Kitty Hawk Wind

AVANGRID

Construction and Operations Plan

Appendix M - Sediment Transport Modeling Report

September 30, 2022

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AVANGRID

Appendix M – Sediment Transport Modeling Report

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Construction and Operations Plan
Kitty Hawk North Wind Project
Lease Area OCS-A 0508

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Sediment Transport Modeling Report

Prepared for:

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ACRONYMS AND ABBREVIATIONS

cm	centimeter
electrical service platform	Offshore structure that connects the inter-array cables to the offshore export cables
ESPreSSO	Experimental System for Predicting Shelf and Slope Optics
ft	foot
HDD	horizontal directional drilling
inter-array cable	Submarine cable interconnecting the WTGs and ESP
landfall	The location where the export cables transition from offshore to onshore
Lease Area	the designated Renewable Energy Lease Area OCS-A 0508
m	meter
mg/L	milligrams per liter
mm	millimeter
offshore export cables	Cables connecting the electrical service platform to the transition bay at the landfall
offshore Project Area	The Wind Development Area and the offshore export cable corridor from the Wind Development Area to the landfall
onshore export cables	Cables connecting the electrical service platform to the transition bay at the landfall
onshore substation	The landside substation constructed for the Project that contains transformers and other electrical gear
Project	Kitty Hawk North Wind Project
SO_2	sulfur dioxide
Tetra Tech	Tetra Tech, Inc.
TSHD	trailing suction hopper dredge
Wind Development Area	approximately 40 percent of the Lease Area in the northwest corner closest to shore (19,441 hectares)
wind turbine generator	wind turbine that will generate electricity

M.1 INTRODUCTION

Tetra Tech, Inc. (Tetra Tech) was contracted by Kitty Hawk Wind, LLC (the Company), a wholly owned subsidiary of Avangrid Renewables, LLC, to evaluate the potential suspended sediment transport and deposition associated with the Kitty Hawk North Wind Project (Project) construction activities, including installation of submarine export and inter-array cables. Disturbance of sediments during Project construction has the potential to affect water quality through increases to total suspended solids in the water column and deposition of sediments away from the location of sediment disturbance through resuspension, dispersal, and subsequent sedimentation.

In order to provide a conservative estimate of potential maximum suspended sediment transport and deposition impacts in the Construction and Operations Plan, site-specific sediment data and publicly available water circulation data covering the northwest portion of the designated Renewable Lease Area OCS-A 508 (Lease Area), closest to land (Wind Development Area) and along the offshore export cable corridor (altogether, offshore Project Area) were used to develop the sediment transport model. The modeling was undertaken to quantify potential maximum plume dispersion; suspended sediment concentrations; and potential maximum sediment deposition thicknesses that may occur due to Project construction.

Modeling performed for the previous COP submittal was limited to analysis of sediment disturbance due to jet-plow cable installation and HDD at landfall and used site-specific sediment characteristics described in the Kitty Hawk Project Benthic Assessment Report – Phase 2 Reconnaissance dated June 16, 2020. To address BOEM comments provided in March 2022 based on the previous COP submittal, Tetra Tech analyzed the sediment disturbance due to pre-cable installation dredging and used site-specific sediment characteristics described in the Kitty Hawk Project Benthic Assessment Report – Phase 2 Reconnaissance and the newer Kitty Hawk Wind Project Benthic Assessment Report – Phase 3 dated June 24, 2021.

The sediment transport assessment contained herein includes a description of the Project components and Project Design Envelope that were evaluated (Section M.1.1 and Section M.1.2); a discussion of the modeling approach undertaken (Section M.2); a summary of the data sources and associated hydrodynamic and sediment characteristics applied (Section M.2.1); description of the model runs executed (Section M.3); and results of the analysis and associated conclusions (Section M.4 and Section M.5).

The approach undertaken for this assessment was presented to the Bureau of Ocean Energy Management and the United States Army Corps of Engineers in April and May 2020; feedback provided by these agencies is included herein.

M.1.1 Project Description

The Project will be located in the Lease Area. The Lease Area covers 49,536 hectares and is located approximately 44 kilometers offshore of Corolla, North Carolina (Figure M-1).

At this time, the Company proposes to develop approximately 40 percent of the Lease Area in the northwest corner closest to shore (19,441 hectares; the Wind Development Area). The offshore components of the Project, including the wind turbine generators, electrical service platform, and inter-array cables, will be in federal waters within the Wind Development Area, while the offshore export cable corridor will traverse both federal and state territorial waters of Virginia. The onshore components of the Project, including the onshore export cables, and onshore substation will be located in the City of Virginia Beach, Virginia.

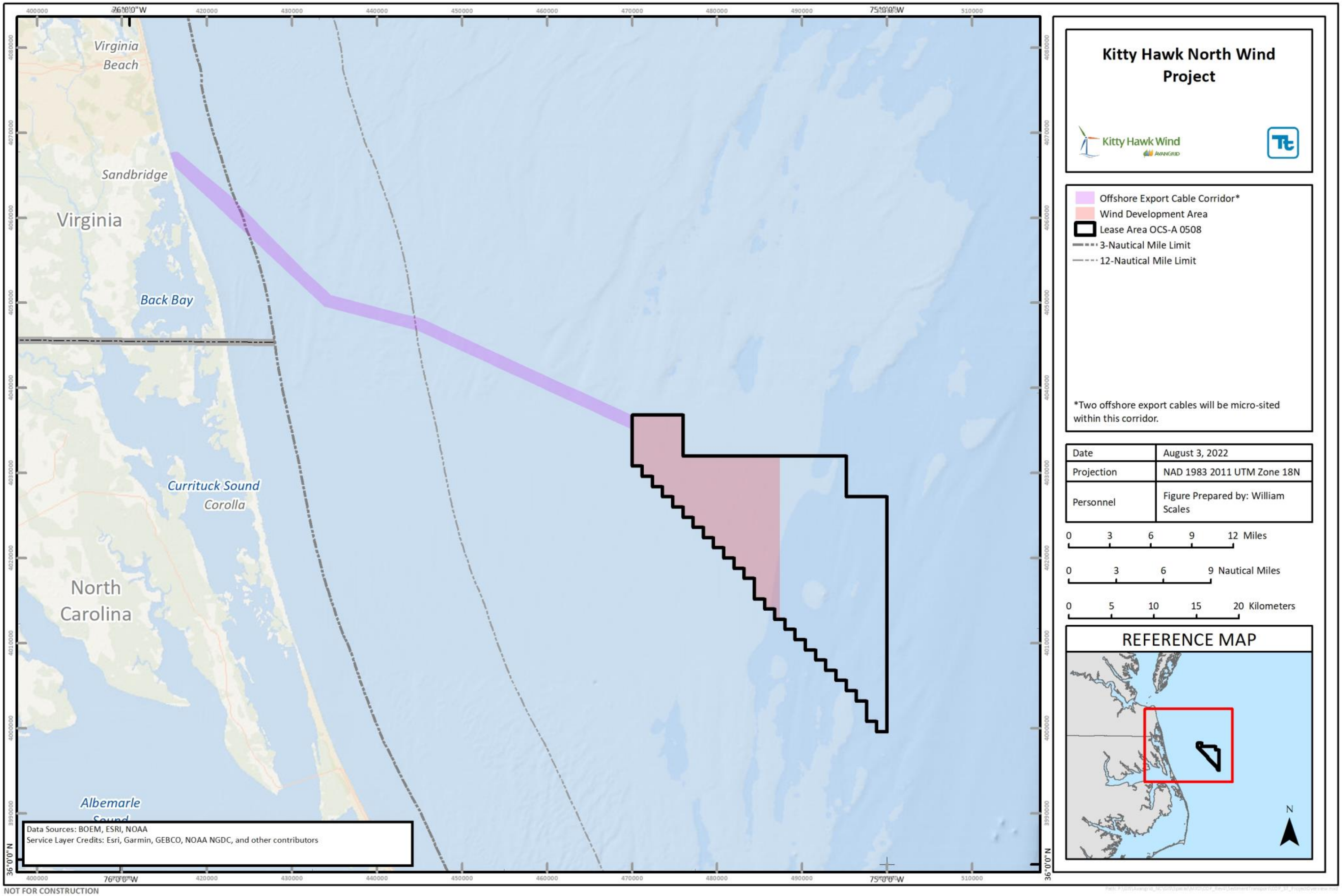

Figure M-1 Project Location

Based on current understanding of site-specific conditions within the Wind Development Area and along the offshore export cable corridor, the Company is currently considering jet plow, mechanical plow, and mechanical cutter as the primary cable installation methodologies. For the ocean to land transition at the cable landfall, horizontal directional drilling (HDD) may be employed. In general, the offshore export cables and inter-array cables will be buried to a target depth of up to 2.5 meters (m) below the seabed surface.

The offshore installation corridor and inter-array cable maximum design scenarios assume dredging will be required at selected locations where there are mobile bedforms. Dredging will occur before cable installation and dredge material is anticipated to be side-cast. If dredging is performed, it would be completed prior to jet plow installation, not concurrently. Any impacts from dredging will have dissipated and the area will have returned to background before jet plow installation. This approach is consistent with the Bureau of Ocean Energy Management's *Draft Guidance Regarding the Use of a Project Design Envelope in a Construction and Operations Plan* (BOEM 2018).

M.1.2 Modeling Assumptions and the Project Design Envelope Approach

In order to evaluate how offshore export cable installation will affect suspended sediment concentrations, transport and deposition, Tetra Tech conducted a sediment transport analysis of the Project. An analytical sediment transport model was developed to predict the fate and transport of sediment suspended by cable burial activities along the offshore export cables and within the Wind Development Area and along the offshore export cables and inter-array cables.

Tetra Tech used site-specific sediment data and flow direction and current velocity from a publicly available hydrodynamic model to inform the analytical model. The analytical model adopted a project design envelope approach to evaluate the effects of proposed offshore export cable burial activities in terms of suspended sediment concentrations in the water column and sediment transport and deposition characteristics, such as deposition depth and sediment footprint, to assess potential Project effects on surrounding water quality and habitats. Two primary cable burial activities were simulated: pre-cable installation dredging and jet-plow cable installation. The paragraphs below describe assumptions about these activities to represent a maximum design scenario consistent with the project design envelope approach.

M.1.2.1 Pre-cable Installation Dredging

A conservative preliminary analysis using bathymetry collected in 2020 along the proposed cable routes was used to identify possible areas of dredging. Possible dredge areas are shown in results figures in Section M.4. Tetra Tech computed dredge volume estimates using a conservative trench width of 20 m (65.5 feet [ft]) for seafloor preparation dredging to mitigate mobile seabed. Dredging is expected when the seabed preparation for cable installation requires that the seabed be lowered an additional 2.5 m (8.2 ft). Other burial tools may be able to mitigate some or all the need for seabed preparation or pre-installation dredging; however, this methodology is assessed herein to provide flexibility in final installation design.

To evaluate sediment transport from pre-cable installation dredging, Tetra Tech simulated trailing suction hopper dredge (TSHD) with hopper overflow and disposal of the dredge material assumed from the vessel bottom near the dredge location. TSHD operations would result in higher suspended sediment concentrations than mass flow excavation primarily due to hopper overflow and the release of a large volume of dredge material from the bottom of the vessel (Vineyard Wind 2018). A relatively small amount of sediment (about 1 percent dry weight basis) is resuspended at the seabed due to disturbance from the suction head (Anchor Environmental 2003).

TSHD operations vary based on sediment characteristics, economics, and environmental concerns. The chosen method of TSHD hopper loading is important when considering suspended sediment concentrations. TSHD hopper loading is accomplished by one of three methods: pumping past overflow, agitation dredging, and pumping to overflow (USACE 2015). Pumping past overflow and agitation dredging increase suspended sediment concentrations at the surface by allowing sediment laden water to spill over the hopper to make room for additional sediment prior to disposal. If the material is clean sand, the percentage of solids in the overflow is low (USACE 2015). Pumping to overflow describes the process of filling the hopper to capacity without allowing for overflow. Suspended sediment is usually lower for TSHD pumping to overflow than pumping past overflow (Anchor Environmental 2003). Pumping to overflow is recommended when the dredged material contains contaminated sediments and/or adverse environmental effects have been identified (USACE 2015).

M.1.2.2 Jet Plow Cable Installation

The model simulated jet plow[1] installation, which would result in greater disturbance of marine sediments than mechanical plow or mechanical cutter installation, and therefore provide the maximum expected disturbance of seabed sediment in the offshore Project Area of the three installation methods. Sediment disturbance due to pre-cable installation dredging is considered separately as described in Section M.1.2.1. The model also evaluates the effects of HDD in areas where jet plowing may not be suitable. This approach provides the Project reasonable flexibility to make prudent development and design decisions prior to construction.

M.1.2.3 Maximum Design Scenario

For the purpose of this analysis, the Project has assumed the following as the maximum design scenario:

- The proposed offshore export cables with landfall at Sandbridge Beach, City of Virginia Beach, Virginia;
- A target maximum burial depth for inter-array cables and offshore export cables of 2.5 m;
- The use of TSHD with hopper overflow and dredge material disposal from the vessel bottom (6.1 m [20 ft] below the surface) to smooth mobile seabed features prior to cable installation;
- The use of a jet plow/jet trencher,[2] since this is anticipated to be the cable installation method used for the majority of the inter-array and offshore export cable installation; and
- The use of HDD for cable landfall.

It is also assumed that activities during installation will capture the maximum scenario for sediment disturbance where the disturbance is expected to be equal to or greater than that associated with operations or decommissioning activities. Project activities during operations may include inspection and repair of subsea infrastructure (i.e., cables); however, any impacts are expected to be less than those anticipated during construction since they would only involve a portion of the overall project. Thus, this assessment focuses on activities and impacts during the construction phase of the Project.

M.2 MODELING APPROACH

The aim of this study is to evaluate the effects of proposed offshore export pre-cable installation dredging and proposed offshore export and inter-array cable installation and burial activities in terms of suspended sediment concentrations in the water column and sediment deposition characteristics, such as deposition

[1] As a base case, a towed jet plow is anticipated to be used for the offshore export cable installation and a remote-operated jet trencher will be used for the inter-array cable installation. Both tools use the same methodology to fluidize the sediment and bury the cable. Therefore, impacts to sediment suspension and dispersal from both tools are expected to be the same. These tools are collectively referred to as “jet plow” in this analysis.

[2] To install the cable, the jet plow’s water nozzle temporarily loosens the soil, creating a narrow trench. The cable is fed into this trench as the plow moves along the ocean floor. Marine sediment resettles upon the cable, closing the trench with minimal impact to the sea floor. However, some marine sediments may stay suspended in the water column, temporarily increasing total suspended solids, and dispersion of the sediments may cause material to deposit outside the area of disturbance.

depth and sediment deposition footprint. Publicly available current velocity and flow direction and Project collected sediment characteristics were used.

M.2.1 Current Velocity and Flow Direction

The modeling approach uses the publicly available Experimental System for Predicting Shelf and Slope Optics (ESPreSSO) hydrodynamic model to develop information regarding current velocity and flow direction in the offshore Project Area. This model has been used to obtain velocities and flows for other sediment transport models in the region (Tetra Tech 2015). ESPreSSO uses the Regional Ocean Modeling System, a three-dimensional, free-surface, terrain-following ocean model that solves the Reynolds-averaged Navier-Stokes equations using the hydrostatic vertical momentum balance and Boussinesq approximation (Haidvogel et al. 2000; Shchepetkin and McWilliams 2005). The ESPreSSO model domain covers the Mid-Atlantic Bight from the center of Cape Cod, Massachusetts southwards to Cape Hatteras, North Carolina. It has a horizontal resolution of 5 kilometers, and 36 terrain following vertical levels were selected and paired with the sediment data in the analytical model. Vertical levels were selected to represent flood and ebb current velocities at the surface, at a depth of 6.1 m (20 ft) below the surface, and at the seabed.

The velocity stations used in the analytical sediment transport model are shown in Figure M-2. For the purpose of this study, the stations were assigned station identification numbers (station ID) from 1 through 13 for easy reference. The stations were also assigned zones based on their proximity to different Project components.

Table M-1 lists the representative velocities at the surface. These velocities were used to estimate sediment transport during hopper overflow. Table M-2 lists the representative velocities at the dredge vessel bottom (depth of 6.1 m (20 ft). Velocities in Table M-2 were used to estimate transport of dredge material after disposal. Table M-3 lists the representative seabed flood and ebb velocities at all the stations. These velocities were used to estimate sediment transport during jet-plow cable installation. Both ebb and flood velocities were used to calculate the possible maximum extent of sediment deposition and suspended sediment water column concentrations within the offshore Project Area under these conditions.

