APPENDIX J

Sediment Transport Analysis

Prepared for
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TETRA TECH

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FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

BOEM	U.S. Bureau of Ocean Energy Management
cm	centimeter
cm/s	centimeters per second
Empire	Empire Offshore Wind LLC
ESPreSSO	Experimental System for Predicting Shelf and Slope Optics
EW	Empire Wind
ft	foot
ft/s	feet per second
in	inch
km	kilometer
Lease Area	designated Renewable Energy Lease Area OCS-A 0512
m	meter
MFE	mass flow excavation
mg/L	milligrams per liter
mi	statute mile
mm	millimeter
MOCHA	Mid-Atlantic Climatological Hydrographic Analysis
PDE	project design envelope
POI	point of interconnection
Project	The offshore wind project for OCS A-0512 proposed by Empire Offshore Wind LLC consisting of Empire Wind 1 (EW 1) and Empire Wind 2 (EW 2).
Project Area	The area associated with the build out of the Lease Area, submarine export cable routes, interarray cables, and all onshore Project facilities.
ROMS	Regional Ocean Modeling System
Tetra Tech	Tetra Tech, Inc.
TSS	total suspended solids
USGS	United States Geological Survey

J.1 INTRODUCTION

Tetra Tech, Inc. (Tetra Tech) was contracted by Empire Offshore Wind LLC (Empire) to evaluate the potential suspended sediment, transport and deposition associated with Empire Wind Lease Area OCS-A 0512 Offshore Wind Project (Project) construction activities, including installation of submarine export and interarray cables. Disturbance of sediments during Project construction has the potential to affect water quality through increases to total suspended solids (TSS) into the water column and deposition of sediments away from the location of sediment disturbance, including potentially outside the Project Area (i.e. the Lease Area and submarine export cable routes) through resuspension, dispersal, and subsequent sedimentation.

In order to provide a conservative estimate of potential maximum suspended sediment transport and deposition impacts, publicly available sediment and water circulation data covering the Project Area was 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.

The sediment transport assessment contained herein includes a description of the Project components and project design envelope (PDE) that were evaluated (Section J.1.1); a discussion of the modeling approach undertaken (Section J.1.2); a summary of the data sources and associated hydrodynamic and sediment characteristics applied (Section J.1.3); description of the model runs executed (Section J.1.4); and results of the analysis and associated conclusions (Sections J.1.5 and J.1.6).

J.1.1 Project Description

The Project will be located in the designated U.S. Bureau of Ocean Energy Management (BOEM) designated Renewable Energy Lease Area OCS-A 0512 (Lease Area), which is approximately 14 statute miles (mi) (12 nautical miles, 22 kilometers [km]) south of the southern shore of Long Island. Empire proposes to develop the Lease Area in two wind farms: EW 1 and EW 2. The Project includes the installation of wind turbines, up to two offshore substations, up to two individual submarine export cable routes, and interarray cables. EW 1 and EW 2 will be electrically isolated and independent from each other. Each wind farm will connect via offshore substations to separate Points of Interconnection (POIs) at onshore locations by way of export cable routes and onshore substations. In this respect, the Project includes two onshore locations in New York where the renewable electricity generated will be transmitted to the electric grid. Empire proposes to connect the Project into New York through the Gowanus and the Oceanside POIs (**Figure J-1**).

