesting success. However, the presence of the new beach could attract birds into areas where construction activities would occur, thereby increasing the probability for adverse interactions. Effects on prey availability are expected to be a contributing factor, and given that the beach is likely in a biologically suppressed state, it is possible that avian species would congregate closer to more forage-rich areas outside of the affected area. As discussed under *Benthos*, following the proposed renourishment, available forage would again be suppressed, however the infauna and epifauna would be expected to recolonize the affected area within approximately 1 year.

Due to the uncertainty in potential avian use (and potential effects) during the proposed repairs, if work were to be conducted between the months of April and September, NASA would ensure that the work site and adjacent areas are surveyed for nesting by a biological monitor on a daily basis. The biological monitor would coordinate directly with onsite project employees to ensure that all parties are made aware of potential nesting status and any need to suspend or relocate work activities until nesting activities have ceased.

Long term, the renourished beach could create suitable waterbird nesting habitat. At a time when storm intensity and frequency are expected to increase, having an elevated, sparsely vegetated beach and dune along the entire length of Wallops Island is expected to be of notable benefit to all beach nesting species.

Herpetofauna: The primary concern regarding diamondback terrapin would be the potential to crush or bury an individual or its nest should beach fill occur within the early summer months. To mitigate this potential effect, NASA's biological monitor (discussed under *Avifauna*) would report any known areas of concentrated nesting to construction personnel such that they could be avoided until the turtles have moved from the immediate area.

Offshore

Dredging the offshore shoal by an estimated additional 1.5-3 ft on average (additional 10 ft maximum) would not substantially change shoal topography or impact the availability of seabird food sources as considered in the *Final PEIS*. Though the additional dredging would increase the water depths at the borrow area, diving species could still effectively forage on the shoal, however forage sources would be suppressed for several seasons following the work. All additional sand would be removed within areas already disturbed; therefore it would not expand the footprint of the area having reduced available forage following the dredge event. Both adjacent undisturbed areas on Shoal A and neighboring shoals (discussed in Section 3.1.1 of this EA) would provide adequate forage should seabirds avoid the directly affected area.

3.2.3 Fisheries & Essential Fish Habitat

3.2.3.1 Regulatory Context

In accordance with the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSA), Federal agencies must consult with the National Marine Fisheries Service (NMFS) for activities that may adversely influence Essential Fish Habitat (EFH) that is designated in a Federal Fisheries Management Plan. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Both the offshore borrow area and the nearshore discharge location are designated EFH for multiple life stages of managed fish species, therefore the EFH consultation requirement applies to the Proposed Action.

3.2.3.2 Affected Environment

Section 3.2.7 and 3.2.8 of the *Final PEIS* describes in detail the fisheries and EFH that occur within the project area. This section provides both a summary and updated information obtained since the *Final PEIS*.

Fisheries

The nearshore and offshore project site are home to a diverse mix of finfish including many of commercial and recreational value. In general, most fish encountered are within the site seasonally, migrating south or offshore as the waters cool in the fall and returning in the spring.

Essential Fish Habitat

The EFH Assessment prepared in conjunction with the *Final PEIS* (NASA 2010a) describes in detail all managed species and life stages that could occur within the project area. As such, the document is incorporated by reference in this section.

3.2.3.3 Environmental Consequences

Section 4.3.7 and 4.3.8 of the *Final PEIS* describe in detail the expected effects of dredging and beach nourishment on fisheries and EFH. This section provides both a summary and updated information obtained since the *Final PEIS*.

No Action Alternative

Under the No Action Alternative, the proposed repairs to the beach and seawall would not occur. Therefore, there would be no project related effects on fisheries or EFH.

Proposed Action

Offshore

Fisheries: Entrainment in the dredge would be the most pronounced direct impact on finfish. On-dredge protected species observers from the spring/summer 2012 initial fill reported that the most common species entrained in the dredge were northern stargazer (*Astroscopus guttatus*), summer flounder (*Paralicthys dentatus*), clearnose skate (*Raja eglanteria*), and hake (species unspecified). Additionally, dredging would temporarily reduce and/or modify the benthic organisms and assemblages upon which finfish at higher trophic levels feed. Conversely, dredging could also attract fish due to the suspension of benthic prey species in the water column along with the suspended sediment.

Essential Fish Habitat: Dredging at the proposed borrow area would be conducted in a manner generally consistent with the recommendations made in two publications examining the dredging of offshore shoals in the mid-Atlantic (CSA International, Inc. et al. 2009 and Dibajnia and Nairn 2011). These recommendations include targeting depocenters for extraction, avoiding active erosional areas, shallow dredging over large areas rather than deep pits, dredging shoals in less than 98 ft of water, and avoiding longitudinal dredging over the entire length of shoal.

Adverse effects within the dredged area would include removal and modification of benthic assemblages upon which managed species feed, modification of shoal topography, and an increase in water turbidity. Of these effects, the duration would be temporary in nature, with turbidity on the order of hours and benthic recovery on the order of several seasons. Recovery of shoal topography would be a longer process. While all affected areas on the shoal would not be expected to regain their pre-dredge elevation, it is expected that over time, the site would regain its same general morphology, although at lower elevation.

Nearshore

Fisheries: The most pronounced effect on finfish within the nearshore zone would be the burial of existing intertidal and subtidal habitat within which they would forage. Increased turbidity down current of the discharge pipe could also disrupt foraging behavior, however as discussed under *Water Quality*, the extent and duration of such effects would be very limited.