Table M-1 Maximum Flood and Ebb Current Velocity from the ESPreSSO Model at the Surface

Station ID	Longitude (° W)	Latitude (° N)	Flood Velocity (meters per second)	Ebb Velocity (meters per second)
3	-75.72	36.63	0.50	0.30
4	-75.67	36.59	0.46	0.34
5	-75.63	36.55	0.56	0.24
6	-75.52	36.56	0.45	0.18
7	-75.47	36.52	0.50	0.24
8	-75.43	36.48	0.44	0.23
9	-75.32	36.49	0.49	0.19

Table M-2 Maximum Flood and Ebb Current Velocity from the ESPreSSO Model at Dredge Vessel Bottom

Station ID	Longitude (° W)	Latitude (° N)	Flood Velocity (meters per second)	Ebb Velocity (meters per second)
3	-75.72	36.63	0.51	0.20
4	-75.67	36.59	0.44	0.28
5	-75.63	36.55	0.47	0.27
6	-75.52	36.56	0.42	0.18
7	-75.47	36.52	0.41	0.16
8	-75.43	36.48	0.44	0.16
9	-75.32	36.49	0.46	0.21

Table M-3 Maximum Flood and Ebb Current Velocity from the ESPreSSO Model at the Seabed

Station ID	Longitude (° W)	Latitude (° N)	Depth (m)	Flood Velocity (meters per second)	Ebb Velocity (meters per second)	Zone
1	-75.81	36.71	14.48	0.23	0.17	Offshore export cable corridor
2	-75.77	36.67	16.68	0.22	0.18	Offshore export cable corridor
3	-75.72	36.63	17.47	0.23	0.19	Offshore export cable corridor
4	-75.67	36.59	19.49	0.23	0.20	Offshore export cable corridor
5	-75.63	36.55	22.06	0.23	0.21	Offshore export cable corridor
6	-75.52	36.56	22.63	0.24	0.20	Offshore export cable corridor
7	-75.47	36.52	24.53	0.25	0.20	Offshore export cable corridor
8	-75.43	36.48	25.97	0.26	0.20	Offshore export cable corridor
9	-75.32	36.49	26.90	0.27	0.18	Offshore export cable corridor
10	-75.33	36.40	27.95	0.28	0.19	Wind Development Area
11	-75.27	36.45	28.31	0.27	0.18	Wind Development Area
12	-75.22	36.41	30.33	0.27	0.18	Wind Development Area
13	-75.18	36.37	32.44	0.27	0.18	Wind Development Area

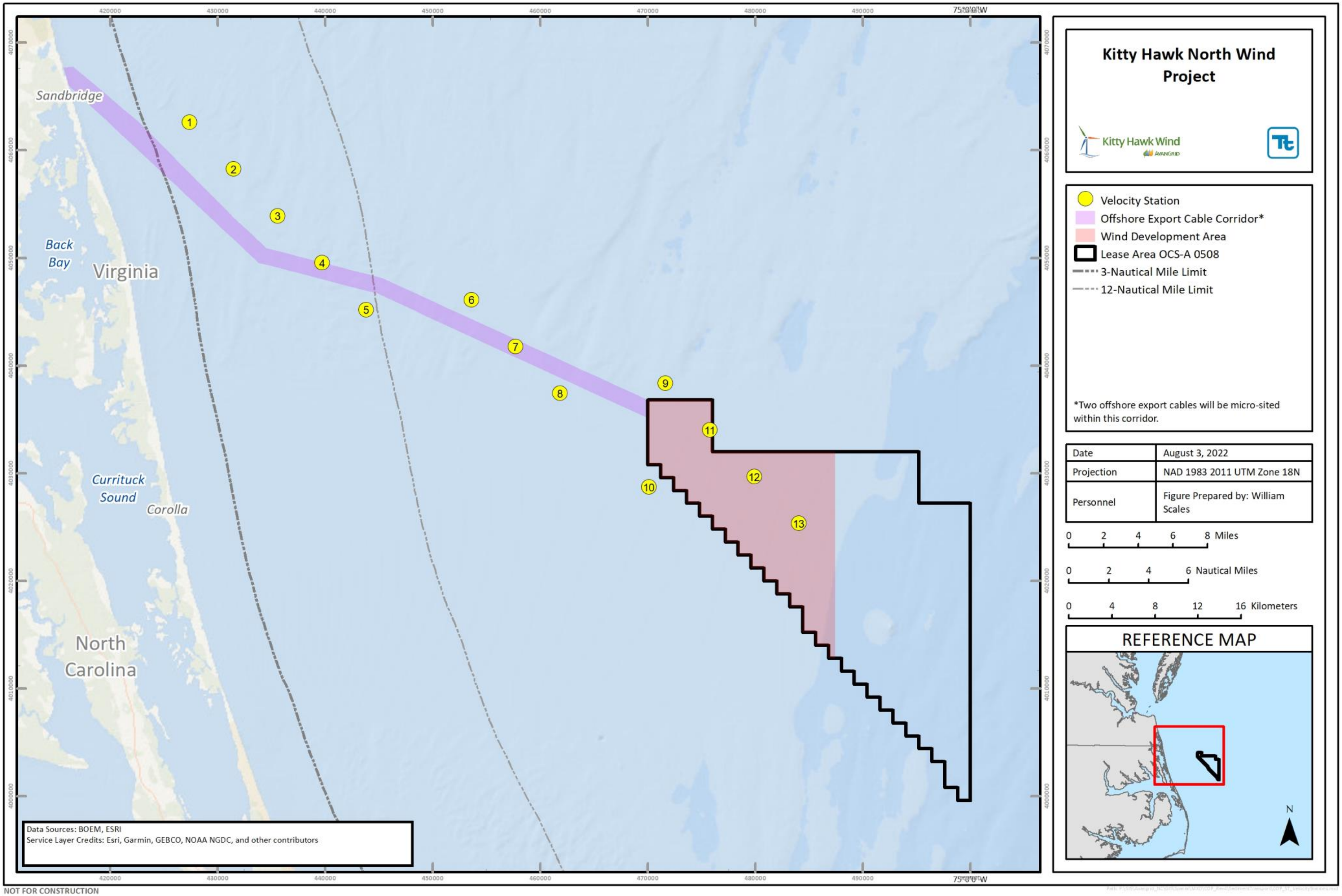

Figure M-2 Velocity Station Locations

M.2.2 Sediment Characteristic Data

Two sets of sediment characteristic data were collected by the Company and used in the sediment transport analysis. Modeling performed to analyze sediment disturbance due to jet-plow cable installation and HDD at landfall used site-specific sediment characteristics from grab samples described in the Kitty Hawk Project Benthic Assessment Report – Phase 2 Reconnaissance dated June 16, 2020. Results of this analysis were described in the previous COP submittal and reviewed by BOEM. To address BOEM comments from the previous COP submittal, Tetra Tech analyzed the sediment disturbance due to pre-cable installation dredging and used site-specific sediment characteristics described in the Kitty Hawk Project Benthic Assessment Report – Phase 2 Reconnaissance and the Kitty Hawk Wind Project Benthic Assessment Report – Phase 3 dated June 24, 2021. The jet-plow and cable installation analysis described in the previous COP was unchanged.

Preliminary sediment characteristic data, including site-specific sediment grain size distribution data, were collected throughout the offshore Project Area by the Company on 4 and 5 Feb 2020 (TerraSond-Avangrid Renewables 2020). The Company collected surface sediment grab samples in and around the offshore Project Area at 49 locations. Of the 49 locations where sediment data were collected, 30 locations fell in the offshore export cable corridor and Wind Development Area (Figure M-3). The sampling event evaluated sediment grain size, moisture content, solids content, and organic content. Sediment sample particle classification percentages were provided based on the sediment grain size.

Additional sediment characteristic data were collected by the Company in October and November of 2020 (TerraSond-Avangrid Renewables 2021). Of the 201 locations where sediment data were collected, 31 locations fell within the export cable corridor. Characteristics from 38 sediment grab samples were near the anticipated dredge areas and averaged to use in the analytical model (Figure M-4).

Tetra Tech classified the sediment data into coarse sediment (i.e., gravels and large sands; greater than 0.25 millimeter [mm]) and fine sediment (i.e., fine sand and mud; less than 0.25 mm) based on the sediment grain size (USGS 2005). When cables are installed using jet plowing, only fine sand and smaller particle sizes remain suspended in the water column long enough to be transported away from the immediate trench. Larger particle sizes such as coarse sediment re-settle immediately into the trench (Tetra Tech 2012, 2015). Only fine sand and mud were assessed in the jet plow cable installation sediment transport model. Both larger particle sizes and fine sand and mud were assessed in the pre-cable installation dredging sediment transport model.

Tetra Tech assumed that fine sand and mud were comprised of finer classes. The percent fine sand class was equally divided into percent fine sand and percent very fine sand. The percent mud class was equally divided into percent silt and percent clay. This was done so that a finer scale modeling effort could be completed with the sediment distribution presented in an un-biased manner and for a broader range of size classes consistent with the full range of particle size distribution typical for marine sediments in the region. Settling velocities were assigned to these classes (USGS 2005). Density data was not collected during the sediment grab sample study. An average density of 2,600 kilograms per cubic meter was assigned to all samples.

Table M-4 summarizes the grab sample locations used to estimate sediment characteristics in the pre-cable installation dredging sediment transport model. Of the grab sample locations used, mud particles made up 6 percent or less of the total sediment sample. To represent the composition of sediment from the dredged areas, grab sample data were assigned to a velocity station and averaged.

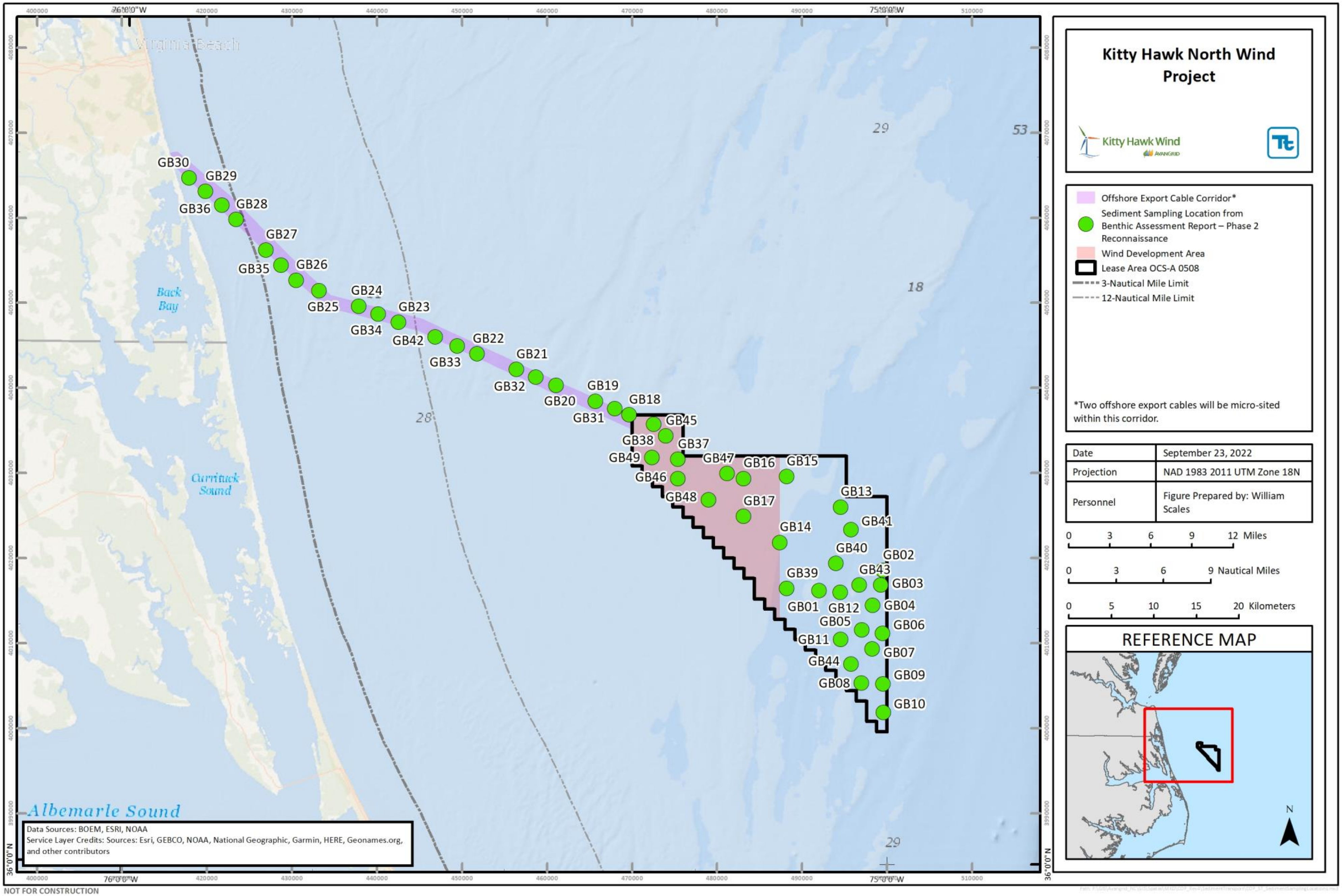

Figure M-3 Sediment Sampling Locations used for Sediment Transport Analysis of Jet-Plow Cable Installation and HDD at Landfall

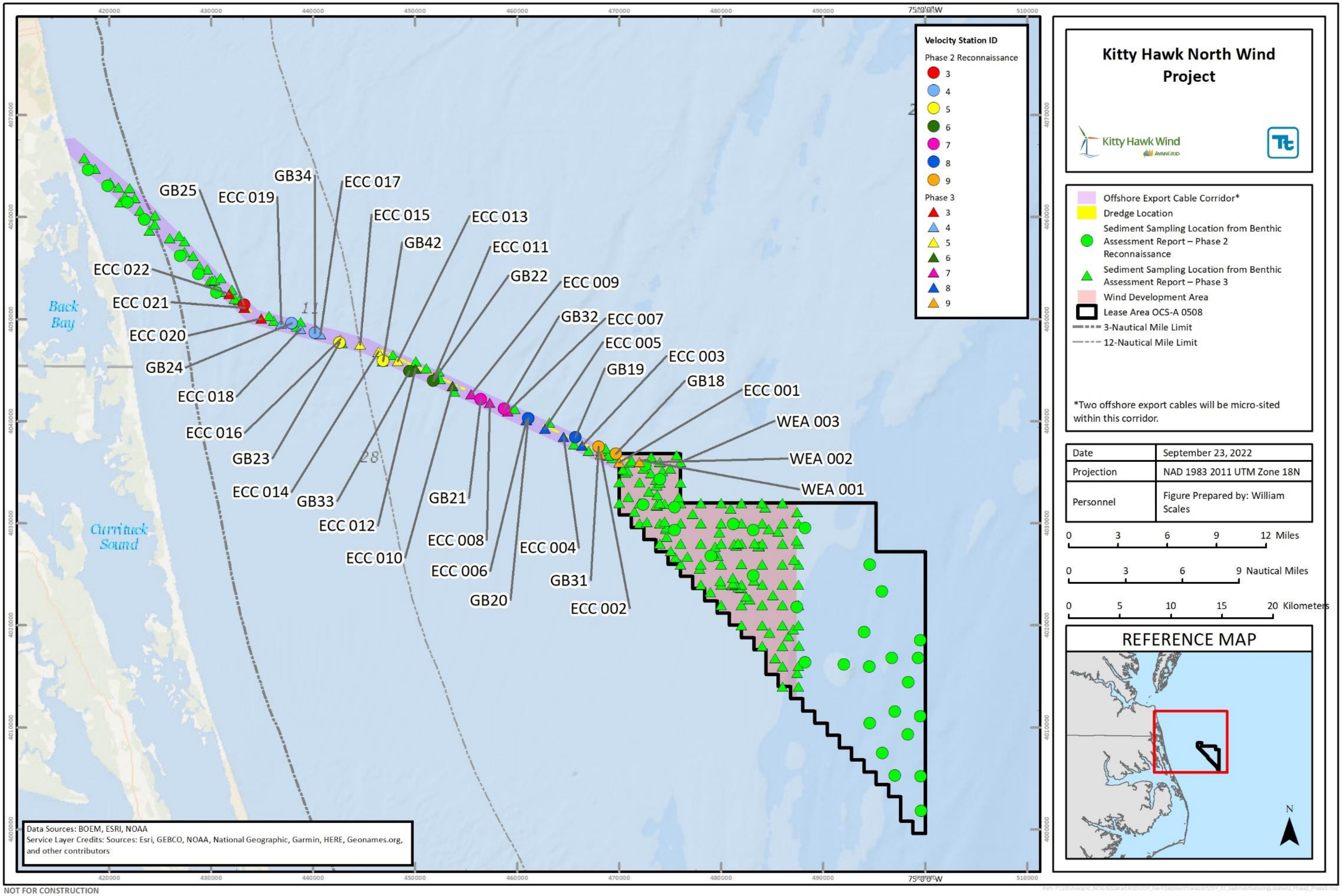

Figure M-4 Sediment Sampling Locations used for Sediment Transport Analysis of Pre-Cable Installation Dredging

Table M-4 Grab Sample Sediment Particle Size Distributions for Sample Locations Used in Pre-Cable Installation Dredge Analysis

Sample	Total Coarse Sediment	Total Fine Sediment a/	Fine Sand		Mud		Velocity Station ID
			Fine Sand	Very Fine Sand	Silt	Clay	
ECC_020	35%	65%	32%	32%	1%	1%	3
ECC_021	38%	62%	29%	29%	2%	2%	3
ECC_022	93%	7%	2%	2%	2%	2%	3
GB25	5%	95%	46%	46%	1%	1%	3
ECC_017	22%	78%	38%	38%	1%	1%	4
ECC_018	11%	89%	43%	43%	2%	2%	4
ECC_019	4%	96%	47%	47%	2%	2%	4
GB24	2%	98%	49%	49%	0%	0%	4
GB34	2%	98%	48%	48%	1%	1%	4
ECC_013	19%	81%	38%	38%	3%	3%	5
ECC_014	14%	86%	42%	42%	1%	1%	5
ECC_015	4%	96%	47%	47%	2%	2%	5
ECC_016	3%	97%	46%	46%	3%	3%	5
GB23	4%	96%	47%	47%	1%	1%	5
GB42	72%	28%	13%	13%	1%	1%	5
ECC_010	6%	94%	46%	46%	1%	1%	6
ECC_011	13%	87%	42%	42%	2%	2%	6
ECC_012	25%	75%	35%	35%	3%	3%	6
GB22	19%	81%	39%	39%	1%	1%	6
GB33	0%	100%	49%	49%	1%	1%	6
ECC_007	12%	88%	43%	43%	2%	2%	7
ECC_008	2%	98%	47%	47%	2%	2%	7

Sample	Total Coarse Sediment	Total Fine Sediment a/	Fine Sand		Mud		Velocity Station ID
			Fine Sand	Very Fine Sand	Silt	Clay	
ECC_009	5%	95%	45%	45%	3%	3%	7
GB21	0%	100%	48%	48%	2%	2%	7
GB32	0%	100%	48%	48%	1%	1%	7
ECC_003	16%	84%	41%	41%	2%	2%	8
ECC_004	10%	90%	44%	44%	1%	1%	8
ECC_005	6%	94%	45%	45%	3%	3%	8
ECC_006	3%	97%	47%	47%	2%	2%	8
GB19	12%	88%	43%	43%	1%	1%	8
GB20	1%	99%	49%	49%	1%	1%	8
ECC_001	63%	37%	18%	18%	1%	1%	9
ECC_002	27%	73%	35%	35%	2%	2%	9
GB18	51%	49%	23%	23%	1%	1%	9
GB31	3%	97%	47%	47%	1%	1%	9
WEA_001	11%	89%	44%	44%	1%	1%	9
WEA_004	8%	92%	45%	45%	1%	1%	9
WEA_005	4%	96%	46%	46%	2%	2%	9

provides the fine sediment particle percentages for the different grab sample locations in the offshore Project Area that were used in the jet-plow and HDD installation analysis. In 5 of the samples, fine particles made up less than 25 percent of the total sediment sample, while 18 samples had more than 75 percent total fine sediment. The percentage of fine particles within the sediment samples was highly variable and ranged from 11 percent to 100 percent. This variability can be seen in both zones. The highest average fine sediment percentage was observed in stations in the offshore export cable corridor with fine particles accounting for nearly 75 percent of the total sediments. The Wind Development Area, on average, has around 60 percent fine sediment particles.