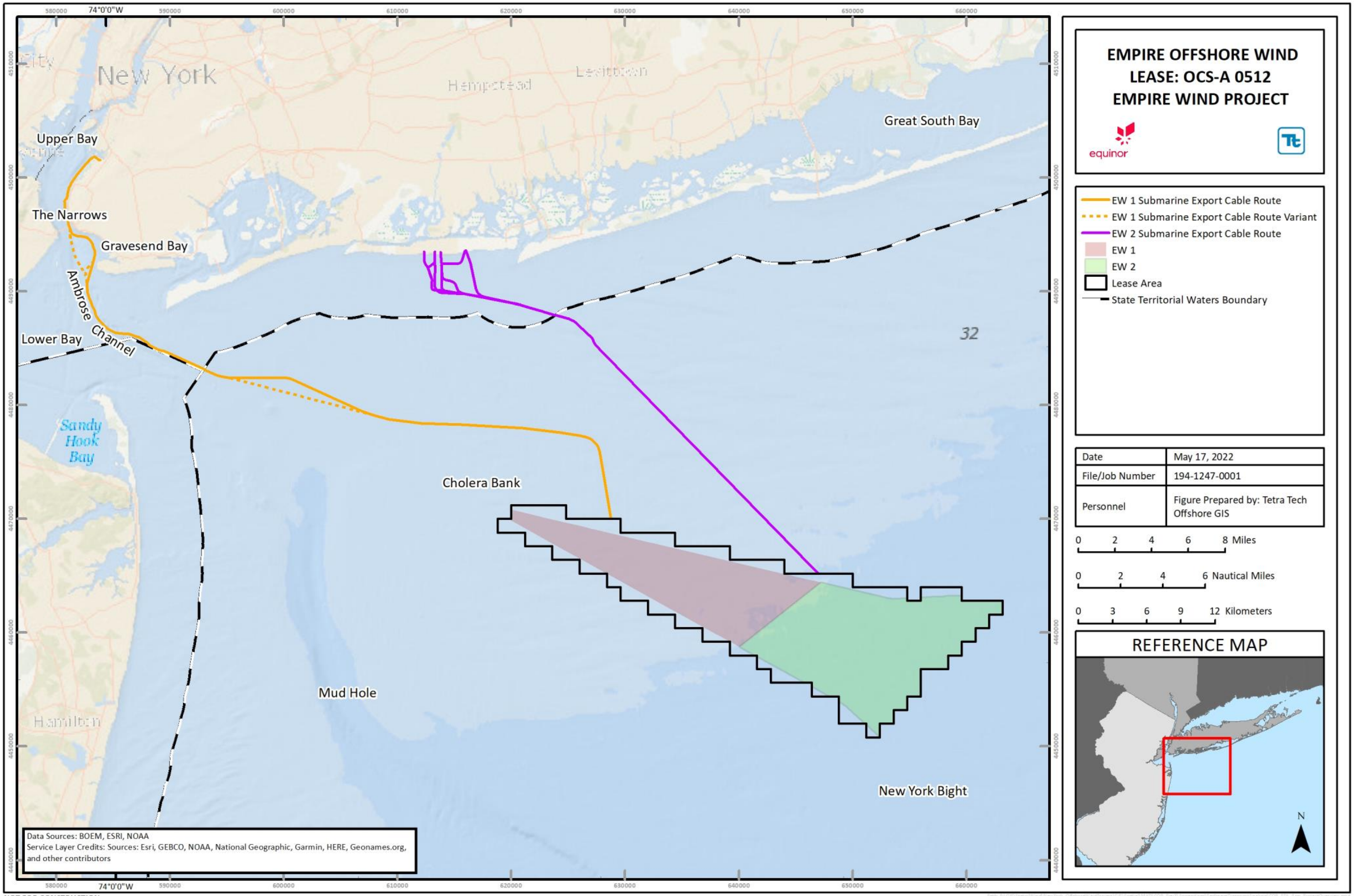

Figure J-1 Project Overview

Based on current understanding of site-specific conditions within the Lease Area and along the submarine export cable routes to shore (submarine export cable siting corridors), Empire is currently recommending jet plow, mechanical plow, and mechanical cutter as the primary cable installation methodologies. In areas where these methods cannot be employed due to deeper burial requirements or other challenges such as vessel draft requirements, dredging or mass flow excavation (MFE) may be employed. In general, the submarine export cables and interarray cables will be buried to a target depth of 6 ft (1.8 m)[1] below the seabed surface; and installation will often be to a depth of 8 ft (2.5 m) to account for immediate sediment settling and to achieve the target burial depth.

J.1.2 Modeling Assumptions and the Project Design Envelope Approach

In order to evaluate how submarine export cable installation will affect suspended sediment concentrations, and transport and deposition, Tetra Tech conducted a sediment transport analysis of the Project. Results from a previously developed publicly available hydrodynamic model was used to gather information regarding current velocity and direction in the Lease Area and submarine export cable siting corridors (Project Area). An analytical sediment transport model was developed to predict the fate and transport of sediment suspended by cable installation along the submarine export cable routes. Tetra Tech used existing publicly available sediment data to inform the analytical model.