Essential Fish Habitat: The placement of fill would bury existing benthic habitat, therefore reducing its foraging value for a period of time ranging from several months to a year following placement. Additionally, elevating the beach from intertidal to sub-aerial (dry beach) would immediately reduce the availability of in-water habitat, however from a regional perspective the size of the area would not be substantial, and the area would return over time as the beach erodes.

To stabilize the dune area and reduce borrow requirements (and potential effects on EFH), NASA would plant the dunes with native vegetation and install sand fencing to trap windblown sand.

EFH Consultation

While preparing the *Final PEIS*, NASA consulted with NMFS Habitat Conservation Division (HCD) regarding effects of the project on EFH. In parallel with preparing this EA, NASA again consulted with NMFS HCD (NASA 2013b). In an April 24, 2013 letter, NMFS HCD offered three Conservation Recommendations (CRs) relating to dredging at the borrow area and stabilization of the beach and dune (see Appendix A). NASA accepted the three CRs in an April 29, 2013 letter (see Appendix A) and has incorporated them as integral components of the Proposed Action (see Sections 2.3.3 and 2.3.4 of this EA).

3.2.4 Marine Mammals

3.2.4.1 Regulatory Context

Under the MMPA, NMFS has defined noise-related levels of harassment for marine mammals. The current Level A (injury) threshold is 190 and 180 dB rms for pinnipeds (e.g., seals) and cetaceans (e.g., bottlenose dolphin [*Tursiops truncates*]), respectively. The current Level B (disturbance) threshold for underwater impulse noise (e.g., pile driving) is 160 dB rms for cetaceans and pinnipeds. The Level B (disturbance) threshold for continuous noise (e.g., dredging) is 120 dB rms for cetaceans and pinnipeds.

3.2.4.2 Affected Environment

Section 3.2.9 of the *Final PEIS* describes in detail the marine mammals that may occur within the project area. This section provides a summary. Those federally listed species are discussed under *Threatened and Endangered Species* within Section 3.2.5 of this EA.

Of the approximately nineteen species of non-ESA listed marine mammals that could occur within or adjacent to the project area, the bottlenose dolphin would be the most common, and could be within the project site at any time of year. However, it would be most commonly encountered during the non-winter months. During winter, the species is rarely observed north of the North Carolina-Virginia border. Those individuals encountered would be expected to be the coastal morphotype; the offshore morphotype are primarily found farther offshore.

3.2.4.3 Environmental Consequences

Section 4.3.9 of the *Final PEIS* describe in detail the expected effects of dredging and beach nourishment on marine mammals. This section provides both a summary and updated information obtained since the *Final PEIS*.

No Action Alternative

Under the No Action Alternative, the proposed repairs to the beach and seawall would not occur. Therefore, there would be no project related impacts to marine mammals.

Proposed Action

Potential adverse impacts to marine mammals would be associated with physical disturbance to habitats during dredging and fill, temporary increases in water turbidity, a reduction in prey availability, vessel strike, and increased noise from vessel activities. However, given the relatively slow speed of the dredge, the limited extent of habitat affected, and with the implementation of mitigation measures described below, effects are expected to be minimal.

As discussed in Section 3.1.5 of this EA, NASA participated in a study (Reine et al. *in prep.*) to better characterize dredge noise within its project site. As summarized in Table 3-3, in-water sounds levels associated with dredging would not reach the 190 and 180 dB rms thresholds; 160 dB rms would only be reached several meters from the dredge; and 120 dB rms would be reached at between 0.1 and 1.2 mi (0.2 and 1.9 km) from the dredge, depending on the specific activity within the dredging cycle.

When compared to the assessment of effects presented in the *Final PEIS*, the revised estimates of distances to the MMPA harassment thresholds are comparable to the original analysis with the exception of the 120 dB rms level for continuous noise. However, despite this approximately twofold increase in distance to the 120 dB rms threshold, it is expected that adverse effects could still be avoided with a modification to the observer protocol developed in consultation with NMFS for the initial fill cycle.

More specifically, NASA would ensure that an NMFS-approved bridge watch is stationed on each dredge at all times of year to scan the horizon for up to 1.2 mi (2 km) for marine mammals. At this distance, marine mammals could be readily detected with the aid of binoculars.

Table 3-3: Estimated Distances to NMFS Underwater Noise Thresholds[1]

Reference	Description	Received Level (dB)	Distance (m)	Trans. Loss (log R)	160 dB (m)	120 dB (m)	120 dB (km)
Final PEIS							
Clarke et al. (2003)	Hopper Dredge	140	40	15	2	862	0.9
New Information							
Reine et al. *(in prep.)*	Transit to Borrow Site	135	50	15.778	1	430	0.4
	Transition: Transit to Excavation	143	50	15.778	4	1,475	1.5
	Excavating Sediment	145	50	15.778	6	1,896	1.9
	Transition: Excavation to Transit	139	50	15.778	2	773	0.8
	Transit to Pump-out	143	50	15.778	4	1,439	1.4
	Transition: Transit to Pump-out	145	50	15.778	5	1,844	1.8
	Pump-out Water	132	50	15.778	1	308	0.3
	Pump-out Material	141	50	15.778	3	1,002	1.0
	Transition: Pump-out to Transit	129	50	15.778	1	182	0.2

[1]Distances presented in metric units for consistency with existing NMFS documents
To convert from meters to feet, multiply by 3.28; to convert kilometers to miles, multiply by 0.62

Should an individual be detected, the vessel would be required to turn off its pumps until the animal has left the immediate vicinity, upon which the dredging activity could resume. For the initial fill cycle, the distance to which observers were required to scan for species was approximately 0.6 mi (1 km).