M.3 SEDIMENT TRANSPORT MODEL

This section describes the methodology followed to develop the analytical sediment transport model to characterize the potential maximum sediment transport and deposition scenario for jet plow activities. The model simulates sediment resuspension due to jet plow operations and analyzes the water column suspended sediment concentrations and subsequent sediment deposition pattern in order to determine potential sediment impacts during Project installation activities. The model also looks at the impacts of HDD that may occur closer to the shore near the HDD exit locations for the export cables. The analytical model incorporates the hydrodynamic data from the ESPreSSO model. The sediment settling and transport assumptions are conservative in nature so that the expected maximum water quality column concentrations and potential sediment transport are calculated. The analytical model is based on the physical laws governing transport of sediment due to local current conditions, and the settling of sediment is based on Stokes Law. Assumptions used to develop a project design envelope approach for the sediment transport analysis are listed in detail in Section M.3.1.

M.3.1 Model Setup and Parameterization

Model setup and parameterization differed between the pre-cable installation dredge analysis and the jet plow and HDD analysis reflecting the differences in the activity's sediment volumes and vertical release location.

M.3.1.1 Pre-cable Installation Dredging

TSHD uses a drag arm and pumps located on a vessel to suction sediments from the seabed to a storage hopper on the vessel. A relatively small amount of sediment (about 1 percent dry weight basis) is resuspended at the seabed due to disturbance from the suction head (Anchor Environmental 2003). During the suctioning, water accompanies seabed sediment into the hopper. Production rates range from 380 m^3-3,800 m^3 (500-5,000 cubic yards) per hour (USACE 2015) and hopper capacities can range from 3,400 m^3 to up to 45,000 m^3 (International Association of Dredging Companies 2014). The empty hopper fills with water and sediment until the initial hopper volume is full. During this time, heavier materials settle into the hopper and small particles stay suspended. Pumping continues and water plus some sediment overflows the hopper and is released into the water column at the surface. Van Rijn (2019) reports that total overflow is typically 5 percent to 10 percent of the total volume of sand pumped into the hopper and as high as 30 percent of the total mud volume. Once the hopper is filled to disposal capacity, the vessel sails to the disposal location and releases the hopper contents through an opening at the bottom of the vessel.

Tetra Tech did not simulate the 1 percent sediment resuspension at the seabed because the maximum concentrations and sediment deposition due to TSHD will be determined by the hopper overflow and dredge material disposal. A conservative approach was taken to simulate overflow and dredge disposal by assuming the entire volume of sediment present in the overflow is released into the water column instantaneously at the start of the simulation. In reality, this volume is released over the time that pumping occurs, which results in lower sediment concentrations than the model estimate.

Table M-5 Offshore Project Area Sediment Particle Size Distributions

Sample	Zone	Total Coarse Sediment	Total Fine Sediment a/	Fine Sand		Mud		Velocity Station ID
				Fine Sand	Very Fine Sand	Silt	Clay	
GB14 b/	Wind Development Area	80%	21%	9%	9%	1%	1%	15
GB16	Wind Development Area	1%	99%	48%	48%	1%	1%	12
GB17	Wind Development Area	0%	100%	48%	48%	1%	1%	13
GB18	Offshore export cable corridor	51%	49%	23%	23%	1%	1%	9
GB19	Offshore export cable corridor	12%	88%	43%	43%	1%	1%	8
GB20	Offshore export cable corridor	1%	99%	49%	49%	1%	1%	8
GB21	Offshore export cable corridor	0%	100%	48%	48%	2%	2%	7
GB22	Offshore export cable corridor	19%	81%	39%	39%	1%	1%	6
GB23	Offshore export cable corridor	4%	96%	47%	47%	1%	1%	5
GB24	Offshore export cable corridor	2%	98%	49%	49%	0%	0%	4
GB25	Offshore export cable corridor	5%	95%	46%	46%	1%	1%	3
GB26	Offshore export cable corridor	69%	31%	15%	15%	1%	1%	3
GB27	Offshore export cable corridor	90%	11%	3%	3%	2%	2%	2
GB28	Offshore export cable corridor	46%	55%	26%	26%	1%	1%	1
GB29	Offshore export cable corridor	0%	100%	44%	44%	6%	6%	1
GB30	Offshore export cable corridor	0%	100%	47%	47%	2%	2%	1
GB31	Offshore export cable corridor	3%	97%	47%	47%	1%	1%	9
GB32	Offshore export cable corridor	0%	100%	48%	48%	1%	1%	7
GB33	Offshore export cable corridor	0%	100%	49%	49%	1%	1%	6
GB34	Offshore export cable corridor	2%	98%	48%	48%	1%	1%	4
GB35	Offshore export cable corridor	69%	31%	15%	15%	1%	1%	2

Sample	Zone	Total Coarse Sediment	Total Fine Sediment a/	Fine Sand		Mud		Velocity Station ID
				Fine Sand	Very Fine Sand	Silt	Clay	
GB36	Offshore export cable corridor	60%	40%	19%	19%	1%	1%	1
GB37	Wind Development Area	82%	18%	8%	8%	1%	1%	11
GB38	Wind Development Area	77%	24%	11%	11%	1%	1%	9
GB42	Offshore export cable corridor	72%	28%	13%	13%	1%	1%	5
GB45	Wind Development Area	23%	77%	38%	38%	1%	1%	11
GB46	Wind Development Area	19%	81%	39%	39%	1%	1%	12
GB47	Wind Development Area	1%	99%	48%	48%	1%	1%	12
GB48	Wind Development Area	79%	21%	10%	10%	1%	1%	12
GB49	Wind Development Area	72%	29%	13%	13%	1%	1%	10
HDD exit pit	HDD zone	0%	100%	47%	47%	2%	2%	1

Note:
a/ Total fine sediment = fine sand + very fine sand + silt + clay. Values may not add due to rounding
b/ Sample GB14 is located immediately adjacent to the Wind Development Area and is included for the purposes of this analysis.

M.3.1.2 Jet-Plow and HDD Installation

Jet plowing utilizes high-pressured water jets to fluidize soil as the machine traverses along a submarine cable route. The cable descends into a temporary trench incised by the jetting blades and is subsequently buried as the fluidized sediments re-settle inside the trench. During jet plow operations, monitoring of burial allows the operator to adjust the angle of the jetting blades and the water pressure to obtain desired burial depth while minimizing sediment mobilization into the water column. By design, coarser sediments settle immediately to fill the trench and bury the cable or settle in the immediate vicinity (typically within 0.3 m) (Tetra Tech 2012, 2015; Vinhateiro et al. 2013). Earlier studies have shown that sediments coarser than 0.2 mm settle immediately over the trench (Tetra Tech 2015). A conservative approach was taken by assuming that sediments finer than 0.25 mm (fine sand) would be mobilized into the water column and transported by the ambient currents varying distances depending on a number of factors.

The ocean to land transition at the landfall will be installed using HDD, a trenchless method of installing underground utilities within a pipe along a pre-designed bore path, which will avoid or minimize impacts to the beach, intertidal zone, and nearshore areas and achieve a burial significantly deeper than any expected erosion. HDD operations for the export cable landfall will originate from the onshore landfall. A rig will drill a borehole underneath the surface for each of the circuits. Each HDD will be 655-910 m long, exiting 506-724 m offshore. Once the drill exits onto the seabed, the ducts in which the offshore export cables will be installed will be floated out to sea and then pulled back onshore within the drilled borehole. The HDD drilling process involves pumping a drilling fluid, usually bentonite (a naturally occurring volcanic clay) into the borehole. The drilling fluid maintains borehole stability, removes cuttings, and cools the drilling tools (Onsarigo 2011; Eversource Energy 2018; Orsted 2019). If temporary cofferdams are required for work at the HDD exit areas, an individual cofferdam of 21 m long by 6 m wide will be installed using vibratory methods for each cable exit area; cofferdams will be removed, and the area backfilled upon completion of installation. The current base case for the HDD duct punch out/exit is an exit pit which will be dredged at HDD exit areas with a back-hoe dredge. The exit pit will have the same dimensions as the cofferdam and the dredged sediment will be side-cast adjacent to the exit pit.

The height of the sediment plume above the seabed is dependent on local hydrodynamics, sediment size distribution, and the dredge, jet plow, or HDD operating parameters. Previous studies have shown that the plume of sediment released during jet plowing reaches heights of roughly 2 m above the seabed (Tetra Tech 2012, 2015; Vinhateiro et al. 2013; Swanson et al. 2015). The height of the sediment plume due to TSHD reaches the water surface where sediment spills over the hopper. During dredge material disposal, the plume height reaches the bottom of the vessel due to dumping of hopper contents through bottom doors. The suspended sediment plume is then dispersed by local tidal currents and moves in the direction of the dominant current, which for this Project is northward during flood tides and southwards during ebb tides. Tidal conditions and currents will be dependent on current conditions during each phase of Project construction. The analytical sediment transport model simulated transport for both the maximum flood and maximum ebb conditions to better estimate potential transport in both directions.

Settling velocity determines the time it takes for a fine grain sediment to settle down based on Stokes Law. Based on the sediment grain size distribution, representative sediment classes were selected and settling velocities assigned to those classes (USGS 2005). Table M-6 lists the different sediment classes and the associated settling velocities used for the modeling. However, in many instances, the fine clay and silt sediment particles become cohesive when they are forced into resuspension by the jet plow, causing them to have settling velocities similar to larger sized particles (Swanson et al. 2015; Van Rijn 2019). Therefore, the values in Table M-6 are conservative. The settling velocities determine the duration for which the resuspended sediment stays in the water column before eventually settling to the seabed. These velocities have been assigned to each sediment class based on a United States Geological Survey study (USGS 2005).

Table M-6 Project Sediment Particle Diameter Classes and Settling Velocity

Sediment Class	Settling Velocity (centimeters per second)
Coarse sand and larger	30.000
Fine sand	3.000
Very fine sand	1.000
Silt	0.126
Clay	0.023

M.3.2 Methodology

This section describes how the analytical sediment transport model was implemented to calculate the maximum suspended sediment water column concentrations and deposition depths for pre-cable installation dredging and jet-plow cable installation.

M.3.2.1 Pre-cable Installation Dredging

Previous studies have shown that TSHD operations disturb sediments at the seabed during the suctioning process, introduce dredged sediments into the water column through hopper overflow, and introduce a large volume of sediment into the water column during dredge material disposal. For pre-cable installation dredging, the approach assumed that hopper overflow and dredge material disposal are the primary activities which impact suspended sediment concentrations and deposition depths.

To estimate the overflow sediment volume, a production rate of 3,058 m^3/hr (4,000 cubic yards per hour) was assumed. Dredge production rate is usually defined as the volume of dredged material (referenced to in situ density) dredged during a given period (USACE 2015). Dredge production rate, in situ density of 2,226 kg/m^3, 76 percent solids and solids density of 2,600 kg/m^3 were used to estimate a sediment production rate of 1,989 m^3/hr.

The volume of sediment released was estimated based on sediment production rate, an operation time of 1 hour, and dredge area specific sediment characteristics. Overflow volume after 30 minutes of operation is instantaneously suspended at time step 0 seconds in the model. To simulate disposal, the hopper volume after 1 hour is released instantaneously. This is a conservative assumption resulting in a higher concentration of suspended sediments in the water column. In reality, overflow and disposal are not instantaneous and occur over several minutes. Tetra Tech assumed 5 percent of the sand volume pumped into the hopper and 30 percent of the mud volume is contained in the overflow. The composition of the hopper material at disposal is the remaining 70 percent of dredged mud/silt volume and 95 percent of dredged sand volume.

Grain size distribution from nearby grab sample locations were averaged for each dredge location to represent the general sediment characteristics of the dredge area. Grain size distributions were used to estimate the volume of sand and mud in the hopper. Overflow occurs until the hopper is filled with solids to a level ready for disposal. For this analysis, it was assumed that pumping ceases after 1 hour. Assumptions used to estimate hopper overflow and dredge disposal sediment volumes are listed in Table M-7.

Hopper overflow and dredged material disposal occur at different times and locations; therefore, they were modeled separately. The time between hopper overflow and disposal depends upon the distance to the disposal area and the vessel speed. An average sail speed of 5 km/hr and a travel distance of 400 m estimates approximately 5 minutes between overflow and disposal.

Table M-7 Model Assumptions for Hopper Overflow and Dredge Disposal

Parameter	Value
Dredge production rate	3,058 m^3/hr
Solids density	2,600 kg/m^3
In-situ density	2,226 kg/m^3
Percent solids in-situ	76%
Sediment production rate	1,989 m^3/hr
Dredge operation time	1 hr
Hopper volume	2,294 m^3
Mud/silt in overflow	30% of dredged volume
Sand and coarser in overflow	5% of dredged volume
Mud/silt in disposal	70% of dredged volume
Sand and coarser in disposal	95% of dredged volume
Hopper overflow release	At surface
Disposal release	6.1 m (20 ft) below surface at vessel bottom

The expected sediment transport was calculated for each dredge location. Each dredge area was assigned the representative flood and ebb velocities that corresponded to the nearest velocity station. Velocities at the surface layer were used to estimate transport of hopper overflow and velocities at approximately 6 m (assumed depth of vessel bottom) were used to estimate transport of sediment in dredge material disposal. The flood and ebb velocities were used to calculate the maximum extent of sediment deposition and the duration for which the sediment remained in suspension for each sediment class at all stations.

M.3.2.2 Jet-plow Cable Installation

For jet-plow cable installation, the approach assumed that the fine sediments released from the jet plow were released at the maximum expected plume height of 2 m and were then transported by local tidal currents and settled down at fixed rates over the horizontal sea floor (Vinhateiro et al. 2013; Swanson et al. 2015). No secondary resuspension of sediment particles was considered. Resuspension is a result of the naturally occurring bottom currents and turbulence and is therefore not directly related to jet plowing activities. The model focused on the initial dispersion of particles due to jet plowing activities that may generate brief episodes of elevated fine sediment concentrations in the water column and the resulting transport and deposition of these suspended sediments.

For jet-plow cable installation, the expected sediment transport was calculated for each sediment sample location. It was assumed that these stations would be representative of the general conditions of the offshore Project Area including the offshore export cable corridor. Each sediment sample location was assigned the representative flood and ebb velocities that corresponded to the velocity station and sediment characteristics based on the project zone it fell in. The flood and ebb velocities were used to calculate the maximum extent of sediment deposition and the duration for which the sediment remained in suspension for each sediment class at all stations. It was assumed that at the landfall location, HDD will be used, with the operations originating from the onshore landfall. Appropriate velocities were assigned for this region and based on the sediment characteristics, expected maximum sediment concentration and deposition were calculated.

The travel speed of the jet plow was assumed to be 200 meters per hour. For the model analysis, it was assumed that one half-hour of trenching activities was suspended at each time step. Based on the provided specifications, the trench was assumed to be 100 m long, [3] 1 m wide, and 2.5 m deep. Therefore, for each sediment location, the maximum volume of potential sediment fluidized in the water column was 250 cubic meters if all of it is fine sand or smaller. This volume of sediment was assumed to be instantaneously suspended at time step 0 seconds in the analytical sediment transport model. This conservative assumption resulted in a higher concentration of suspended sediments in the water column than if a smaller volume of sediments at a shorter time step were suspended.

The sediment concentration at the release location was determined based on the estimated seabed sediment and the percentage of sediment in each class. The sediment concentrations of each class were added together to calculate the total volume of sediment resuspended at the release point. With time, the sediment plume was allowed to grow based on the velocity at that location. The sediment plume did not grow in the vertical direction and was always close to the bottom of the water column. The duration of suspension for each sediment class was calculated using the release height and sediment class settling velocity. The maximum extent of travel for each sediment class was calculated using the current velocity and sediment settling velocity. Sediment particles in each class were assumed to settle out of the water column at a linear rate. The suspended sediment concentrations at each location along the trench were calculated based on the sediment left in the water column at the time and the size of the plume.

The analytical sediment model was also applied to the places where HDD is anticipated to used. Maximum sediment impact would occur if the exit pit was dredged and the sediment side-cast. The exit pit was assumed to be 21 m long by 6 m wide by 2.5 m deep. Therefore, the volume of sediment fluidized in the water column was assumed at 315 cubic meters. This volume of sediment was completely displaced from the exit pit and side-cast adjacent to the excavation site. The displaced sediments were instantaneously suspended and transported by local currents. The discharged sediment was initialized in the water column at a depth of 2 m above the seabed. The Project Design Envelope considers both six-conduit and four-conduit options. The current study evaluates the maximum sediment impact for a single conduit and this analysis will be valid for any conduit option that is selected.

The point of deposition for each particle was calculated based on the settling velocity of each sediment class. Coarser sediments with higher settling velocity settled out of the water column faster and closer to the release point as compared to finer sediments. The finer sediment classes stayed in the water column for longer periods of times and were advected further than the coarser sediments. In addition, the finer clay and silt sediment particles, which are typically cohesive, underwent enhanced settling due to flocculation and settled out of the water column with large-sized particles (Swanson et al. 2015; Van Rijn 2019). Sediments were assumed to settle out of the water column at a linear rate for each sediment particle class. This assumed that varying sized sediments within each class are evenly distributed within the plume. In addition, the model did not explicitly simulate dispersion, which could cause some particles to be transported further than estimated and could result in a larger area of deposition. Instead, dispersion was represented by the plume growth in terms of spreading of the sediment particles based on the ambient currents and the settling velocity.

M.4 RESULTS

This section describes the sediment transport analytical model results in terms of suspended sediment concentrations, deposition depth, and distance at which the sediment is deposited. Results of the

[3] The Company assumed a jet plow speed of 200 meters per hour. As a conservative assumption, the model assumed that all the fine material dislodged by the jet plow during a 30-minute time interval would be dispersed into the water column at the same time.

conservative analytical sediment transport model representing pre-cable installation dredging and jet-plow cable installation are provided.

M.4.1 Pre-Cable Installation

M.4.1.1 Suspended Sediment Concentrations

Maximum predicted suspended sediment concentrations from hopper overflow and disposal are presented in Table M-8 for flood conditions and Table M-9 for ebb conditions. These tables provide maximum concentrations at select distances from the dredge location for overflow and from the disposal location for hopper material disposal. Table M-10 and Table M-11 show maximum suspended sediment concentrations over time. Maximum concentrations were mapped at dredge locations and are shown in Figure M-5 and Figure M-6.

Van Rijin reported maximum measured sediment concentrations from field studies at various US sites of hopper dredging with overflow of about 900 mg/L near the bed and 350 mg/L near the surface at about 30 m (Van Rijin 2019). Concentrations measured without hopper overflow were about 50 mg/L. The maximum concentration from the analytical sediment transport model at 25 m ranged between 1,666 mg/L and 2,114 mg/L.