The analytical model adopted a PDE approach to evaluate the effects of proposed submarine 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. The model simulated installation impacts of one trench, although two trenches will be installed during construction and an additional run may be conducted as part of the pre-construction activities (i.e. pre-trenching); the trenches will be conducted at separate times, however. The model simulated jet plow installation, the installation method proposed to be utilized for most of the submarine export cable route, which would result in greater disturbance of marine sediments than mechanical plow or mechanical cutter installation. Jet plowing therefore provides the maximum expected disturbance of seabed sediment in the Project Area. In several locations in the Project Area, jet plowing is not feasible or desired due to sediment materials or the presence of other submarine assets, therefore MFE will be used. In other limited areas, underwater megaripples and sandwaves are present on the seafloor, and pre-sweeping using MFE may be necessary prior to cable lay activities. In these locations the model simulated MFE. Pre-sweeping involves smoothing the seafloor by removing ridges and edges, where present. This approach is consistent with BOEM's *Draft Guidance Regarding the Use of a Project Design Envelope in a Construction and Operations Plan* (BOEM 2018). This approach provides the Project reasonable flexibility to make prudent development and design decisions prior to construction. Therefore, for the purpose of this analysis, the Project has assumed the following as the maximum design scenario:

- Two proposed submarine export cable routes: Empire Wind (EW) 1 and EW 2[2];

[1] Based upon guidance provided by the U.S. Army Corps of Engineers in letters dated September 20, 2018 and August 20, 2020, and the United States Coast Guard in a letter dated December 15, 2020, submarine export cables will be buried to a minimum target burial depth of 15 ft (4.7 m) below the current (and future) authorized depth or depth of existing seabed (whichever is deeper) of federally maintained navigation features (e.g. anchorages and shipping channels).

[2] Subsequent to initial modelling efforts, Empire continues to refine the submarine export cable routes, as proposed in this COP. A minor variant to the EW 1 submarine export cable route is now included in the PDE; this variant is similar to the route presented in **Figure J-8** and **Figure J-11**, and therefore the results of the model are anticipated to be representative of this new variant. In addition, three new potential horizontal directional drilling alignments for the EW

- The use of a jet plow[3], since this is anticipated to be the cable installation method used for the majority of the submarine export cable installation and associated pre-installation activities (i.e. pre-trenching);
  - A target burial depth submarine export cables of 8 ft (2.5 m);
  - A target burial depth for submarine export cables of 18 ft (5.5 m) for sections of the EW 1 submarine export cable route that intersect federally maintained navigational features;
- The use of MFE in select locations where jet plowing will not be used for feasibility reasons:
  - A target removal height of up to 6 ft (2 m);
  - A pre-sweeping corridor width of 82 ft (25 m); and
  - A pre-sweeping corridor length of 82 ft (25 m);
- Activities during construction 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; and
- 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.[4]

J.2 MODELING APPROACH

The aim of this study is to evaluate the effects of proposed submarine export cable installation and burial activities in terms of suspended sediment concentrations in the water column and sediment deposition characteristics, such as deposition depth and sediment deposition footprint.

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 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 (ROMS). ROMS is 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 extends from the center of Cape Cod, Massachusetts southwards to Cape Hatteras, North Carolina, with 3 mi (5 km) horizontal resolution and 36 terrain-following vertical levels. Approximately 95 percent of the Project Area falls inside the model domain, which allows model outputs to be used to gather the circulation characteristics within the Lease Area and along the submarine export cable siting corridors. The current speed and direction from the ESPreSSO model help determine the path of the suspended sediments generated by submarine export cable jet plowing activities. More details about the hydrodynamic data used in the sediment transport model are provided in Section J.3.1.

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2 export cable landfall are now included in the PDE. Due to the proximity to the EW 2 export cable landfall modelled, and uniform sediment conditions in the area, the results of the EW 2 modeling are anticipated to be representative of all EW 2 export cable landfall options.

[3] 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.

[4] A Scour Protection Analysis for impacts associated with operations will be completed and submitted as part of the Facility Design Report/Fabrication and Installation Report .

An analytical sediment transport model was developed to assess the suspended sediment water column concentrations and sediment deposition characteristics as a result of the submarine export cable jet plowing activities. Regional average sediment data such as density and grain size distribution were derived from previously conducted studies near the Project Area (such as the Poseidon Project[5], **Figure J-2**, ESS Group 2013). These sediment characteristics were used to inform the calculations of volume and concentrations of suspended sediment due to jet plowing operations.

Calculations were made along the submarine export cable siting corridors based on the different current velocities available from the ESPreSSO model and sediment characteristics from the Poseidon Project. More detail about the sediment characteristics and the analytical model is provided in Sections J.3.2 and J.4.1, respectively. The final results of the analytical model include the extent and duration of suspended sediment concentrations within the water column along the submarine export cable routes and the final sediment deposition thickness associated with the jet plowing operations.

[5] The Poseidon Project includes approximately 39.2 mi (63 km) of high-voltage direct-current submarine cable bundled with a fiber optic cable to be buried in the seafloor of Raritan Bay and the New York Bight with landfalls at Union Beach, in Monmouth County, New Jersey and Jones Beach on Long Island in Suffolk County, New York. This export cable route covers approximately 70 percent of the submarine export cable evaluation area within 3 nautical miles of Long Island, New York. Sediment data is available for 47 different locations along the submarine export cable route.