In consideration of the above described mitigation measures, it would be highly unlikely that marine mammals within or adjacent to the project area would be subjected to noise levels in excess of those prescribed by the MMPA. Therefore, the Proposed Action would not result in the harassment of any non-listed marine mammals. This conclusion is supported by the recent consultation with NMFS regarding the same issue as it applies to listed marine mammals, which is discussed in more detail in Section 3.2.5 of this EA.

3.2.5 Threatened & Endangered Species

3.2.5.1 Regulatory Context

Section 7 of the ESA requires Federal agencies to evaluate the effects of their actions on listed species and consult with either the USFWS or NMFS if the agency determines that its action "may affect" an individual or critical habitat of the respective species.

3.2.5.2 Affected Environment

Section 3.2.10 of the *Final PEIS* describes in detail the federally listed species that inhabit the project site. This section provides a both a summary and updated information obtained since the *Final PEIS*.

Onshore

A review of the Accomack County species list indicates that the species potentially within the project area have not changed from those discussed in the *Final PEIS*. In preparing the *Final PEIS*, NASA determined that project activities may affect the threatened seabeach amaranth (*Amaranthus pumilus*), threatened piping plover (*Charadrius melodus),* candidate red knot (*Calidris canutus rufa*), and several species of nesting sea turtles, including loggerhead (*Caretta caretta),* leatherback (*Dermochelys coriacea*), Kemp's ridley (*Lepidechelys kempii),* and Atlantic green (*Chelonia mydas*). Although there is suitable seabeach amaranth habitat present on the Wallops Island beach, recent biological surveys have not identified any of these listed plants (NASA 2010c; 2011b; 2012a). Therefore, seabeach amaranth will not be discussed further, and this section will focus on piping plovers, red knots, and sea turtles.

Piping Plover: NASA conducted piping plover surveys 3-4 times weekly from March 2012 to September 2012, during which six nests were found on the recreational beach and north end of Wallops Island. All were outside of the area within which the beach was nourished. One nest had a 75 percent fledge rate with three of four chicks fledging, and the remaining five nests were unsuccessful either due to inundation during storms or predation (NASA 2012a). In 2011, prior to the initial beach fill, NASA undertook a similar monitoring protocol, during which three nests were found on Wallops Island. Two nests were on the north end and one on the south. One nest had a 0 percent fledge rate, the second had a 25 percent fledge rate, and the third had a 50 percent fledge rate (NASA 2011b).

Red Knot: During the month of May 2012, NASA observed flocks of red knots ranging in size from just under 10 individuals to more than 650. All observed birds were on the recreational beach and north end of Wallops Island as has been the case in previous years (NASA 2012a).

Sea Turtles: In 2012, NASA identified two loggerhead sea turtle nests, the first of which was located in June within the Recreational Beach area and was ultimately predated. In early July, two false crawls on different days led to a nest on the crest of the newly constructed dune just east of Navy Building V-10. After the closure of the hatch window, the nest was excavated under observation from the USFWS and five live hatchlings were discovered and subsequently released to the ocean. One hundred hatched eggs shells were counted resulting in a 78% success rate, which is high (NASA 2012a). No marine sea turtle activity was identified on Wallops Island during the 2011 season (NASA 2011b).

Offshore

In preparing the *Final PEIS*, NASA determined that project activities may affect in-water sea turtles (species listed above under *Onshore*) and several whale species, including right (*Eubalaena glacialis),* fin (*Balaeanoptera physalus*), sperm (*Physeter macrocephalus),* sei (*Balaenoptera borealis),* and blue (*Balaenoptera musculus*). Of note is the recent listing of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus),* which could be affected by project activities. Though Atlantic sturgeon was not discussed in the *Final PEIS*, NASA prepared a Supplemental Biological Assessment (2011c) that provides a detailed description of the species. It is incorporated by reference into this section. During the initial beach fill cycle, no sightings of either listed in-water species were reported by observers onboard each of the three dredges.

3.2.5.3 Environmental Consequences

Section 4.3.10 of the *Final PEIS* describes in detail the expected effects of dredging and beach nourishment on listed species. In conjunction with the preparation of the *Final PEIS*, NMFS (2012) and USFWS (2010) each issued NASA a Biological Opinion (BO) addressing the effects of its 50-year design life shoreline restoration program. This section provides both a summary and updated information obtained since the *Final PEIS*.

No Action Alternative

Under the No Action Alternative, the proposed repairs to the beach and seawall would not occur. Therefore, there would be no direct impact to listed species. However, the recently nourished beach would continue its biological recovery and its forage value to avian species would increase. Conversely, as the beach erodes, it is expected to provide less available nesting habitat for piping plovers and sea turtles. As the beach berm is lowered, the remaining habitat would be more susceptible to storm-induced flooding and washout of nests.