At a distance of 50 m from the dredge location, maximum concentrations during flood conditions range from 592 mg/L to 862 mg/L due to hopper overflow. At most dredge locations, concentrations fall below 100 mg/L by 250 m during flood conditions. This occurs within about 10 to 20 minutes after dredging ceases. During ebb conditions, concentrations range from 335 mg/L to 1,013 mg/L at 50 m from the dredge location. At four dredge locations, ebb concentrations fall below 100 mg/L by 150 m and all locations fall below 100 mg/L by 250 m. Overflow concentrations shown in Table M-8 and Table M-9 would not occur at all locations simultaneously. Overflow would only occur during active dredging which would cease after approximately 1 hour when the hopper is filled and sails away for disposal.

Suspended sediment concentrations during dredge material disposal are much higher than concentrations during overflow due to the large volume of sediment dumped from the hopper. At a distance of 50 m from the disposal location, maximum flood concentrations due to disposal range from 2.4×10^4 mg/L to 4.2×10^4 mg/L. At 350 m from the disposal location, flood concentrations range from 50 mg/L to 962 mg/L with six locations falling below 100 mg/L by 500 m from the disposal location. Ebb concentrations range from 110 mg/L to 4.3×10^4 mg/L at 50 m and all locations are below 100 mg/L at 350 m from the disposal location. Depending upon the sediment composition and current velocities at the disposal location, concentrations fall below 100 mg/L within 30 to 60 minutes during flood and ebb conditions.

M.4.1.2 Sediment Deposition Rates

The analytical sediment transport model was used to estimate maximum deposition depths at select distances. Expected deposition is greater during ebb conditions than during flood conditions for overflow and disposal. Table M-12 and Table M-13 show maximum deposition depths over distance from the dredge and disposal locations. Maximum deposition depths were mapped at dredge locations and are shown in Figure M-7 and Figure M-8.

The analytical sediment transport model estimated a maximum of less than 2 cm of deposition at all distances and locations resulting from hopper overflow. During flood conditions, the model estimated a maximum of 1 cm at all distances and locations.

The analytical sediment transport model estimated maximum deposition depth of 206 cm occurring during ebb conditions at distances less than 0.5 m from the point of disposal. For flood conditions, the maximum deposition is 43 cm at a distance approximately 5 m from the point of disposal. By 100 m from the disposal location, deposition is less than 2 cm for all locations for flood and ebb conditions.

Table M-8 TSHD Maximum Suspended Sediment Concentrations for Flood Conditions (With Distance)

Sample	Velocity Station	Total Fines (%)	Distance from Dredge Location (m)															
			0	1	5	10	25	50	75	100	150	250	350	500	800	1,000	2,500	5,000
			Maximum Sediment Concentration (mg/L)															
Dump-3	3	57%	2,800,333	2,096,489	598,858	305,255	78,260	33,229	20,152	13,833	4,466	1,654	962	54	22	15	2	0
Dump-4	4	92%	2,410,169	1,803,352	559,805	291,364	101,021	41,531	24,622	16,593	4,892	1,749	51	27	11	7	1	0
Dump-5	5	80%	2,010,739	1,504,166	456,356	235,341	75,194	30,701	18,063	12,100	3,769	1,325	749	33	13	9	1	0
Dump-6	6	87%	1,948,437	1,457,837	449,853	233,654	79,217	32,600	19,310	13,005	4,013	1,423	809	28	12	8	1	0
Dump-7	7	96%	1,749,825	1,308,878	412,722	215,168	77,253	31,413	18,430	12,320	3,801	1,330	750	29	12	8	1	0
Dump-8	8	92%	1,625,823	1,216,121	381,225	198,394	69,815	28,400	16,661	11,136	5,362	1,224	685	20	8	5	1	0
Dump-9	9	76%	1,549,945	1,159,912	357,743	186,163	58,086	24,206	14,444	9,785	4,958	1,252	659	320	8	6	1	0
Overflow-3	3	63%	56,301	42,105	12,293	6,245	1,666	683	398	265	99	37	21	5	2	1	0	0
Overflow-4	4	93%	49,067	36,697	11,523	5,992	2,114	862	504	336	164	42	23	4	1	1	0	0
Overflow-5	5	84%	45,881	34,343	10,894	5,731	2,053	837	502	343	183	74	30	16	3	2	0	0
Overflow-6	6	89%	43,577	32,591	10,194	5,293	1,821	744	434	289	143	39	21	10	2	1	0	0
Overflow-7	7	97%	41,668	31,185	10,040	5,297	1,986	859	514	349	184	74	29	15	2	2	0	0
Overflow-8	8	93%	37,675	28,183	8,944	4,675	1,690	698	410	275	140	39	21	10	1	1	0	0
Overflow-9	9	79%	35,822	26,805	8,412	4,396	1,519	592	352	238	124	49	19	10	1	1	0	0

Table M-9 TSHD Maximum Suspended Sediment Concentrations for Ebb Conditions (With Distance)

Sample	Velocity Station	Total Fines (%)	Distance from Dredge Location (m)															
			0	1	5	10	25	50	75	100	150	250	350	500	800	1,000	2,500	5,000
			Maximum Sediment Concentration (mg/L)															
Dump-3	3	57%	2,369,142	1,760,996	305,369	137,330	22,456	838	422	259	121	43	14	6	2	2	0	0
Dump-4	4	92%	2,407,172	1,802,423	557,216	288,664	102,395	43,197	26,372	10,930	5,340	1,958	64	35	15	10	1	0
Dump-5	5	80%	1,998,082	1,494,935	432,329	205,730	70,580	28,317	16,754	6,731	3,238	115	64	34	14	9	1	0
Dump-6	6	87%	1,898,587	1,416,584	384,073	182,094	48,274	11,464	5,891	255	126	49	27	13	3	2	0	0
Dump-7	7	96%	1,714,549	1,277,146	360,040	166,992	45,165	32,729	8,393	384	235	114	43	23	11	2	2	0
Dump-8	8	92%	1,444,066	968,404	111,530	27,610	422	110	51	17	7	2	1	1	0	0	0	0
Dump-9	9	76%	1,539,777	1,152,871	339,232	174,806	55,292	23,491	14,303	9,850	2,917	1,101	44	24	10	7	1	0
Overflow-3	3	63%	55,998	41,905	11,764	5,934	1,668	703	419	284	103	41	12	6	3	2	0	0
Overflow-4	4	93%	49,117	36,785	11,748	6,227	2,320	1,013	624	434	228	65	37	19	2	2	0	0
Overflow-5	5	84%	45,235	33,778	9,460	4,542	1,474	543	224	138	65	11	6	3	1	1	0	0
Overflow-6	6	89%	42,794	31,908	8,921	4,248	1,235	335	165	104	18	7	4	2	1	0	0	0
Overflow-7	7	97%	41,559	31,089	9,790	5,106	1,817	750	441	295	100	38	9	5	2	1	0	0
Overflow-8	8	93%	37,546	28,078	8,672	4,444	1,534	621	361	162	77	29	6	3	1	1	0	0
Overflow-9	9	79%	35,487	26,544	7,737	3,590	1,247	507	298	134	65	24	5	3	1	1	0	0

Table M-10 TSHD Maximum Suspended Sediment Concentrations for Flood Conditions (With Time)

Sample	Zone	Total Fines (%)	Time (second)															
			0.5	10	20	30	60	90	120	150	240	300	600	1,200	1,800	3,600	7,200	14,400
			Maximum Sediment Concentration (mg/L)															
Dump-3	3	57%	3,623,876	838,223	464,049	319,781	101,600	65,946	48,501	37,959	19,786	16,032	3,107	109	55	15	4	1
Dump-4	4	92%	3,228,341	993,830	572,606	400,130	191,263	123,839	91,361	71,645	38,083	30,633	6,225	1,450	48	14	3	1
Dump-5	5	80%	2,694,478	810,160	465,113	324,446	139,542	89,482	65,830	51,489	27,673	21,964	4,733	1,143	59	16	4	1
Dump-6	6	87%	2,630,059	841,137	489,049	343,326	160,071	103,361	76,594	60,306	33,056	26,470	5,945	1,502	61	18	5	1
Dump-7	7	96%	2,375,039	808,103	475,098	335,077	169,488	110,978	82,309	64,937	36,081	28,843	8,909	1,783	947	23	6	1
Dump-8	8	92%	2,196,709	722,243	421,788	296,666	148,111	94,796	69,925	55,141	30,758	24,518	7,762	1,584	816	15	4	1
Dump-9	9	76%	2,052,212	588,797	335,811	234,061	110,422	62,577	45,988	36,254	20,299	16,169	5,229	1,094	557	11	3	1
Overflow-3	3	63%	75,872	22,562	12,953	9,035	3,141	2,018	1,482	1,157	633	495	130	36	10	3	1	0
Overflow-4	4	93%	66,112	21,410	12,429	8,704	4,313	2,742	2,009	1,572	863	677	211	45	23	2	1	0
Overflow-5	5	84%	58,557	14,546	8,064	5,545	2,642	1,565	1,136	887	491	383	109	30	11	2	0	0
Overflow-6	6	89%	58,926	19,431	11,346	7,975	3,970	2,481	1,816	1,429	805	633	215	52	26	3	1	0
Overflow-7	7	97%	54,243	15,041	8,481	5,872	2,937	1,924	1,396	1,093	613	479	163	40	19	2	1	0
Overflow-8	8	93%	50,713	16,524	9,608	6,737	2,353	2,181	1,582	1,242	699	187	115	45	11	2	1	0
Overflow-9	9	79%	47,206	13,506	7,684	5,347	2,593	1,483	1,077	848	483	379	135	34	16	2	0	0

Table M-11 TSHD Maximum Suspended Sediment Concentrations for Ebb Conditions (With Time)

Sample	Zone	Total Fines (%)	Time (second)															
			0	10	20	30	60	90	120	150	240	300	600	1,200	1,800	3,600	7,200	14,400
			Maximum Sediment Concentration (mg/L)															
Dump-3	3	57%	2,835,340	340,503	175,376	117,643	36,325	23,346	17,085	13,331	6,917	5,597	1,081	38	19	5	1	0
Dump-4	4	92%	2,424,088	318,215	164,793	110,557	50,579	32,250	23,608	18,426	9,726	7,805	1,579	367	12	3	1	0
Dump-5	5	80%	2,026,651	262,186	135,528	90,830	37,420	23,638	17,257	13,436	7,172	5,679	1,219	294	15	4	1	0
Dump-6	6	87%	1,961,115	257,386	89,676	45,974	39,872	18,605	14,574	6,332	2,235	1,415	357	246	4	1	0	0
Dump-7	7	96%	1,757,079	234,411	121,743	81,842	39,298	25,264	18,563	14,563	8,023	6,396	1,965	392	208	5	1	0
Dump-8	8	92%	1,633,510	217,005	112,671	75,740	36,005	22,651	16,563	12,992	7,189	5,716	1,800	367	189	3	1	0
Dump-9	9	76%	1,559,817	203,344	105,499	70,943	32,207	18,009	13,145	10,320	5,743	4,565	1,470	307	156	3	1	0
Overflow-3	3	63%	56,952	7,208	3,718	2,489	828	524	382	297	161	126	33	9	2	1	0	0
Overflow-4	4	93%	49,282	6,536	3,383	2,267	1,071	670	487	379	206	161	50	11	5	0	0	0
Overflow-5	5	84%	46,035	6,057	3,134	2,100	974	571	413	321	177	138	45	11	5	1	0	0
Overflow-6	6	89%	43,789	5,811	3,014	2,024	959	589	427	334	187	147	50	12	6	1	0	0
Overflow-7	7	97%	41,754	5,591	2,899	1,945	940	609	439	343	191	149	51	12	6	1	0	0
Overflow-8	8	93%	37,803	5,045	2,616	1,755	842	533	383	299	167	130	45	11	5	0	0	0
Overflow-9	9	79%	35,985	4,747	2,463	1,655	773	437	315	247	140	110	39	10	5	0	0	0

Table M-12 TSHD Maximum Deposition Depths for Flood Conditions

Sample	Zone	Total Fines (%)	Distance from Dredge Location (m)															
			0.5	1	5	10	25	50	75	100	150	250	350	500	800	1,000	2,500	5,000
			Maximum Deposition Depth (cm)															
Dump-3	3	57%	22.10	16.54	43.26	28.75	2.09	2.01	1.22	0.84	0.09	0.22	0.13	0.00	0.00	0.00	0.00	0.00
Dump-4	4	92%	7.90	5.91	15.36	10.13	4.49	3.63	2.15	1.45	0.30	0.36	0.00	0.00	0.00	0.00	0.00	0.00
Dump-5	5	80%	11.29	8.45	21.90	14.40	2.61	2.52	1.49	0.99	0.07	0.24	0.14	0.00	0.00	0.00	0.00	0.00
Dump-6	6	87%	8.84	6.62	17.19	11.33	3.18	2.94	1.74	1.17	0.13	0.29	0.17	0.00	0.00	0.00	0.00	0.00
Dump-7	7	96%	4.67	3.49	9.05	5.95	3.20	3.04	1.78	1.19	0.10	0.29	0.16	0.00	0.00	0.00	0.00	0.00
Dump-8	8	92%	5.69	4.25	11.02	7.24	2.30	2.59	1.52	1.01	1.11	0.24	0.14	0.00	0.00	0.00	0.00	0.00
Dump-9	9	76%	9.29	6.95	18.11	11.97	0.88	1.77	1.06	0.72	0.80	0.10	0.10	0.08	0.00	0.00	0.00	0.00
Overflow-3	3	63%	0.52	0.39	1.01	0.66	0.04	0.04	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Overflow-4	4	93%	0.15	0.11	0.30	0.19	0.06	0.07	0.04	0.03	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Overflow-5	5	84%	0.15	0.12	0.30	0.20	0.23	0.04	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Overflow-6	6	89%	0.18	0.13	0.34	0.22	0.04	0.06	0.03	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Overflow-7	7	97%	0.07	0.05	0.13	0.09	0.10	0.05	0.03	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Overflow-8	8	93%	0.11	0.08	0.22	0.14	0.02	0.05	0.03	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Overflow-9	9	79%	0.18	0.14	0.36	0.24	0.28	0.03	0.02	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00

Table M-13 TSHD Maximum Deposition Depths for Ebb Conditions

Sample	Zone	Total Fines (%)	Distance from Dredge Location (m)															
			0.5	1	5	10	25	50	75	100	150	250	350	500	800	1,000	2,500	5,000
			Maximum Deposition Depth (cm)															
Dump-3	3	57%	206.36	153.39	26.14	17.71	3.11	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dump-4	4	92%	9.90	7.41	19.42	1.07	6.45	4.94	3.01	0.20	0.60	0.56	0.00	0.00	0.00	0.00	0.00	0.00
Dump-5	5	80%	19.16	14.34	37.24	2.00	5.92	4.36	2.58	0.34	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dump-6	6	87%	38.80	28.95	11.30	14.20	14.97	2.01	1.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dump-7	7	96%	27.07	20.16	20.57	19.17	0.57	3.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dump-8	8	92%	21.68	68.32	8.89	14.92	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dump-9	9	76%	17.74	13.28	34.77	23.14	4.62	3.57	2.18	1.50	0.41	0.40	0.00	0.00	0.00	0.00	0.00	0.00
Overflow-3	3	63%	0.74	0.55	1.44	0.95	0.08	0.06	0.04	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Overflow-4	4	93%	0.14	0.11	0.28	0.18	0.05	0.07	0.04	0.03	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Overflow-5	5	84%	0.66	0.49	1.25	0.13	0.18	0.12	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Overflow-6	6	89%	0.80	0.60	0.14	0.29	0.30	0.02	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Overflow-7	7	97%	0.16	0.12	0.31	0.20	0.14	0.10	0.06	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Overflow-8	8	93%	0.24	0.18	0.45	0.01	0.15	0.10	0.06	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Overflow-9	9	79%	0.52	0.39	1.02	0.02	0.13	0.10	0.06	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00

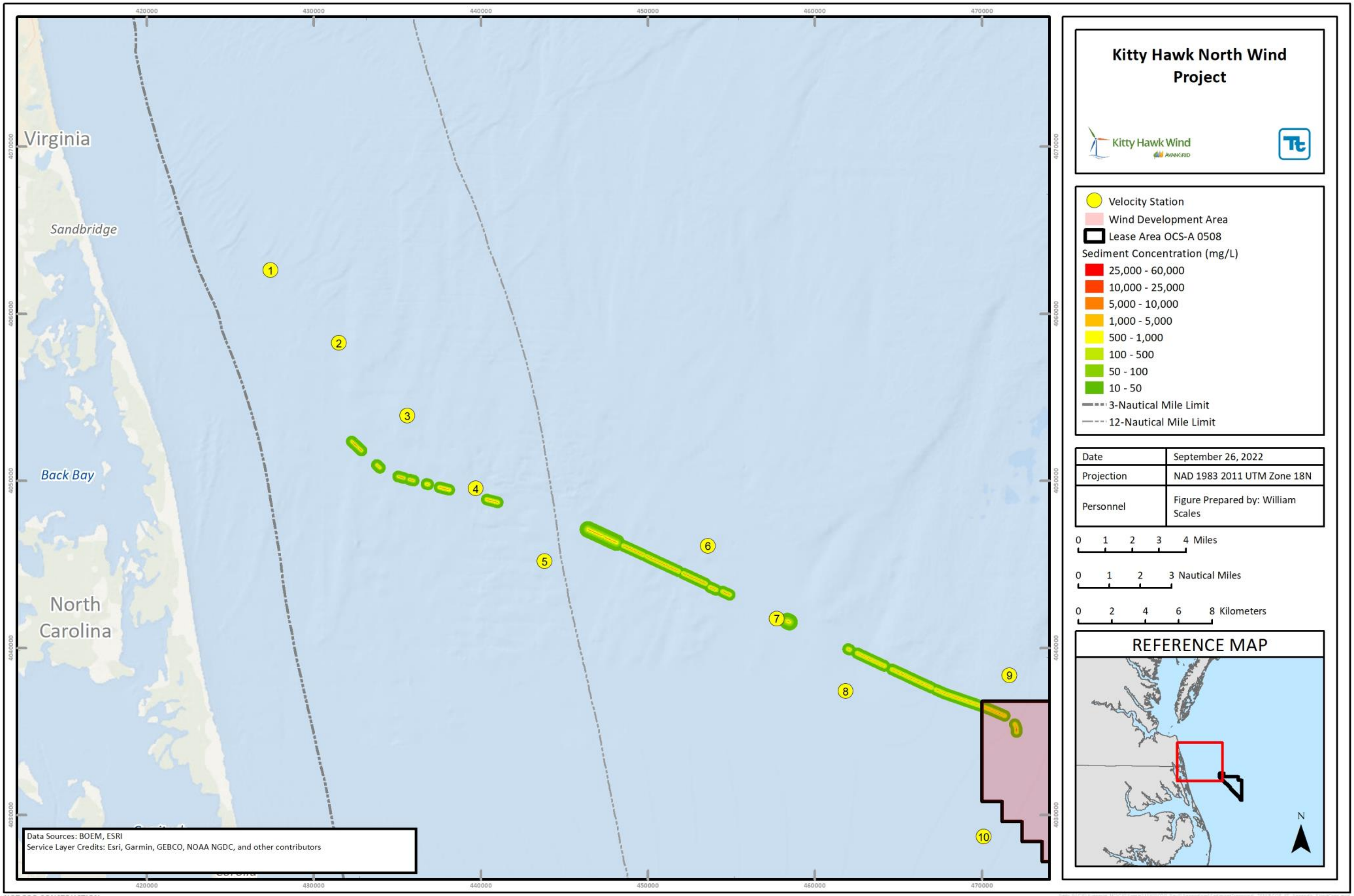

Figure M-5 Maximum Flood Tide Suspended Sediment Concentrations from Hopper Overflow during Dredging