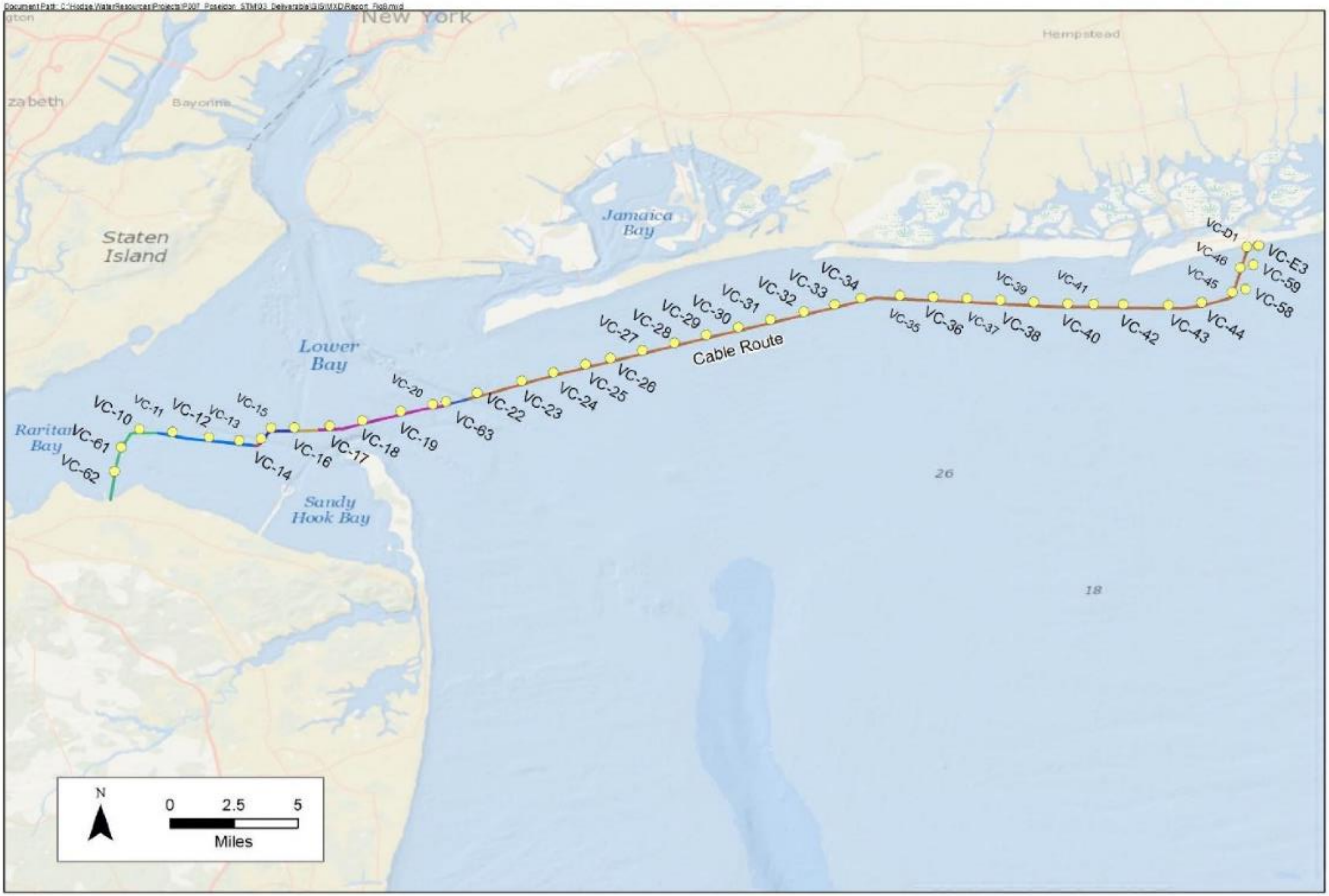

Figure J-2 Location of sediment sampling locations for the Poseidon Project (Source: ESS Group 2013)