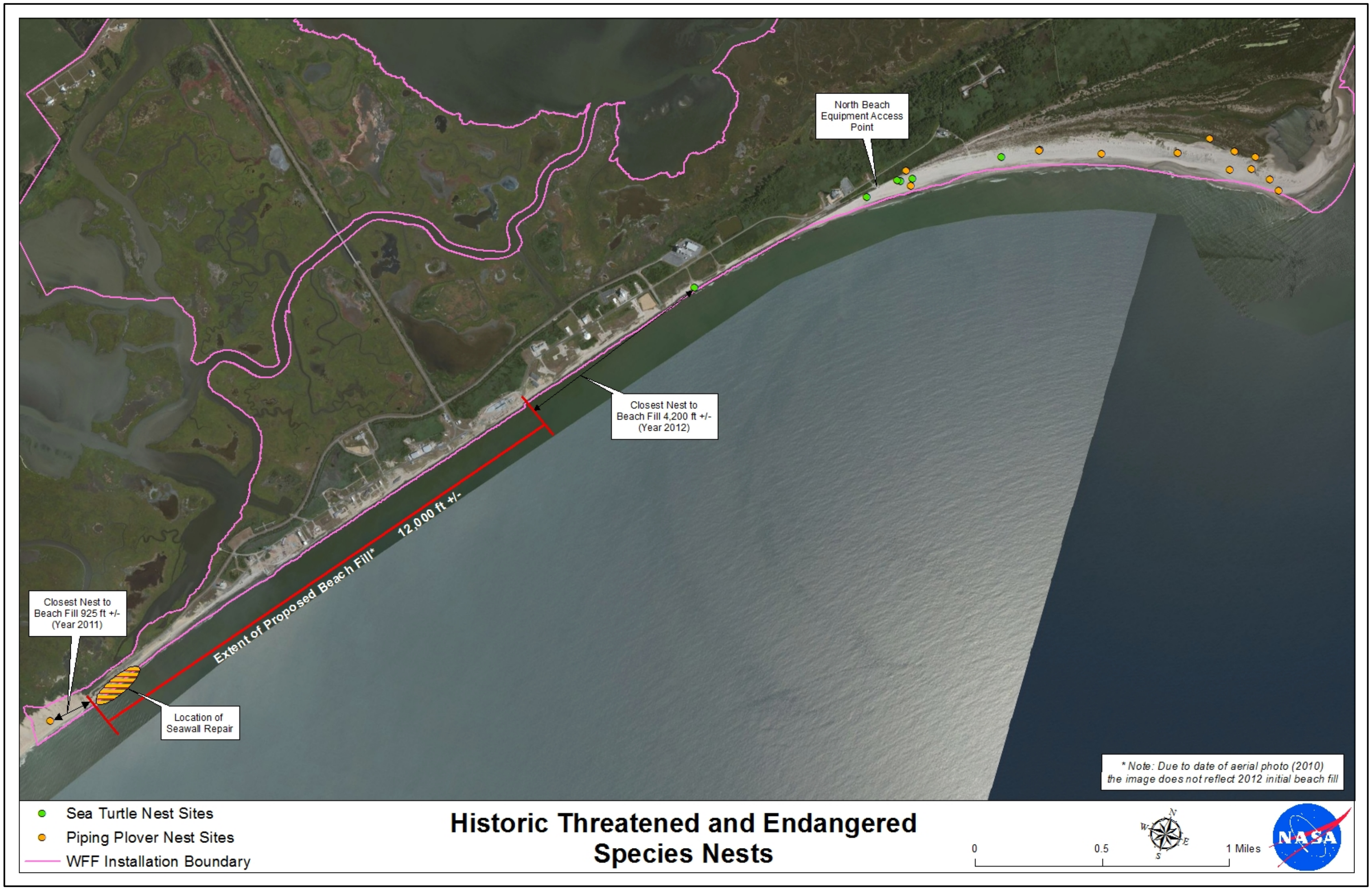

Figure 3-4: Recent (2010-2012) Listed Species Nests in Relation to Proposed Action

Proposed Action

Avifauna: Impacts on piping plover and red knot would be generally the same as those discussed for non-listed avian species in Section 3.2.2.2 of this EA. In summary, these effects would include the potential for startle or disruption of foraging, reduction in prey availability, and for plovers, the potential for disruption of courtship and nesting activities. However, the majority of both plover and red knot activity on Wallops Island has historically occurred on the north end of the island, well outside of where work would occur under the Proposed Action (Figure 3-4). The potential exists for plover nesting activity to occur within the proposed project site, and accordingly, NASA would employ a biological monitor to survey the project site on a daily basis should work occur between the months of April and September.

Herpetofauna: Impacts to nesting sea turtles could include avoided nesting attempts due to nighttime construction activity (particularly artificial lighting) on the beach, unintentional burial of a newly dug nest if it were to go undetected, disorientation of hatchlings (due to project-related light sources), or obstruction to hatchlings during their emergence and subsequent trip to the ocean.

In the long term, it is possible that the replenished beach could prove unsuitable to nesting turtles due to a number of physical factors, including sand grain size, color, level of compaction, and scarping, which could impede access to the dry portion of the beach. However, given that the beach fill material is not substantially different from nearby native beaches, it is not expected that such effects would be major. Moreover, as evidenced by the sea turtle nesting that occurred on the Wallops Island beach during the initial beach fill cycle (Figure 3-4), it is possible that the additional elevated beach would provide suitable nesting habitat, a net benefit to the species.