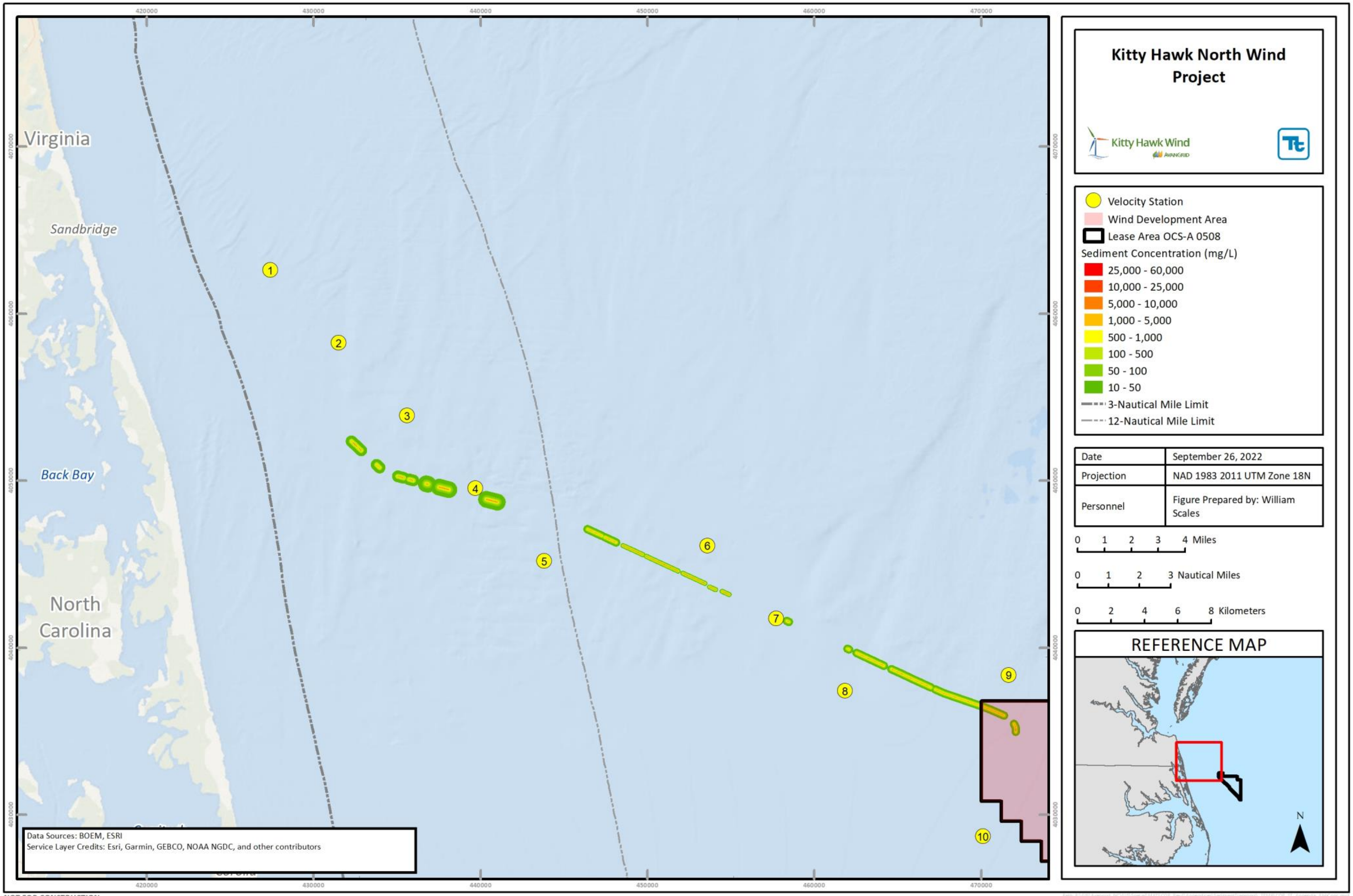

Figure M-6 Maximum Ebb Tide Suspended Sediment Concentrations from Hopper Overflow during Dredging

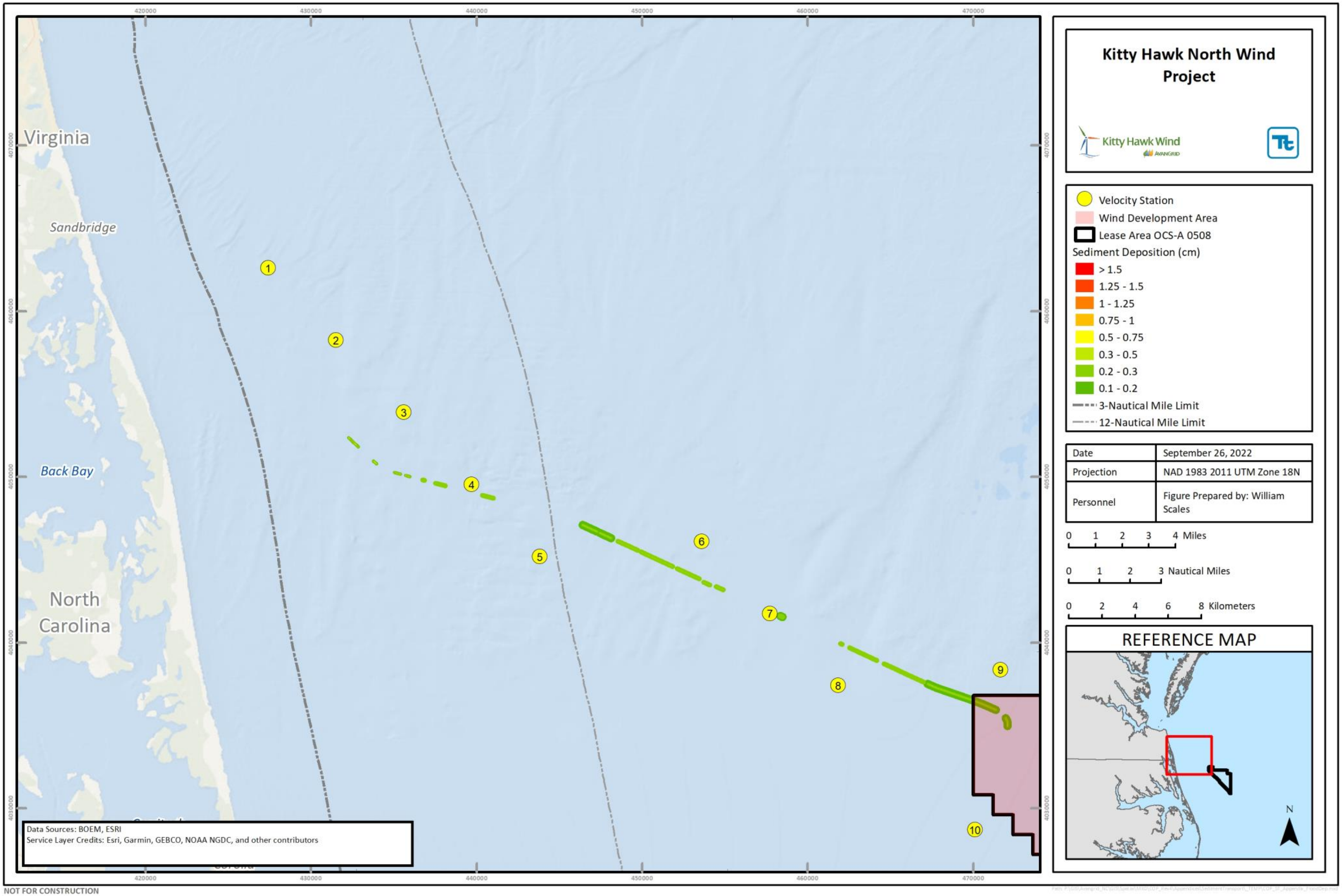

Figure M-7 Maximum Flood Tide Sediment Deposition from Hopper Overflow during Dredging

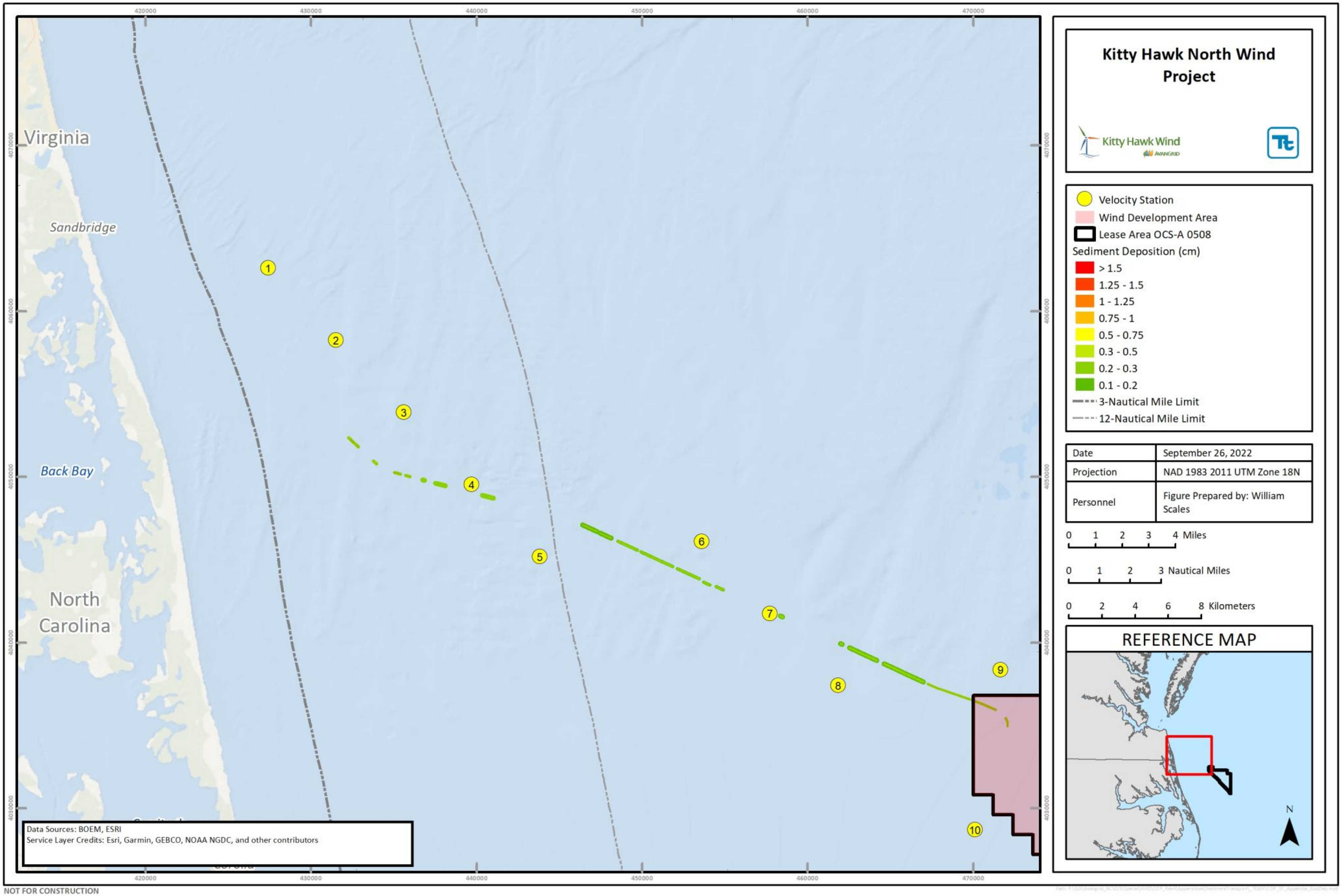

Figure M-8 Maximum Ebb Tide Sediment Deposition from Hopper Overflow during Dredging

M.4.2 Jet-plow Installation

M.4.2.1 Suspended Sediment Concentrations

Table M-14 and Table M-15 list the predicted maximum suspended sediment concentrations by distance from the trench centerline at locations perpendicular to the trench centerline for all sample stations for flood and ebb currents. Figure M-9 and Figure M-10 show the estimated maximum suspended sediment concentrations at two representative sediment sample stations, GB19 and GB38, for maximum ebb and flood tides. The fine sediment percentage is 88 percent at GB19 and 24 percent at GB38. These stations were chosen to ensure that the variability in fine sediment percentage is captured well. Figure M-11 and Figure M-12 show the expected maximum instantaneous suspended sediment concentrations at any given time step along the offshore export cable installation corridor. It is important to note that these concentrations do not occur at all locations simultaneously. Due to jet plow speed, only small sections of the offshore export cable corridor and Wind Development Area would be disturbed at any given time during Project construction; the model therefore used the volume of sediment put into suspension in one half-hour of jet plow travel (100-m trench length). In addition, due to the depth of water within the offshore Project Area, the plume should not be visible from the surface. The plume concentrations are typically lower at stations in the Wind Development Area due to lesser fine sediment content, plume dispersion and sediment deposition.

Table M-14 Project Maximum Suspended Sediment Concentrations for Flood Conditions (With Distance)

Sample	Zone	Total Fines (%)	Distance from Trench (m)															
			0	1	5	10	25	50	75	100	150	250	350	500	800	1,000	2,500	5,000
			Maximum Sediment Concentration (mg/L)															
GB14	Wind Development Area	21%	666,250	310,256	72,551	22,033	3,109	892	479	292	129	38	19	8	2	1	0	0
GB16	Wind Development Area	99%	3,214,250	1,502,276	359,259	104,457	13,191	1,090	604	378	177	50	26	12	3	1	0	0
GB17	Wind Development Area	100%	3,237,000	1,506,393	351,067	95,961	10,686	1,094	598	370	169	48	25	11	3	1	0	0
GB18	Offshore export cable corridor	49%	1,605,500	753,605	184,752	57,649	8,522	1,070	598	378	180	53	27	12	4	2	0	0
GB19	Offshore export cable corridor	88%	2,873,000	1,327,038	295,372	79,770	5,173	667	359	219	97	29	14	6	1	0	0	0
GB20	Offshore export cable corridor	99%	3,227,250	1,490,884	332,147	89,950	5,988	823	444	270	120	35	18	8	2	1	0	0
GB21	Offshore export cable corridor	100%	3,246,750	1,480,953	303,468	84,384	3,743	1,459	762	449	184	58	28	11	2	0	0	0
GB22	Offshore export cable corridor	81%	2,619,500	1,187,836	233,558	63,821	2,127	821	424	247	98	32	15	6	1	0	0	0
GB23	Offshore export cable corridor	96%	3,107,000	1,323,062	161,189	38,179	1,404	469	210	103	43	14	5	1	0	0	0	0
GB24	Offshore export cable corridor	98%	3,185,000	1,361,931	165,555	40,332	718	244	111	56	23	7	3	1	0	0	0	0
GB25	Offshore export cable corridor	95%	3,097,250	1,281,551	147,329	24,307	1,964	616	256	123	54	16	5	0	0	0	0	0
GB26	Offshore export cable corridor	31%	1,001,000	416,356	50,444	9,654	1,236	388	161	77	34	10	3	0	0	0	0	0
GB27	Offshore export cable corridor	11%	341,250	156,085	32,870	13,884	3,737	1,287	592	302	121	40	16	4	0	0	0	0
GB28	Offshore export cable corridor	55%	1,771,250	795,525	145,631	40,136	1,629	616	312	178	67	23	11	4	0	0	0	0
GB29	Offshore export cable corridor	100%	3,243,500	1,471,270	289,970	91,394	11,404	4,313	2,184	1,246	466	161	75	28	2	0	0	0
GB30	Offshore export cable corridor	100%	3,237,000	1,456,040	269,674	76,062	4,254	1,609	815	465	174	60	28	10	1	0	0	0
GB31	Offshore export cable corridor	97%	3,149,250	1,475,457	357,891	108,312	14,127	856	479	302	144	43	21	10	3	1	0	0
GB32	Offshore export cable corridor	100%	3,243,500	1,477,990	300,779	82,259	2,714	1,058	552	326	133	42	20	8	1	0	0	0
GB33	Offshore export cable corridor	100%	3,237,000	1,466,369	286,237	76,905	1,665	642	332	194	77	25	12	5	1	0	0	0
GB34	Offshore export cable corridor	98%	3,181,750	1,364,444	171,337	44,019	2,154	732	333	167	68	22	9	2	0	0	0	0
GB35	Offshore export cable corridor	31%	1,001,000	433,137	57,880	16,588	1,462	503	232	118	47	16	6	2	0	0	0	0
GB36	Offshore export cable corridor	40%	1,306,500	587,372	108,351	30,321	1,539	582	295	168	63	22	10	4	0	0	0	0
GB37	Wind Development Area	18%	594,750	279,697	69,293	22,270	3,659	639	357	225	107	32	16	7	2	1	0	0
GB38	Wind Development Area	24%	763,750	358,983	88,681	28,263	4,510	728	407	257	122	36	18	8	2	1	0	0
GB42	Offshore export cable corridor	28%	913,250	393,969	54,908	15,941	2,183	729	326	161	67	21	8	2	0	0	0	0
GB45	Wind Development Area	77%	2,492,750	1,167,908	283,306	85,812	11,252	725	404	255	121	36	18	8	2	1	0	0
GB46	Wind Development Area	81%	2,629,250	1,229,625	295,119	86,762	11,484	1,216	674	422	198	56	29	13	4	2	0	0
GB47	Wind Development Area	99%	3,217,500	1,503,594	359,296	104,218	13,022	1,006	558	349	164	47	24	11	3	1	0	0
GB48	Wind Development Area	21%	679,250	318,609	77,775	24,033	3,821	713	395	247	116	33	17	8	2	1	0	0
GB49	Wind Development Area	29%	926,250	434,598	106,231	33,040	5,439	1,111	612	381	177	50	26	12	3	1	0	0
HDD exit pit	HDD zone	100%	3,237,000	2,491,380	827,221	261,900	13,354	4,121	1,823	948	315	97	42	15	1	0	0	0