Effects on in-water sea turtles could include entrainment in the dredge, interaction with the sediment plume, reduction in available forage, and disturbance due to vessel created sounds. However, given the limited number of sea turtles expected to use the borrow area as habitat and the limited portion of available habitat affected, the potential for interaction is limited. This conclusion is supported by the recently completed initial beach fill cycle, conducted during the months of April and August. Protected species observers stationed onboard each of the three dredges evaluated every load and did not document a sea turtle entrainment.

Atlantic Sturgeon: Effects on sturgeon would be similar to those of in-water sea turtles and could include entrainment in the dredge, interaction with the sediment plume, reduction in available forage, and disturbance due to vessel created sounds. However, given the limited number of sturgeon expected to use the borrow area as habitat and the limited portion of available habitat that would be affected, the potential for interaction is limited. Similar to in-water sea turtles, this conclusion is supported by the recently completed initial beach fill cycle. Endangered species observers stationed onboard each of the three dredges evaluated every load and did not observe an entrained sturgeon.

Cetaceans: Similar to the discussion of impacts on non-listed marine mammals, potential effects could include ship strike, loss of habitat and prey species, interaction with the sediment plume, and exposure to elevated sound levels, which could interrupt normal behaviors, including foraging, migrating, or communicating. The likelihood of interaction with a listed whale would likely occur between November and April. However, the project is not a concentration area, rather the site is expected to be only a migratory corridor, therefore numbers in the area would be low. To mitigate potential effects on listed marine mammals, NASA would ensure that the dredge contractor followed the updated mitigation measures summarized in Section 3.2.4.3 of this EA as well as those described in detail in the NMFS BO (summarized below).

Section 7 Consultations

NMFS: NASA consulted with NMFS regarding the Proposed Action and the new information regarding dredge noise (NASA 2013c). On March 21, 2013, NMFS responded that the scope of the Proposed Action would be within that already considered in its August 3, 2012 BO and that the new information did not warrant re-initiation of formal ESA consultation (see Appendix A).

USFWS: NASA consulted with USFWS regarding the effects of the Proposed Action on piping plover and nesting sea turtles (NASA 2013d). On March 20, 2013, USFWS responded that the scope of the Proposed Action would be within that already considered in its July 30, 2010 programmatic BO (see Appendix A).

In developing the BOs, NMFS and USFWS provided mandatory terms and conditions that NASA must follow to reduce potential effects to listed species. As such, NASA and USACE would ensure that their contractors implemented these measures on their behalf.

3.3 Social Environment

3.3.1 Cultural Resources

3.3.1.1 Regulatory Context

The National Historic Preservation Act (NHPA) of 1966, as amended, outlines Federal policy to protect historic properties and promote historic preservation in cooperation with other nations, Tribal governments, States, and local governments.

Section 106 of the NHPA and its implementing regulations outline the procedures for Federal agencies to follow to take into account their actions on historic properties. Under Section 106, Federal agencies are responsible for identifying historic properties within the Area of Potential Effects for an undertaking, assessing the effects of the undertaking on those historic properties, if present, and considering ways to avoid, minimize, and mitigate any adverse effects.

3.3.1.2 Affected Environment

Section 3.2.10 of the *Final PEIS* describes in detail the cultural resources that may occur within or adjacent to the project site.

While preparing the *Final PEIS*, NASA sponsored remote sensing surveys of the borrow area. Additionally, prior to conducting the initial beach fill, NASA's dredge contractor surveyed the nearshore zone for submerged cultural resources prior to anchoring its dredge pumpout buoys. No archaeological (below ground or underwater) resources or aboveground historic properties were identified within the project area.

3.3.1.3 Environmental Consequences

Section 4.4.8 of the *Final PEIS* describe in detail the expected effects of dredging and beach nourishment on cultural resources. This section provides both a summary and updated information obtained since the *Final PEIS*.

No Action Alternative

Under the No Action Alternative, the proposed repairs to the beach and seawall would not occur. Therefore, cultural resources would not be impacted.

Proposed Action

All dredging and sand placement would be conducted within areas previously surveyed for cultural resources. Given the lack of potential resources identified during the surveys, no archeological resources or aboveground historic properties would be impacted. However, if unanticipated archaeological artifacts or remains are identified during the project, the contractor would be required to halt work and immediately contact the WFF Historic Preservation Officer, who would consult with the VDHR to 1) determine the significance of the resource; 2) evaluate the effects of the undertaking on the resource; and 3) identify the appropriate avoidance or mitigation measures.

Section 106 Consultation

While preparing the *Final PEIS*, NASA consulted with the VDHR and BOEM; both agencies concurred with NASA that seawall extension, sand retention structure construction, dredging, and beach fill would not have an adverse effect on historic properties.

However, there remained uncertainty as to where the dredge contractor would locate nearshore pumpout stations, some of which could entail anchoring and related seafloor disturbance. Given this uncertainty, NASA and VDHR agreed that remote sensing surveys of proposed pumpout locations would be performed as a term of the dredge contract prior to their establishment. Any anomalies identified by the surveys would be avoided.

Consistent with the agreement, NASA's dredge contractor conducted additional remote sensing surveys of the nearshore pumpout areas, which NASA provided to VDHR. On April 2, 2012, VDHR concurred that no additional survey effort would be needed.

In parallel with preparing this EA, NASA again consulted with VDHR to ensure that the protocol employed for the initial fill cycle would be appropriate for the proposed repairs (NASA 2013e). On March 20, 2013, VDHR concurred with NASA that the protocol would be appropriate and with its implementation the Proposed Action would have no effect on historic properties (see Appendix A).

3.4 Cumulative Effects

The CEQ defines cumulative effects as the "impact on the environment which results from the incremental impact of the action(s) when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7).

Section 4.7 of the *Final PEIS* provides a detailed Cumulative Effects Analysis (CEA) for all potentially affected resource areas throughout the 50-year design life of the shoreline restoration program, including effects of past actions dating to Federal settlement of Wallops Island in the early 1940s. That analysis is incorporated by reference with the focus of this CEA being the timeframe immediately prior to the initial beach fill (i.e., 2012) up until 5 years into the future (i.e., 2018), which is the general timeframe expected for when the next renourishment would be necessary, and when another tiered NEPA document (with corresponding CEA) would be prepared to support the decision-making process.

3.4.1 Resources Evaluated

Following CEQ's 1997 guidance, the scope of the CEA should be related to the magnitude of the environmental impacts of the proposed action. Proposed actions of limited scope and impact typically do not require as comprehensive a CEA as proposed actions that have environmental impacts over a large area.

Therefore, similar to the methodology employed for deciding those resources to be considered in detail in the "direct and indirect effects" section of this EA, only those resource areas upon which the Proposed Action would cause measurable effects are considered in detail in this CEA. Table 3-4 provides a summary of those resources considered and whether they were included for detailed analysis in this CEA.

3.4.2 Actions Included

Sections 3.4.2.1 – 3.4.2.6 below describe the actions that NASA included in this CEA. It should be noted that NASA is currently preparing a twenty-year planning horizon "master plan" *Site-wide PEIS*, and accordingly it considered the relevance of those actions to this CEA.

Table 3-4: Resources Considered for Cumulative Effects
Only Those Analyzed in Detail in this EA are Shown

Resource	Analyzed in Detail in this CEA?	If *Yes*, EA Section If *No*, Rationale for Elimination
Physical Environment		
Coastal Geology & Processes	Yes	3.4.3.1
Water Quality	No	Negligible impacts identified in this EA
Coastal Zone Management	No	Negligible impacts identified in this EA
Air Quality & Climate Change	No	Negligible impacts identified in this EA
Noise	No	Negligible impacts identified in this EA
Biological Environment		
Benthos	Yes	3.4.3.2
Wildlife	Yes	3.4.3.3
Fisheries & Essential Fish Habitat	Yes	3.4.3.4
Marine Mammals	No	Negligible impacts identified in this EA
Threatened & Endangered Species	Yes	3.4.3.5
Social Environment		
Cultural Resources	No	Negligible impacts identified in this EA

However, it was determined that those actions possibly presenting additive impacts to resources affected by the Proposed Action either would not overlap temporally (i.e., they would occur well into the future) or are not well defined enough to be considered reasonably foreseeable for inclusion in this CEA.

3.4.2.1 Wallops Island Initial Beach Fill and Seawall Extension

Between April and August 2012, USACE (on NASA's behalf) contracted the placement of approximately 3.2 million CY of sand along approximately 3.7 mi of the Wallops Island shoreline. Nearly the entire area 100-200 ft east of the existing rock seawall was converted from open water to an elevated beach and dune. Additionally, the seawall was extended approximately 1,415 ft south.

3.4.2.2 Wallops Island Range Activities

NASA can currently launch up to 108 rockets a year from the pads on Wallops Island. These include a maximum of 60 from the Sounding Rockets Program, 12 from orbital rocket missions at Pad 0-B, 6 from orbital rocket missions at Pad 0-A, and 30 from Navy missiles and drones (NASA 2005; NASA 2009). However, the current expected launch tempo within the analysis period is approximately 10-15 sounding rockets and 4-6 orbital launches per year. NASA also conducts unmanned aerial system (UAS) flights from the existing airstrip on south Wallops Island.

In support of its launch range, NASA recently proposed to establish a protocol for enabling the temporary landing of its UH-1 surveillance helicopter on North Wallops Island to provide rapid safety surveillance of Chincoteague Inlet and Atlantic Ocean during rocket launches. During launch countdowns, NASA utilizes its helicopter and crew to monitor boat traffic and to either escort encroaching vessels or to notify the Coast Guard that further action is required to ensure safety.

3.4.2.3 North Wallops Island Unmanned Aerial Systems Airstrip

In March 2013, NASA obtained permits for the construction of an approximately 2,600-ft-long UAS airstrip on north Wallops Island. Funding has not yet been secured, however NASA intends to construct the project as soon as practicable. While the footprint of construction would be well outside the areas frequented by resources potentially impacted by the Proposed Action (e.g., beach nesting birds), the project would enable routine overflight of the Wallops Island beach during either approach or departure. The expected level of activity from the new airstrip is not expected to exceed 1,044 sorties (flights) per year (NASA 2012b).

3.4.2.4 Installation and Operation of a U.S. Navy Powder Gun and Railgun

The Naval Surface Warfare Center Dahlgren Division (NSWCDD) has proposed to install and operate a 5”/62 powder gun and electromagnetic railgun on Wallops Island beginning in 2014. This research, development, test, and evaluation project would begin with the installation of a 5”/62 powder gun that fires the same projectiles as the railgun. The preferred installation site is Pad 5, located mid-island east of Navy building V-3. The original plan was to fire approximately 100 inert test rounds from the powder gun in 2014; however the number of rounds would likely be reduced due to budget and schedule issues. Installation of the railgun is expected to follow in 2015 and railgun testing is expected to continue through 2019. The railgun is projected to fire a combination of mostly inert rounds with a small percentage of live warheads. The live warheads would have a net explosive weight of less than approximately 2 pounds each. NSWCDD, in cooperation with NASA WFF, is preparing an EA to evaluate the environmental consequences of the powder gun and railgun activities at Wallops Island.