Table M-15 Project Maximum Suspended Sediment Concentrations for Ebb Conditions (With Distance)

Sample	Zone	Total Fines (%)	Distance from Trench (m) Maximum Sediment Concentration (mg/L)															
			0	1	5	10	25	50	75	100	150	250	350	500	800	1,000	2,500	5,000
GB14	Wind Development Area	21%	666,250	206,677	9,868	4,226	906	190	80	39	10	0	0	0	0	0	0	0
GB16	Wind Development Area	99%	3,214,250	733,348	10,550	4,265	743	170	65	27	2	0	0	0	0	0	0	0
GB17	Wind Development Area	100%	3,237,000	752,383	10,919	4,406	771	174	67	28	3	0	0	0	0	0	0	0
GB18	Offshore export cable corridor	49%	1,605,500	571,971	42,334	5,304	1,389	316	135	74	27	3	0	0	0	0	0	0
GB19	Offshore export cable corridor	88%	2,873,000	961,388	45,929	3,405	830	170	77	40	14	1	0	0	0	0	0	0
GB20	Offshore export cable corridor	99%	3,227,250	1,080,885	52,361	4,206	1,025	209	95	50	17	1	0	0	0	0	0	0
GB21	Offshore export cable corridor	100%	3,246,750	799,282	16,134	6,510	1,164	255	99	43	6	0	0	0	0	0	0	0
GB22	Offshore export cable corridor	81%	2,619,500	280,577	6,505	1,834	247	35	0	0	0	0	0	0	0	0	0	0
GB23	Offshore export cable corridor	96%	3,107,000	437,812	5,891	1,948	261	52	12	0	0	0	0	0	0	0	0	0
GB24	Offshore export cable corridor	98%	3,185,000	231,291	2,253	550	75	7	0	0	0	0	0	0	0	0	0	0
GB25	Offshore export cable corridor	95%	3,097,250	34,010	2,901	716	28	0	0	0	0	0	0	0	0	0	0	0
GB26	Offshore export cable corridor	31%	1,001,000	21,414	1,827	451	18	0	0	0	0	0	0	0	0	0	0	0
GB27	Offshore export cable corridor	11%	341,250	124,097	19,589	8,315	1,715	369	153	73	16	0	0	0	0	0	0	0
GB28	Offshore export cable corridor	55%	1,771,250	667,604	59,149	4,086	1,170	313	122	70	28	6	0	0	0	0	0	0
GB29	Offshore export cable corridor	100%	3,243,500	1,258,029	143,764	28,599	8,190	2,191	854	487	196	40	1	0	0	0	0	0
GB30	Offshore export cable corridor	100%	3,237,000	1,225,445	113,471	10,668	3,055	817	319	182	73	15	0	0	0	0	0	0
GB31	Offshore export cable corridor	97%	3,149,250	1,108,839	71,554	4,243	1,111	253	108	59	22	3	0	0	0	0	0	0
GB32	Offshore export cable corridor	100%	3,243,500	789,875	11,697	4,720	844	185	72	31	4	0	0	0	0	0	0	0
GB33	Offshore export cable corridor	100%	3,237,000	334,719	5,091	1,435	193	27	0	0	0	0	0	0	0	0	0	0
GB34	Offshore export cable corridor	98%	3,181,750	252,883	6,759	1,649	226	20	0	0	0	0	0	0	0	0	0	0
GB35	Offshore export cable corridor	31%	1,001,000	283,932	7,665	3,254	671	144	60	28	6	0	0	0	0	0	0	0
GB36	Offshore export cable corridor	40%	1,306,500	493,855	45,048	3,859	1,105	296	115	66	26	5	0	0	0	0	0	0
GB37	Wind Development Area	18%	594,750	165,068	6,312	2,647	525	114	46	22	4	0	0	0	0	0	0	0
GB38	Wind Development Area	24%	763,750	274,396	22,159	3,607	945	215	92	50	18	2	0	0	0	0	0	0
GB42	Offshore export cable corridor	28%	913,250	152,864	9,163	3,031	406	80	19	0	0	0	0	0	0	0	0	0
GB45	Wind Development Area	77%	2,492,750	658,778	7,153	3,000	595	129	53	24	5	0	0	0	0	0	0	0
GB46	Wind Development Area	81%	2,629,250	606,336	11,767	4,758	828	190	72	30	2	0	0	0	0	0	0	0
GB47	Wind Development Area	99%	3,217,500	732,398	9,738	3,937	686	157	60	25	2	0	0	0	0	0	0	0
GB48	Wind Development Area	21%	679,250	164,584	6,898	2,789	486	111	42	18	1	0	0	0	0	0	0	0
GB49	Wind Development Area	29%	926,250	157,185	9,241	3,164	437	90	23	1	0	0	0	0	0	0	0	0
HDD exit pit	HDD zone	100%	3,237,000	2,093,275	330,650	32,585	7,790	1,683	584	310	114	21	0	0	0	0	0	0

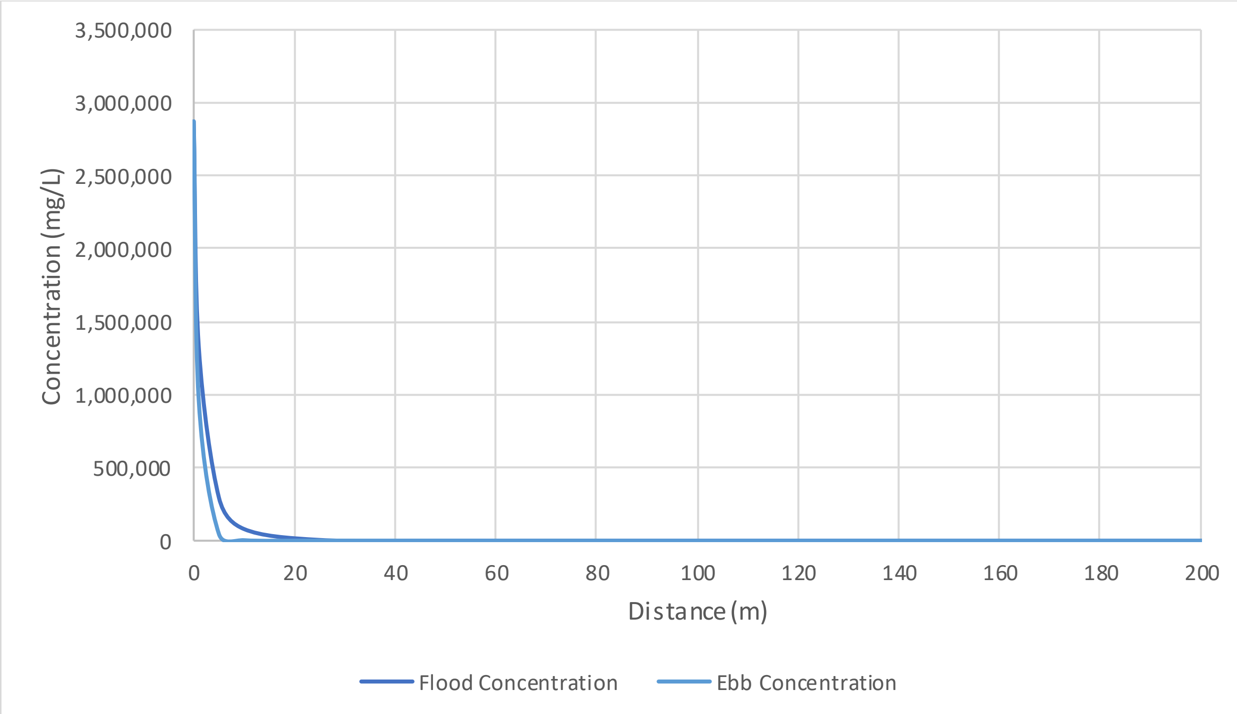

Figure M-9 Maximum Flood and Ebb Tide Suspended Sediment Concentrations at GB19 (88% fine sediment)

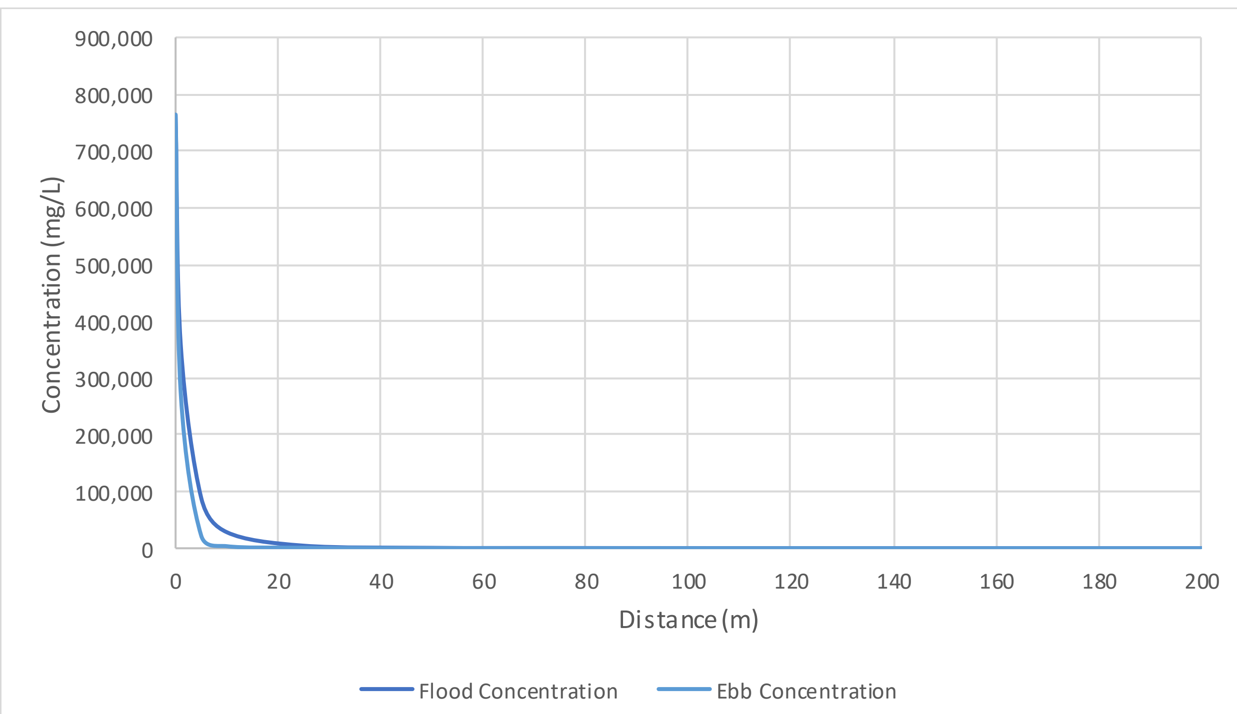

Figure M-10 Maximum Flood and Ebb Tide Suspended Sediment Concentrations at GB38 (24% fine sediment)

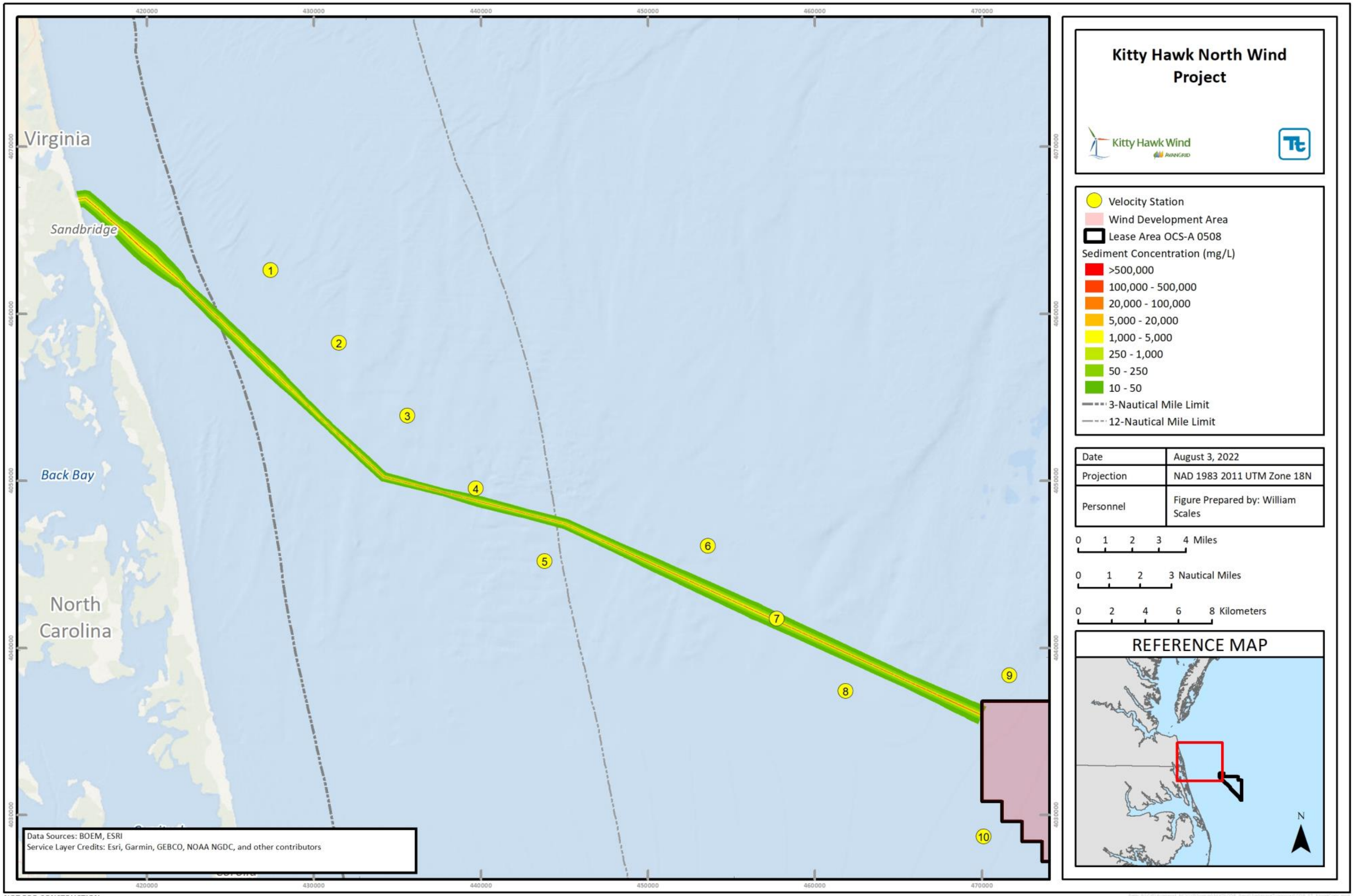

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Figure M-11 Maximum Flood Tide Suspended Sediment Concentrations along the Offshore Export Cable Corridor

The figure represents the instantaneous maximum suspended sediment concentrations at any given point of time predicted for the offshore export cable corridor. These concentrations do not occur at all locations simultaneously. Due to jet plow speed, only small sections of the offshore export cable corridor and Wind Development Area would be disturbed at any given time during Project construction.

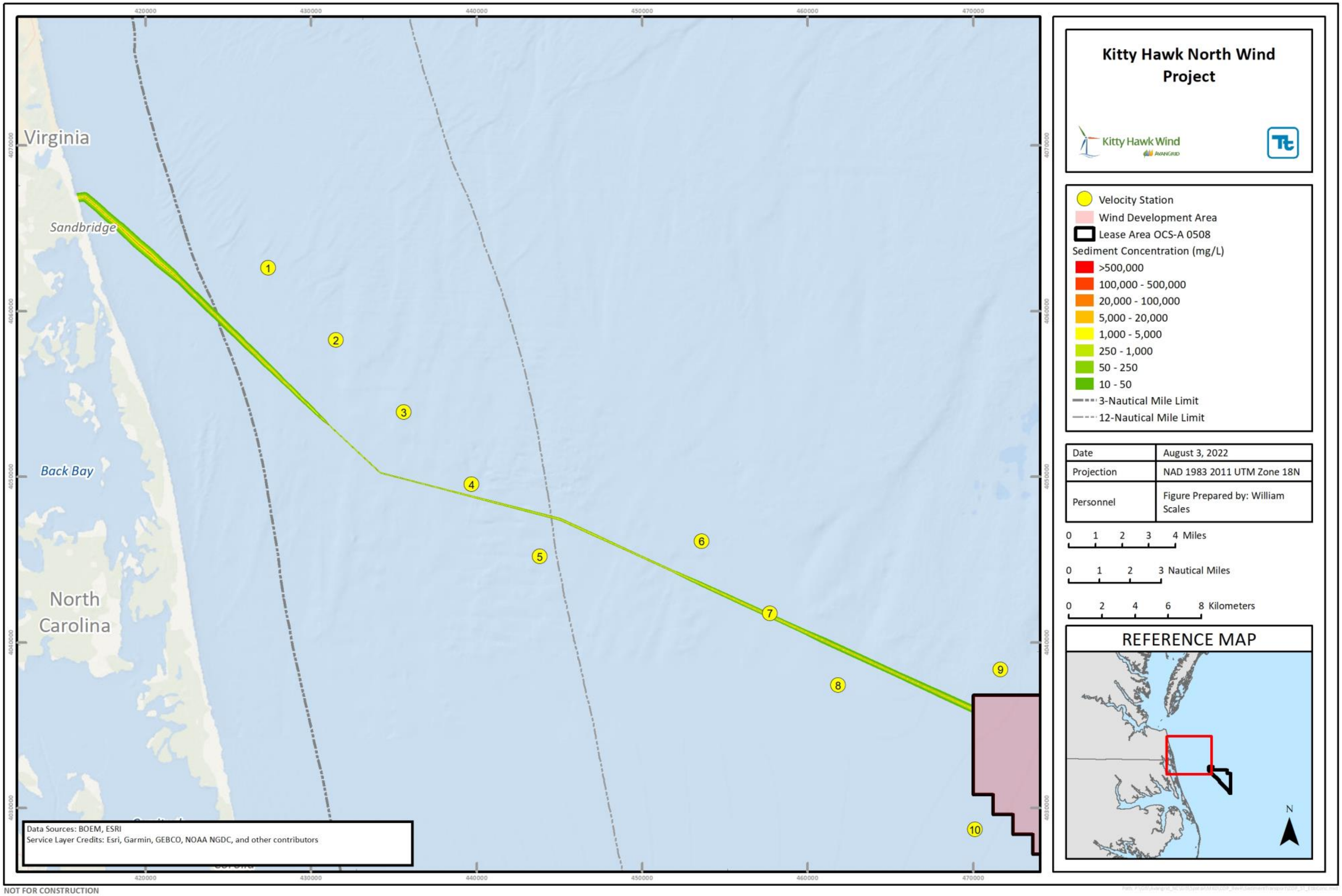

Figure M-12 Maximum Ebb Tide Suspended Sediment Concentrations along the Offshore Export Cable Corridor

The figure represents the instantaneous maximum suspended sediment concentrations at any given point of time predicted for th e offshore export cable corridor. These concentrations do not occur at all locations simultaneously. Due to jet plow speed, only small sections of the offshore export cable corridor and Wind Development Area would be disturbed at any given time during Project construction.