3.4.2.5 Wallops Island Beach Motorized Uses

The WFF security office performs daily vehicle patrols of the Wallops Island beach. All patrols follow a defined protocol, which mandates that the same points of access are used, and that unless emergency conditions dictate, all vehicles are operated within the intertidal zone.

In addition, a portion of the north Wallops Island beach is open to WFF employees for recreational use. The extent of the open area is modified based upon the time of year, with winter months the least restrictive and non-winter months the most restrictive to protect nesting piping plovers and sea turtles. Launch range safety regulations mandate that all areas south of the northern terminus of the rock seawall are closed to recreation, regardless of time of year.

3.4.2.6 Wallops Island Predator Management

On NASA's behalf, the U.S. Department of Agriculture Wildlife Services staff performs regular predator removal on Wallops Island to reduce the potential for the depredation of eggs or young of beach nesting species (e.g., turtles, shorebirds). Efforts focus primarily on the management of raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), red fox (*Vulpes vulpes*), laughing gull (*Larus atricilla*), herring gull (*Larus argentatus*), great black-backed gull (*Larus marinas*), fish crow (*Corvus ossifragus*), American crow (*Corvus brachyrhynchos*), and common grackle (*Quiscalus quiscula*). Activities are conducted year round as needed with more effort being spent during the winter, spring, and early summer months. These times are most important due to mammalian predator dispersal, bird breeding, and nesting times.

3.4.2.7 Wallops Island Protected Species Monitoring

As a component of its Natural Resources Management Program at WFF, NASA regularly surveys the Wallops Island beach for piping plover and sea turtle activity between the months of March and September. Any nests discovered are marked with a global positioning unit and identified with signage. In addition to the regular field survey, program staff also provide outreach to all users of the beach, including security staff and recreational users. Elements of the outreach program include maintenance of signage at all beach access points and development and dissemination of fact sheets, both of which contain information regarding the listed species that may be on the beach and the appropriate reporting protocol if the presence of a species is suspected.

3.4.3 Potential Cumulative Effects

Below is a discussion of the potential cumulative effects for each resource area that would be measurably impacted by the Proposed Action.

3.4.3.1 Coastal Geology and Processes

In combination with the Wallops Island initial fill cycle, the cumulative effect of the Proposed Action would be the introduction of a total of approximately 4,000,000 CY of sediment within the nearshore zone over a 2.5-year period. In consideration of the general trends of sediment movement within the analysis area, it is expected that a majority of the material would move toward the north end of Wallops Island, therefore contributing to its continued growth. In the cross-shore direction, it is expected that the introduction of fill material would result in the formation of more offshore bars.

At the offshore borrow area, the additional dredging under the Proposed Action would have the additive effect of reducing the elevation of sub-area A-1 by a total of 5-10 ft on average, with some areas lowered by up to 20 ft in total. However, as discussed in Section 3.1.1.2 of this EA, the physical process modeling performed for the *Final PEIS* simulated an even greater lowering of the shoal, with the results indicating that removing the entire 50-year program's sand volume (approximately 10 million CY) at one time would not have notable effects on the wave sheltering properties of the subject shoal. Therefore, it can be concluded that the combination of dredging from the initial beach fill and the Proposed Action would not measurably affect the sediment transport processes on properties to the west of the borrow area.

3.4.3.2 Benthos

When considered collectively with the initial beach fill, the proposed renourishment would further delay the recovery of the offshore and nearshore benthic communities affected by the project, however the duration would be relatively short (on the order of several seasons) and spatial extent limited to a smaller area that that was impacted by the initial beach fill.

3.4.3.3 Wildlife

The focus of this section is avian resources, as the Proposed Action would most measurably affect them. When considered in conjunction with the Proposed Action, noise and lighting from launch range activities and the powder gun/railgun firings could produce additive effects on beach dwelling birds. The most likely effect would be the elicitation of a startle or flee response, which would interrupt foraging and nesting activities. Effects would be most pronounced during the spring and summer months, when nesting would occur. Given the additive reduction in available forage (discussed in more detail below) and cumulative presence of anthropogenic sources of sound and light in areas further south, it is possible that most avian activity would remain on the north Wallops Island beach.

In general, given its distance from the launch facilities on south Wallops Island, north Wallops Island is not measurably affected by noise from most range activity with the exception of the proposed helicopter surveillance activities and future UAS overflights from the north airstrip. However, NASA would maintain at least a 1,000 ft buffer from identified shorebird nests to reduce the potential for impacts. This buffer requirement has been applied historically at the south UAS airstrip and was established for the future use of the north airstrip to reduce potential startle effects. Moreover, NASA is currently consulting with USFWS on the helicopter landings due to potential effects on piping plovers and would only conduct such landings during shorebird nesting season following the completion of the consultation.