In general, the offshore Project Area was characterized by stations with a higher percentage of sand in comparison to silt and clay. Typically, stations had around 60 percent sand content and 2 percent silt and clay. The type of fine sediments at each station impacted the maximum plume concentrations. Fine sand, the coarsest fine sediment particle class, has a settling velocity of 3 centimeter per second and remains in suspension for approximately one minute. Therefore, at most stations, suspended sediment concentrations decreased by close to 65 percent within one minute of jet plowing operations and within 10 m of the trench centerline. This reduced the amount of sediment that could be transported in the water column due to currents, and most of the fine sand deposits within 5 m of the trench centerline.

M.4.2.2 Offshore Export Cable Corridor Stations

In the offshore export cable corridor, maximum plume horizontal distances were typically between 500 and 800 m at nearly all stations for the flood tide (Table M-14). Maximum plume distances were always less than 500 m for ebb tides (Table M-15). Suspended sediment concentrations were typically below 200 milligrams per liter (mg/L) at a distance of 150 m from trench centerline during flood and ebb tides. Expected maximum suspended sediment concentrations were between 0 mg/L and 161 mg/L at 250 m from the trench centerline. Studies have shown suspended sediment concentrations of anywhere from 50 mg/L to 1,000 mg/L at distances around 304 m from the centerline (Tetra Tech 2012, 2015; ESS Group 2013; Swanson et al. 2015). The sediment plume was confined near the substrate layer and is not expected to reach the surface. Data collected in the offshore export cable corridor indicated that plume travel distances would be around 800 m during flood tides and around 350 m during ebb tides. GB18, GB20, and GB31 had a maximum plume distance of 1,000 m during flood tide. This is due to the high fine sediment content and high flood velocity at station 8 (assigned to GB20) and at station 9 (assigned to GB18 and GB31).

The potential maximum suspended sediment concentrations were dependent on the burial depth and total percent fines at each sampling location. Stations with higher percentages of fine sediment particle classes had higher concentrations of suspended sediments because more particles were suspended due to jet plowing. If a station had a total percent fine sediment composition of 50 percent, half of the disturbed sediments would be mobilized into the water column following resuspension by the jet plow. Therefore, assuming a maximum trench depth of 2.5 m, slightly over 1.2 m of fine sediments would be resuspended into the water column. The highest concentrations occurred at the release point, and concentrations decreased further from the trench. These concentrations, specifically at the trench, were confined close the substrate. Out of the total 20 stations in the offshore export cable corridor, 13 had more than 80 percent fine sediments, therefore, nearly all of the material disturbed by the jet plow would be released into the water column (Table M-14 and Table M-15).

The conservative sediment transport model predicted that maximum suspended sediment concentration would be greater than 3.1×10^6 mg/L at the release point during flood and ebb conditions. This is observed at stations with a fine sediment content of more than 96 percent. For stations with low fine sediment percentage, the predicted maximum suspended sediment concentration is lower than 1.1×10^6 mg/L at the release point.

M.4.2.3 Wind Development Area Stations

In the Wind Development Area, maximum plume distances were typically between 250 and 1,000 m. The plume travelled further distances during the flood tide as compared to the ebb tide. The total distance the sediment plumes travelled was dependent on the current velocities. Suspended sediment concentrations were always below 200 mg/L at a distance of 150 m from trench centerline during flood and ebb tides. Results indicated that the plume would travel to a maximum distance of 1,000 m during the flood tide, although the maximum suspended sediment concentrations at that distance would always be less than 3 mg/L. During ebb tides, the maximum plume distance travelled is typically around 250 m. Expected maximum suspended sediment concentrations drop to anywhere between 0 mg/L to 56 mg/L at 250 m from the trench centerline.

The sediment transport model predicted that maximum suspended sediment concentrations would be around 3.2×10^6 mg/L for Wind Development Area stations at the release point during flood and ebb conditions. For flood tides, the suspended sediment concentration averaged around 300 mg/L at a distance of 100 m, and for ebb tides, the concentrations averaged around 30 mg/L at a travel distance of 100 m.

M.4.2.4 HDD Zone

In the HDD exit pit area, the maximum suspended sediment concentration was 3.23×10^6 mg/L at the release point. This concentration dropped to 315 mg/L at a distance of 150 m from the trench centerline during flood tide and to 114 mg/L during ebb tide. Results indicated that the plume would travel to a maximum distance of 800 m during the flood tide, and 350 m during ebb tide, although the maximum suspended sediment concentrations at that distance were less than 1 mg/L.

M.4.2.5 General Observations

While the maximum suspended sediment concentrations were relatively high for all stations, these concentrations decreased rapidly with time. The coarser fine particles, such as fine sand, remained in suspension for about one minute, while the very fine sediments (clay) remained in suspension for about four hours, a relatively short period of time. In areas that consist predominantly of gravels and sands, the analysis indicates a limited extent of increased sediment concentrations, as the larger grain size sediments immediately deposit in the trench. In locations that are dominated by fine sand, silts, or clays, these sediments can be released into the water column and temporarily increase total suspended solids near the trench and cause sediment deposition outside of the trench, but eventually settle down to background concentrations (Tetra Tech 2012, Tetra Tech 2015, Vinhateiro et al. 2013). Table M-16 and Table M-17 present the time varying suspended sediment concentrations for flood and ebb tides respectively for all stations. The concentrations decreased rapidly with time, and water column concentrations are expected to return to ambient conditions within 4 hours (7,200 seconds).

M.4.2.6 Sediment Deposition Rates

Table M-18 and Table M-19 list the deposition thicknesses at locations perpendicular to the trench centerline for all stations under the maximum flood and ebb currents. Figure M-13 and Figure M-14 show the maximum predicted sediment deposition along the offshore export cables. It is important to note that deposition does not occur at all locations simultaneously due to the jet plow travel speed. The sediment resuspended due to jet plow operations moves in the direction of the local ambient current and then eventually settles and deposits in a layer along the marine seabed. For the analytical sediment transport model, it was assumed that sediments finer than 0.25 mm (fine sand) would be mobilized in the water column and transported by the ambient currents, which would distribute sediments in each particle class uniformly over the marine seabed. All sediments coarser than 0.25 mm would re-deposit in or immediately adjacent to the trench (and therefore, not be considered suspended).

The deposition thickness was highest in the vicinity of the jet plow; as fine sand tends to deposit close to the trench centerline due to its higher settling rate. Most of the coarser fine sediments settled to the marine floor within 10 m of the trench, and deposition depths decreased rapidly. For example, GB23 had a fine sand content of 94 percent and the maximum observed deposition depth during flood tide was 26.16 centimeters (cm) at the trench, but within 5 m of the trench, the deposition decreased to 6.52 cm.

The highest predicted deposition thicknesses were observed at GB25 for both flood and ebb tides. The deposition thickness was 29.68 cm for flood tides and 158.59 cm for ebb tides. GB25 had the lowest observed velocity perpendicular to the trench movement in both flood and ebb tide and therefore the sediment was not able to travel large distances resulting in thicker depositions. The average deposition thickness was 12.56 cm for flood tides and 55.47 cm for ebb tides immediately adjacent to the trench. For the HDD zone, the maximum observed deposition thickness was 110.66 cm during ebb tides.

Table M-16 Project Maximum Suspended Sediment Concentrations (mg/L) for Flood Conditions (With Time)

Sample	Zone	Total Fines (%)	Time (second)															
			0	10	20	30	60	90	120	150	240	300	600	1,200	1,800	3,600	7,200	14,400
			Maximum Sediment Concentration (mg/L)															
GB14	Wind Development Area	21%	666,250	253,246	143,106	92,300	31,382	15,932	9,526	5,694	1,563	1,162	407	103	38	8	1	0
GB16	Wind Development Area	99%	3,214,250	1,120,353	614,216	387,398	120,764	56,977	31,638	16,560	1,583	1,180	418	107	40	9	1	0
GB17	Wind Development Area	100%	3,237,000	1,169,140	646,494	409,293	128,157	60,556	33,651	17,637	1,727	1,286	453	115	43	9	1	0
GB18	Offshore export cable corridor	49%	1,605,500	547,613	299,503	189,225	60,239	29,054	16,533	9,074	1,471	1,098	390	100	37	8	1	0
GB19	Offshore export cable corridor	88%	2,873,000	1,093,047	612,309	389,688	122,084	57,445	31,714	16,358	1,192	889	314	80	30	7	1	0
GB20	Offshore export cable corridor	99%	3,227,250	1,228,075	688,124	438,082	137,507	64,825	35,865	18,581	1,473	1,098	388	99	37	8	1	0
GB21	Offshore export cable corridor	100%	3,246,750	1,355,279	781,463	505,366	164,139	79,288	44,907	24,253	3,296	2,461	874	224	84	19	2	0
GB22	Offshore export cable corridor	81%	2,619,500	1,121,076	650,742	421,716	136,166	65,215	36,549	19,306	1,992	1,489	530	136	51	11	1	0
GB23	Offshore export cable corridor	96%	3,107,000	1,646,391	1,032,071	695,314	234,477	113,613	63,701	33,151	2,406	1,803	643	165	61	14	1	0
GB24	Offshore export cable corridor	98%	3,185,000	1,664,050	1,036,333	695,139	231,408	110,944	61,510	31,282	1,175	881	316	81	30	7	1	0
GB25	Offshore export cable corridor	95%	3,097,250	1,750,869	1,130,461	775,150	270,003	133,403	76,024	40,562	4,226	3,174	1,139	293	110	24	2	0
GB26	Offshore export cable corridor	31%	1,001,000	567,484	367,700	253,265	90,514	45,833	26,822	15,055	2,661	1,999	717	185	69	15	1	0
GB27	Offshore export cable corridor	11%	341,250	184,494	120,673	86,138	39,181	23,933	16,572	11,997	5,896	4,426	1,592	412	155	35	3	0
GB28	Offshore export cable corridor	55%	1,771,250	796,552	470,195	307,448	100,806	48,723	27,517	14,702	1,720	1,288	461	119	45	10	1	0
GB29	Offshore export cable corridor	100%	3,243,500	1,473,135	880,184	584,362	208,316	108,532	66,163	40,442	12,041	9,017	3,229	835	313	70	6	0
GB30	Offshore export cable corridor	100%	3,237,000	1,457,915	862,197	565,108	187,822	91,970	52,680	28,917	4,492	3,363	1,204	311	117	26	2	0
GB31	Offshore export cable corridor	97%	3,149,250	1,070,739	583,301	366,676	113,396	53,180	29,348	15,174	1,177	878	312	80	30	7	1	0
GB32	Offshore export cable corridor	100%	3,243,500	1,352,339	778,637	502,610	161,517	77,222	43,246	22,847	2,389	1,784	634	163	61	13	1	0
GB33	Offshore export cable corridor	100%	3,237,000	1,383,804	802,131	518,904	165,822	78,609	43,554	22,478	1,559	1,165	415	107	40	9	1	0
GB34	Offshore export cable corridor	98%	3,181,750	1,665,620	1,039,849	699,681	237,233	115,841	65,573	34,803	3,526	2,644	948	244	91	20	2	0
GB35	Offshore export cable corridor	31%	1,001,000	520,188	324,715	219,150	76,335	38,314	22,355	12,573	2,307	1,732	623	161	60	14	1	0
GB36	Offshore export cable corridor	40%	1,306,500	588,129	347,590	227,633	75,305	36,711	20,928	11,385	1,625	1,217	436	113	42	9	1	0
GB37	Wind Development Area	18%	594,750	203,542	111,765	70,967	23,239	11,501	6,722	3,872	880	656	232	60	22	5	0	0
GB38	Wind Development Area	24%	763,750	261,107	143,213	90,806	29,494	14,491	8,407	4,778	1,001	747	265	68	25	6	0	0
GB42	Offshore export cable corridor	28%	913,250	488,104	309,234	211,138	76,751	39,874	24,059	14,338	3,743	2,805	1,000	256	95	21	2	0
GB45	Wind Development Area	77%	2,492,750	847,688	461,822	290,341	89,881	42,196	23,315	12,091	997	744	263	68	25	6	0	0
GB46	Wind Development Area	81%	2,629,250	917,381	503,576	318,127	100,098	47,658	26,729	14,269	1,765	1,316	466	119	44	10	1	0
GB47	Wind Development Area	99%	3,217,500	1,121,241	614,536	387,466	120,541	56,759	31,447	16,387	1,461	1,089	386	99	37	8	1	0
GB48	Wind Development Area	21%	679,250	238,148	131,508	83,706	27,475	13,604	7,950	4,576	1,035	772	273	70	26	6	0	0
GB49	Wind Development Area	29%	926,250	326,126	180,432	115,064	38,160	19,061	11,237	6,574	1,631	1,213	425	108	40	9	1	0
HDD exit pit	HDD zone	100%	3,237,000	2,492,748	1,917,561	1,467,999	602,255	314,277	182,050	98,823	14,240	10,086	2,905	602	202	39	3	0

Table M-17 Project Maximum Suspended Sediment Concentrations (mg/L) for Ebb Conditions (With Time)

Sample	Zone	Total Fines (%)	Time (second)															
			0	10	20	30	60	90	120	150	240	300	600	1,200	1,800	3,600	7,200	14,400
			Maximum Sediment Concentration (mg/L)															
GB14	Wind Development Area	21%	666,250	487,318	366,114	278,877	121,839	69,584	44,614	27,947	8,321	6,386	2,417	647	246	56	5	0
GB16	Wind Development Area	99%	3,214,250	2,449,021	1,885,680	1,454,945	619,209	339,470	206,299	114,772	12,192	9,469	3,701	1,016	391	90	8	0
GB17	Wind Development Area	100%	3,237,000	2,460,057	1,890,468	1,456,378	618,000	338,170	205,256	114,189	12,399	9,608	3,725	1,014	388	89	7	0
GB18	Offshore export cable corridor	49%	1,605,500	1,079,936	766,226	558,484	217,767	114,925	68,882	39,126	6,727	5,134	1,929	518	197	45	4	0
GB19	Offshore export cable corridor	88%	2,873,000	1,977,981	1,420,076	1,040,480	400,161	206,543	120,283	64,259	4,966	3,785	1,409	373	141	32	3	0
GB20	Offshore export cable corridor	99%	3,227,250	2,222,328	1,595,909	1,169,691	450,713	233,077	136,026	72,987	6,134	4,675	1,740	460	174	39	3	0
GB21	Offshore export cable corridor	100%	3,246,750	2,453,309	1,878,220	1,443,770	614,607	338,269	207,068	117,779	17,463	13,470	5,141	1,376	522	118	10	0
GB22	Offshore export cable corridor	81%	2,619,500	2,177,977	1,798,464	1,469,615	708,332	421,096	270,934	157,603	19,279	15,378	6,325	1,758	673	154	13	0
GB23	Offshore export cable corridor	96%	3,107,000	2,510,942	2,023,037	1,617,584	737,101	419,975	260,849	145,704	11,959	9,384	3,702	1,001	379	86	7	0
GB24	Offshore export cable corridor	98%	3,185,000	2,677,084	2,230,129	1,834,743	888,711	527,627	336,753	189,355	8,529	6,867	2,886	811	311	71	6	0
GB25	Offshore export cable corridor	95%	3,097,250	2,705,407	2,336,754	1,989,779	1,065,397	689,003	474,934	292,536	40,365	34,157	16,465	5,068	2,010	474	40	0
GB26	Offshore export cable corridor	31%	1,001,000	876,865	760,065	650,122	357,158	236,720	167,561	108,582	25,415	21,506	10,367	3,191	1,266	298	25	0
GB27	Offshore export cable corridor	11%	341,250	262,259	207,283	166,908	92,252	62,064	45,570	34,331	18,086	13,950	5,365	1,459	559	128	11	0
GB28	Offshore export cable corridor	55%	1,771,250	1,135,349	782,745	559,329	208,905	107,247	62,804	34,403	4,215	3,219	1,220	333	128	30	3	0
GB29	Offshore export cable corridor	100%	3,243,500	2,099,704	1,465,265	1,063,106	431,703	238,896	151,007	94,637	29,505	22,534	8,542	2,330	897	209	18	0
GB30	Offshore export cable corridor	100%	3,237,000	2,078,009	1,435,322	1,028,078	389,231	202,441	120,234	67,668	11,006	8,405	3,186	869	335	78	7	0
GB31	Offshore export cable corridor	97%	3,149,250	2,111,581	1,492,271	1,082,220	409,932	210,361	122,277	65,429	5,381	4,107	1,543	414	158	36	3	0
GB32	Offshore export cable corridor	100%	3,243,500	2,447,986	1,871,428	1,435,895	604,786	329,453	199,408	110,954	12,661	9,766	3,727	998	378	86	7	0
GB33	Offshore export cable corridor	100%	3,237,000	2,688,393	2,216,860	1,808,301	862,606	507,587	322,859	183,505	15,088	12,035	4,950	1,376	527	120	10	0
GB34	Offshore export cable corridor	98%	3,181,750	2,679,610	2,237,696	1,846,730	911,081	550,918	358,996	210,670	25,588	20,600	8,658	2,432	934	214	18	0
GB35	Offshore export cable corridor	31%	1,001,000	739,448	557,768	424,644	179,733	99,358	61,472	35,980	7,077	5,459	2,099	571	219	50	4	0
GB36	Offshore export cable corridor	40%	1,306,500	838,277	578,641	414,124	156,059	80,808	47,766	26,642	3,981	3,040	1,153	314	121	28	2	0
GB37	Wind Development Area	18%	594,750	444,613	338,646	260,101	113,527	64,330	40,741	24,765	6,173	4,769	1,841	501	192	44	4	0
GB38	Wind Development Area	24%	763,750	514,922	366,384	268,009	106,624	57,321	35,026	20,603	4,574	3,491	1,312	352	134	31	3	0
GB42	Offshore export cable corridor	28%	913,250	744,417	606,152	491,193	241,275	147,395	98,519	63,017	18,603	14,597	5,759	1,557	590	133	11	0
GB45	Wind Development Area	77%	2,492,750	1,851,668	1,399,320	1,064,130	439,078	236,008	141,309	77,334	6,996	5,405	2,086	568	218	50	4	0
GB46	Wind Development Area	81%	2,629,250	2,005,337	1,546,008	1,194,785	513,247	283,945	174,293	98,899	13,598	10,561	4,127	1,134	436	101	8	0
GB47	Wind Development Area	99%	3,217,500	2,450,962	1,886,662	1,455,199	618,070	338,172	205,056	113,573	11,254	8,740	3,416	938	361	83	7	0
GB48	Wind Development Area	21%	679,250	520,577	403,737	314,374	140,876	81,053	51,841	31,718	7,971	6,191	2,420	665	256	59	5	0
GB49	Wind Development Area	29%	926,250	752,284	610,741	493,649	240,724	146,375	97,496	62,033	17,829	14,035	5,622	1,551	595	136	11	0
HDD exit pit	HDD zone	100%	3,237,000	2,735,834	2,285,904	1,883,515	922,014	546,923	348,524	203,470	33,668	25,193	8,189	1,804	618	123	9	0

Table M-18 Project Deposition Depths for Flood Conditions

Sample	Zone	Total Fines (%)	Distance from Trench (m)															
			0	1	5	10	25	50	75	100	150	250	350	500	800	1,000	2,500	5,000
			Maximum Sediment Deposition (cm)															
GB14	Wind Development Area	21%	2.73	2.73	2.73	0.65	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB16	Wind Development Area	99%	12.90	12.90	12.90	12.90	3.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB17	Wind Development Area	100%	13.66	13.66	13.66	3.25	3.25	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB18	Offshore export cable corridor	49%	6.07	6.07	6.07	6.07	1.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB19	Offshore export cable corridor	88%	13.30	13.30	13.30	3.18	3.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB20	Offshore export cable corridor	99%	14.91	14.91	14.91	3.56	3.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB21	Offshore export cable corridor	100%	17.10	17.10	17.10	4.13	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB22	Offshore export cable corridor	81%	14.61	14.61	14.61	3.54	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB23	Offshore export cable corridor	96%	26.16	26.16	6.52	6.52	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB24	Offshore export cable corridor	98%	26.42	26.42	6.59	6.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB25	Offshore export cable corridor	95%	29.68	29.68	7.53	7.53	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB26	Offshore export cable corridor	31%	9.33	9.33	2.37	2.37	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB27	Offshore export cable corridor	11%	1.59	1.59	0.41	0.41	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB28	Offshore export cable corridor	55%	10.74	10.74	10.74	2.63	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB29	Offshore export cable corridor	100%	17.80	17.80	17.80	4.38	0.04	0.04	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB30	Offshore export cable corridor	100%	19.35	19.35	19.35	4.73	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB31	Offshore export cable corridor	97%	12.28	12.28	12.28	12.28	2.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB32	Offshore export cable corridor	100%	17.27	17.27	17.27	4.17	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB33	Offshore export cable corridor	100%	18.24	18.24	18.24	4.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB34	Offshore export cable corridor	98%	25.91	25.91	6.47	6.47	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB35	Offshore export cable corridor	31%	7.74	7.74	1.94	1.94	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB36	Offshore export cable corridor	40%	7.85	7.85	7.85	1.92	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB37	Wind Development Area	18%	2.17	2.17	2.17	2.17	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB38	Wind Development Area	24%	2.82	2.82	2.82	2.82	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB42	Offshore export cable corridor	28%	7.06	7.06	1.77	1.77	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB45	Wind Development Area	77%	9.69	9.69	9.69	9.69	2.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB46	Wind Development Area	81%	10.45	10.45	10.45	10.45	2.49	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB47	Wind Development Area	99%	12.94	12.94	12.94	12.94	3.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB48	Wind Development Area	21%	2.57	2.57	2.57	2.57	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB49	Wind Development Area	29%	3.46	3.46	3.46	3.46	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HDD exit pit	HDD zone	100%	63.43	63.43	63.43	15.55	0.03	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table M-19 Project Deposition Depths for Ebb Conditions

Sample	Zone	Total Fines (%)	Distance from Trench (m)															
			0	1	5	10	25	50	75	100	150	250	350	500	800	1,000	2,500	5,000
			Maximum Sediment Deposition (cm)															
GB14	Wind Development Area	21%	11.73	11.73	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB16	Wind Development Area	99%	75.32	75.32	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB17	Wind Development Area	100%	74.78	74.78	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB18	Offshore export cable corridor	49%	23.63	23.63	6.48	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB19	Offshore export cable corridor	88%	47.03	47.03	12.97	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB20	Offshore export cable corridor	99%	52.73	52.73	14.55	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB21	Offshore export cable corridor	100%	71.59	71.59	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB22	Offshore export cable corridor	81%	93.29	32.27	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB23	Offshore export cable corridor	96%	95.53	31.06	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB24	Offshore export cable corridor	98%	125.40	44.81	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB25	Offshore export cable corridor	95%	158.59	0.25	0.25	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB26	Offshore export cable corridor	31%	49.92	0.16	0.16	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB27	Offshore export cable corridor	11%	4.10	4.10	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB28	Offshore export cable corridor	55%	23.43	23.43	6.33	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB29	Offshore export cable corridor	100%	38.86	38.86	10.56	0.11	0.11	0.11	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
GB30	Offshore export cable corridor	100%	42.21	42.21	11.41	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB31	Offshore export cable corridor	97%	47.78	47.78	13.08	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB32	Offshore export cable corridor	100%	72.31	72.31	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB33	Offshore export cable corridor	100%	116.49	40.27	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB34	Offshore export cable corridor	98%	123.02	44.01	0.12	0.12	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB35	Offshore export cable corridor	31%	19.84	19.84	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB36	Offshore export cable corridor	40%	17.12	17.12	4.63	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB37	Wind Development Area	18%	11.91	11.91	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB38	Wind Development Area	24%	10.99	10.99	3.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB42	Offshore export cable corridor	28%	25.83	8.44	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB45	Wind Development Area	77%	53.11	53.11	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB46	Wind Development Area	81%	61.02	61.02	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB47	Wind Development Area	99%	75.55	75.55	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB48	Wind Development Area	21%	15.04	15.04	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GB49	Wind Development Area	29%	26.08	8.53	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HDD exit pit	HDD zone	100%	110.66	110.66	34.97	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

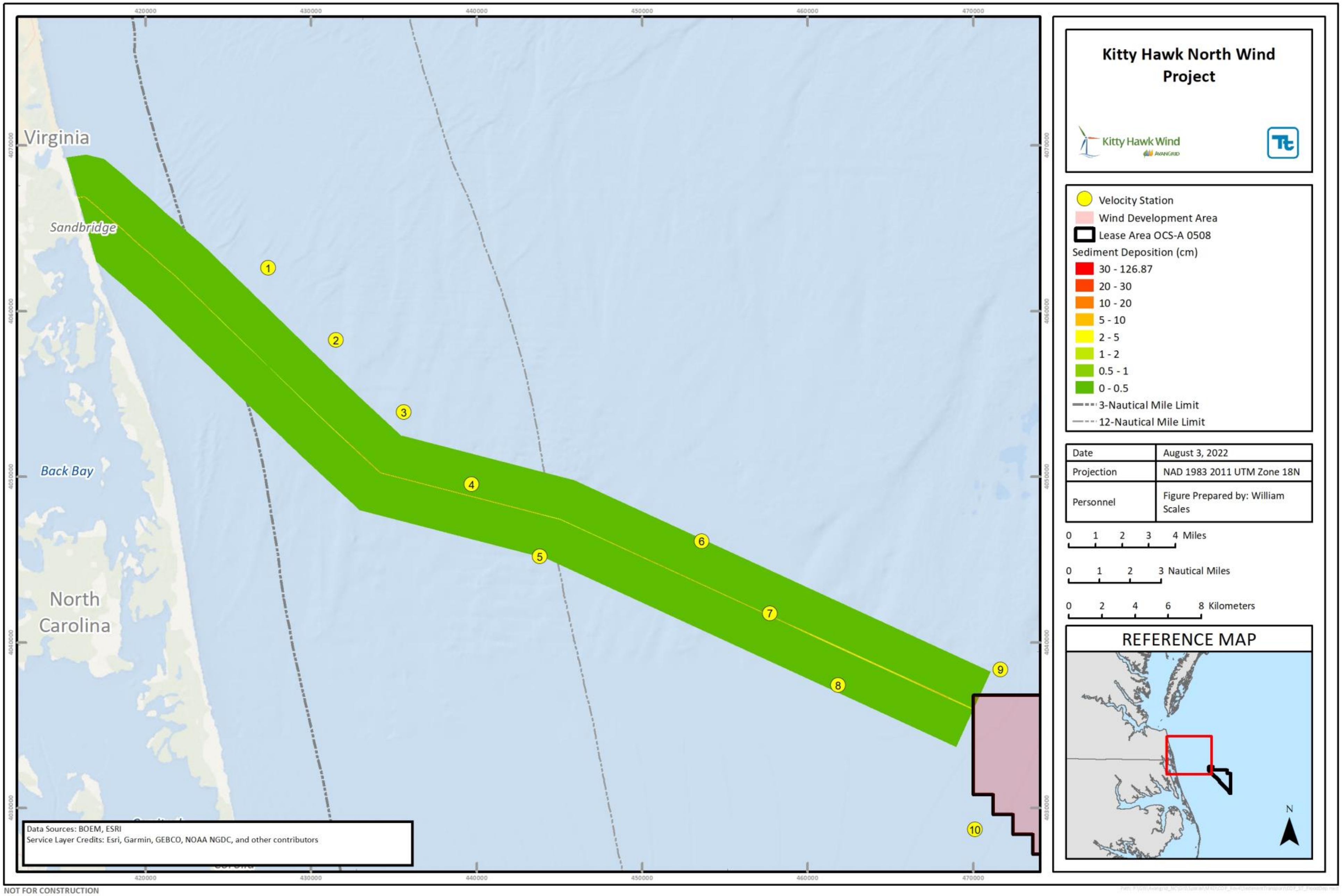

Figure M-13 Maximum Flood Tide Sediment Deposition along the Offshore Export Cable Corridor

The figure represents the instantaneous maximum sediment deposition at any given point of time. These concentrations do not occur at all locations simultaneously. Due to jet plow speed, only small sections of the offshore export cable corridor and Wind Development Area would be disturbed at any given time during Project construction.

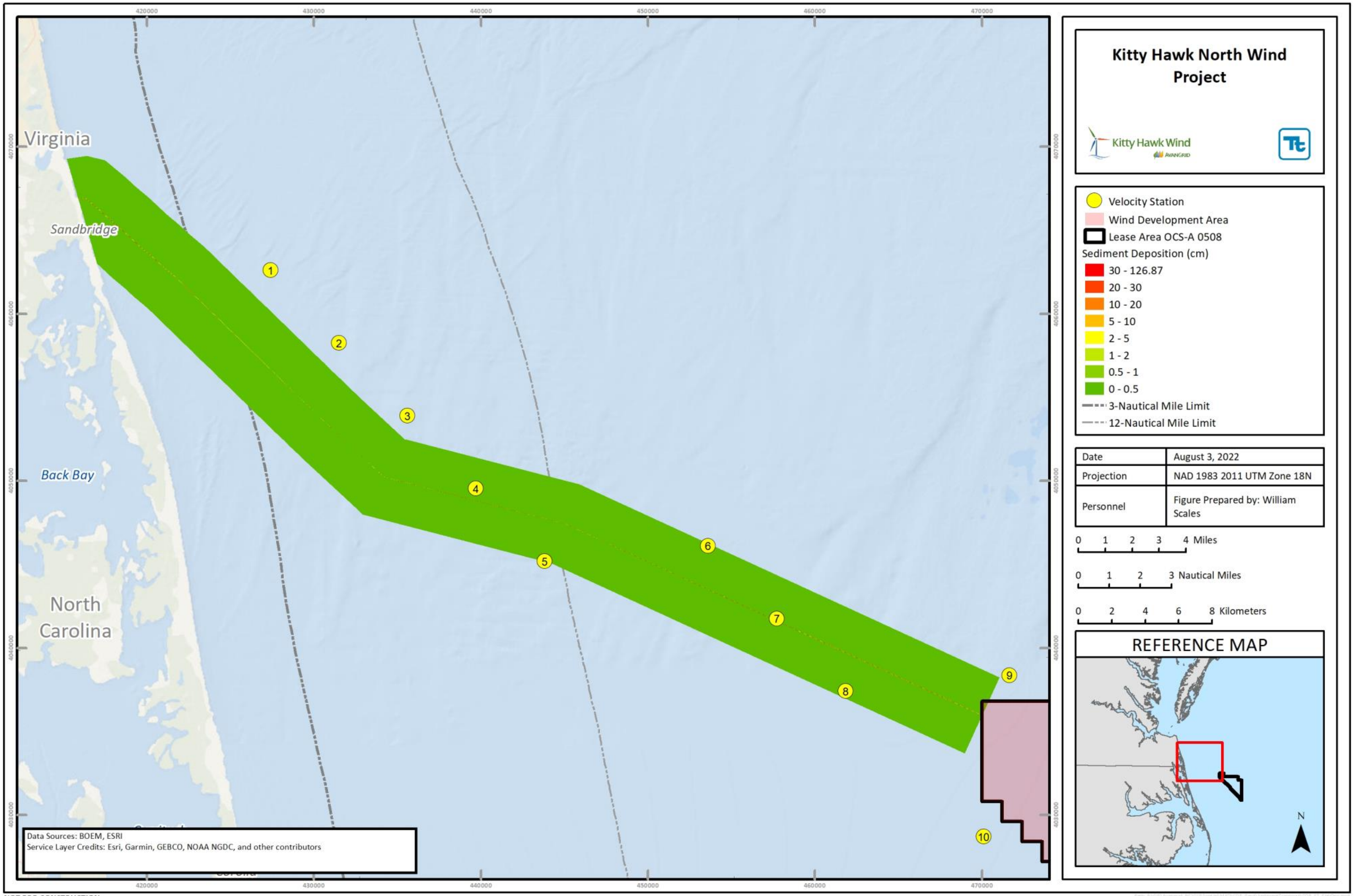

Figure M-14 Maximum Ebb Tide Sediment Deposition along the Offshore Export Cable Corridor

The figure represents the instantaneous maximum sediment deposition at any given point of time. These concentrations do not occur at all locations simultaneously. Due to jet plow speed, only small sections of the offshore export cable corridor and Wind Development Area would be disturbed at any given time during Project construction.

As discussed previously, the model did not evaluate secondary resuspension that could occur after initial deposition as this would not be caused by the jet plow. This could result in the recently deposited sediment being additionally transported further than estimated; however, it would be expected that as this resuspended sediment is dispersed over a wider area, the thickness of deposited sediments will reduce.

M.5 CONCLUSIONS

Tetra Tech performed an analytical sediment transport study to conservatively evaluate the potential suspended sediment transport and deposition characteristics of installation of the Project's offshore export and inter-array cables. The modeling was conducted using existing available data and a project design envelope approach to evaluate the effects of proposed submarine cable burial activities in terms of suspended sediment concentrations in the water column, and sediment deposition characteristics such as deposition depth and deposited sediment footprint, to allow for an assessment of potential Project effects on surrounding water quality and habitats. This model applied conservative assumptions for pre-cable installation dredge operations which can be adjusted during Project construction including extent of allowable hopper overflow, and employing mass flow excavation where appropriate. The conservative model assumed maximum trench dimension parameters and that all fine sediment (fine sand and smaller grain size sediment) disturbed by the jet plow during cable burial would be suspended in the water column; however, jet plow operations, including the angle of the plow blade and water pressure through the jet nozzles, can be adjusted during cable installation and could result in less sediment mobilizing in the water column.

The analytical sediment transport model yielded the following general conclusions:

- The suspended sediment concentration, deposition depth, and area of influence is dependent upon flood and ebb current velocities, burial depth, and the percentage of fine sediments in the sediment sample;
- The very fine sediments particles (silt and clay) remain in suspension for about 4 hours after being mobilized in the water column. Coarser particles (fine sand) settle at a faster rate, about 1 minute after being mobilized; and
- Jet-plow installation for peak flood and ebb tides:
  - The initial maximum concentration at the release point is dependent on the percentage of fine particles (defined as particles in the fine sand class and smaller). At stations that are 90 percent fine particles, maximum concentrations at the trench line are $3.1*10^6$ mg/L for a maximum trench depth of 2.5 m. This instantaneous concentration is conservatively high and assumes that all particles finer than fine sand are instantly mobilized in the water column and remain in suspension until they settle;
  - The suspended sediment concentrations diminish rapidly away from the release point, and at most stations over 80 percent of the suspended particles deposit within 10 m of the trench centerline. The typical concentration at 100 m is about 300 mg/L above background concentration for flood tides and about 50 mg/L above background concentration for ebb tides;
  - The suspended sediment concentrations drop rapidly with time. At most locations, the concentration drops by 75 percent within two minutes of jet plowing activity. The maximum concentration at two minutes is $0.7*10^5$ mg/L for flood tide and $4.7x10^5$ mg/L for ebb tide. Average concentration at two minutes is $3.3*10^4$ mg/L for flood tide and $1.6*10^5$ mg/L for ebb tide;

- The deposition thicknesses were predicted to be greatest closest to the centerline trench. The maximum expected sediment deposition thickness under simulated conditions is 158.59 cm at 0 m from the trench centerline. On average, deposition thicknesses were 12.56 cm at 0 m from the trench centerline for flood tides and 55.47 cm at 0 m from the trench centerline for ebb tides; and
- Deposition thicknesses were predicted to decrease rapidly away from the trench. Deposition thicknesses were less than 4 cm within 25 m of the trench centerline. Deposition thicknesses were less than 0.05 cm at all stations within 150 m of the trench centerline.

- The maximum suspended sediment concentration during jet-plow cable installation was 3.23 x10^6 mg/L in the HDD zone with concentrations dropping below 1,000 mg/L at a distance of 100 m from the trench centerline. The maximum deposition thickness was 110.66 cm during ebb tides and dropped to below 0.1 cm within 50 m of the trench centerline.
- The maximum suspended sediment concentration at 25 m ranged between 1,700 mg/L and 2,200 mg/L during pre-cable installation dredging. The maximum deposition thickness was less than 2 cm during ebb tides.
- For dredge material disposal, maximum flood concentrations range from 2.4 x 10^4 mg/L to 4.2 x 10^4 mg/L at a distance of 50 m from the disposal location. Estimated maximum deposition depth of 206 cm occurring during ebb conditions at distances less than 0.5 m from the point of disposal. By 100 m from the disposal location, deposition is less than 2 cm for all locations for flood and ebb conditions

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