If, during beach reconstruction, avian species relocated north to the recreational beach outside the project site, cumulative effects on nesting shorebirds could also occur from motorized uses on the Wallops Island beach. If unmanaged, motorized vehicle use on beaches can be a threat to beach nesting birds due to the potential for disturbance or mortality of adults, nests, and fledglings. However, with the continued implementation of the protected species monitoring program on the Wallops Island beach, it is expected that nests would be identified shortly after establishment and marked with signage. Site-specific measures, particularly the relocation of recreational activities to areas without nesting activity, could further mitigate any potential effects. Additionally, as vehicular use of the Wallops beach is relatively low, and is limited to WFF employees (who receive protected species awareness training), these effects are not expected to be substantial.

Consistent with the discussion above under *Benthos*, additional dredging and sand placement would essentially "reset" the infaunal recovery that is taking place at the project site following the initial fill cycle, and would have an adverse effect on beach foraging birds, which rely upon organisms in the intertidal zone for sustenance. In general, given that the initial beach fill occurred during the summer months, the additive effect would be the most pronounced if the Proposed Action were to occur in summer. However, given that the extent of the proposed renourishment would not extend beyond the areas previously affected, and along the shoreline the linear extent of the affected area would be approximately 40 percent less, it is expected that beach foraging birds could find necessary food resources within adjacent areas.

One of the greatest threats to nesting shorebirds is predation. To reduce the risks of predation to nesting shorebirds and sea turtles on the Wallops Island beach, WFF employs biologists from USDA Wildlife Services who routinely perform predator removal.

In summary, despite potential adverse cumulative effects on beach nesting and foraging waterbirds, at a time when the availability of elevated beach nesting habitat is declining, the proposed renourishment would return several miles of the beach that are currently intertidal to supratidal, which would be more suitable for nesting. Coupled with long-term active monitoring of nesting activities and predator control, the combined effect would likely be a net benefit on beach-reliant avian species.

Similar to the nearshore effects, dredging at Unnamed Shoal A would again perturb the recovery of benthos upon which seabirds or prey species (e.g., fish) feed, which would reduce the forage value of the shoal. However, given that the spatial extent of the affected area would not expand beyond that which was affected for the initial fill cycle, and that undisturbed areas on the shoal would remain for foraging, effects would not be substantial.

3.4.3.4 Essential Fish Habitat

Coupled with the initial fill cycle, the Proposed Action would have a cumulative adverse effect on EFH, particularly due to the lowering of the shoal's elevation and further reduction in available forage for fish species at higher trophic levels. However as discussed under *Benthos* above, although biological recovery at the borrow area would be prolonged, the effects would only persist for several seasons following disturbance and would not extend beyond the area that was affected by the initial fill cycle.

When considered within the larger context of the inner continental shelf offshore of Virginia and Maryland, nearby shoals such as Blackfish Bank, Chincoteague Shoals, and other unnamed shoals in the area would provide alternate foraging and refuge grounds.

3.4.3.5 Threatened and Endangered Species

Potential cumulative effects on piping plover would be generally the same as those discussed above under beach nesting and foraging *Wildlife*, therefore this section focuses on sea turtles with specific discussion of piping plovers as appropriate. The cumulative effects on in-water sea turtles are discussed in detail in the *Final PEIS*, however where there were no documented adverse interactions during the initial beach fill cycle, this CEA does not provide a detailed discussion and rather focuses on interactions with nesting sea turtles.

Operation of heavy equipment on the Wallops Island beach during renourishment would again compact the beach, which could cause the affected area to be less suitable for sea turtle nesting. The placement of additional fill would also steepen the beach profile, which could lead to scarping in areas. The time of year that the renourishment would be conducted would dictate the likelihood of impacts, with a fall/winter beach fill providing the greatest amount of time for profile equilibration prior to the following nesting season. A beach fill occurring during the spring or summer months would present the greatest potential for effects, however the extent of the affected area would be less than that affected by initial beach fill.

Continued recreational and motorized uses on the beach could inadvertently disturb nesting females, crush eggs within the nest, or crush, entrap, or disturb hatchlings attempting to leave the nest. However, with the continued implementation of the protected species monitoring program on the Wallops Island beach, it is expected that nests would be identified shortly after establishment and marked with signage. Site-specific measures, including relocation of recreational activities, shielding nests from artificial light, or establishment of travel corridors between the nest and ocean could further mitigate any potential effects. Additionally, as vehicular use of the Wallops beach is relatively low, and is limited to WFF employees (who receive protected species awareness training), these effects are not expected to be substantial.

Perhaps the greatest risk to sea turtle success is the predation of eggs and young by mammals, birds, and ghost crabs which may eliminate up to 100 percent of the nests and any hatchlings that emerge on beaches where predation is not managed (NRC 1990). However, in consideration of the predator management program, which includes removal of predator species as well as the establishment of exclosures on identified nests, it is expected that the effects of predation are already mitigated to the greatest extent practicable.

In the longer term, should the re-constructed beach become an area regularly used by nesting and foraging plovers and sea turtles, it could expose them to potential effects of launch operations. However, NASA would continue to follow the terms and conditions of its USFWS programmatic BO (2010), which incorporates aspects of its protected species monitoring program, beach nourishment program, and launch operations to provide protective measures to the greatest extent practicable.

In summary, despite potential adverse cumulative effects on sea turtles and plovers, at a time when the availability of elevated beach nesting habitat is declining, the proposed renourishment would return several miles of the beach that are currently intertidal to supratidal, which would be more suitable for nesting, therefore providing a net benefit to these beach nesting species.

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