J.3 DATA SOURCES

J.3.1 Hydrodynamic Data

As part of the effort to evaluate the variability of ocean currents within the Lease Area and along the submarine export cable routes, Tetra Tech looked at the precipitation record of Eatontown 1.2 NE (Station US1NJMN0010) located in Monmouth County, New Jersey, approximately 31 mi (50 km) west of the Lease Area. Eatontown has a data coverage of 95 percent and was therefore selected to evaluate the precipitation conditions around the Project Area, with precipitation being a proxy for freshwater outflows from major rivers (river flow volume can influence flood and ebb current speeds in nearshore areas). Precipitation data were available for 10 years (2009 through 2018). Total precipitation for each year and the 10-year average of precipitation were calculated (**Table J-1**). A normal precipitation year (neither wet or dry) was selected to represent current (velocity) conditions within the Lease Area and along the submarine export cable routes. The ESPreSSO model contains hourly velocity outputs from October 2009 through October 2013. To ensure that the ocean current variability was accurately represented, different years were evaluated based on their total annual precipitation and the availability of velocity outputs from the ESPreSSO model. Year 2012 was chosen as a representative year to evaluate the current conditions for the Project Area because the velocity data was available for the full year for the ESPreSSO model and the 2012 total annual precipitation at Eatontown was similar to the 10-year total annual precipitation average calculated using data from Eatontown (i.e., normal precipitation).

Table J-1 Yearly Precipitation at Eatontown 1.2 NE, New Jersey

Year	Total Annual Precipitation (in)
2009	48.86
2010	37.59
2011	54.88
2012 a/	38.56
2013	36.54
2014	53.22
2015	34.86
2016	37.66
2017	48.52
2018	70.78
Average	46.15

Note:
a/ 2012 was selected for the sediment transport analysis.

The ESPreSSO model uses ROMS, which is a free-surface, terrain-following, primitive equations ocean model widely used by the scientific community for a diverse range of applications. ROMS is an open-source model that is developed and supported by researchers at the Rutgers University, University of California Los Angeles and contributors worldwide. (Haidvogel et al. 2000; Marchesiello et al. 2003; Peliz et al. 2003). ESPreSSO open boundary values are taken from global HYbrid Coordinate Ocean Model (HYCOM) with adjustments using Mid-Atlantic Climatological Hydrographic Analysis (MOCHA) climatology and the addition of harmonic tides (Mukai et al. 2002). Meteorology forcing is taken from the North American Mesoscale model. Inflows for the seven largest rivers entering the model are from daily average U.S. Geological Survey (USGS) discharge data. Strong constraint four-dimensional variational (4D-Var) data assimilation (Moore et al. 2011) is used to incorporate satellite sea surface height from Jason-2, satellite sea surface temperature from infrared and microwave radiometers, monthly MOCHA temperature, salinity, climatology, and hourly Coastal Ocean Dynamics Applications Radar surface currents (Zavala-Garay et al. 2012).

The ESPreSSO data set includes hourly simulations covering the period from October 2009 through February 2014.[6] The ESPreSSO model provides velocity, salinity, and temperature outputs at regularly spaced output stations throughout the Project Area. Hourly bottom velocity outputs at ESPreSSO model stations located within the Project Area were downloaded for the year 2012. A rolling 4-hour average velocity was calculated at each hourly time step for all stations. The 90th percentile of the rolling 4-hour average ebb and flood velocities was selected to represent the potential high velocities during these tidal periods. To represent the variability in the flow throughout the Project Area, data from stations closest to the submarine export cable routes and Lease Area were selected and paired with the sediment data in the analytical model.

The velocity stations used in the analytical sediment transport model are shown in **Figure J-3**. For the purpose of this study, the stations were assigned station identification numbers (station ID) from 1 through 36 for easy reference. Two additional stations, 1a and 2a, were used to simulate sections of the EW 1 submarine export cable route that intersect federally maintained navigational features. Stations 1a and 2a have the same velocity characteristics as Stations 1 and 2 respectively, but modeling assumed a target burial depth of 18 ft (5.5 m). The stations were also assigned zones based on their proximity to the river mouth. All stations close to the river mouth were assigned "Riverine" zone and the rest were assigned "Non-Riverine" zone (this included consideration of Hudson/Passaic river flows associated with the New York/New Jersey Harbor). The current magnitudes at these stations ranged from 0.14 ft per second (ft/s) (4 centimeters per second [cm/s]) to 1.27 ft/s (39 cm/s). **Table J-2** lists the representative flood and ebb velocities at all the stations. MFE was simulated in New York state waters to model conservative suspended sediment estimates. Velocity from Station 1 was chosen to represent the hydrodynamic conditions present in the Narrows and velocity from Station 2 was chosen to represent the hydrodynamic conditions present near Gravesend Bay. Both ebb and flood velocities were used to calculate the possible maximum extent of sediment deposition and suspended sediment water column concentrations within the Project Area under these conditions.

[6] Model information can be accessed at http://www.myroms.org/espresso/.

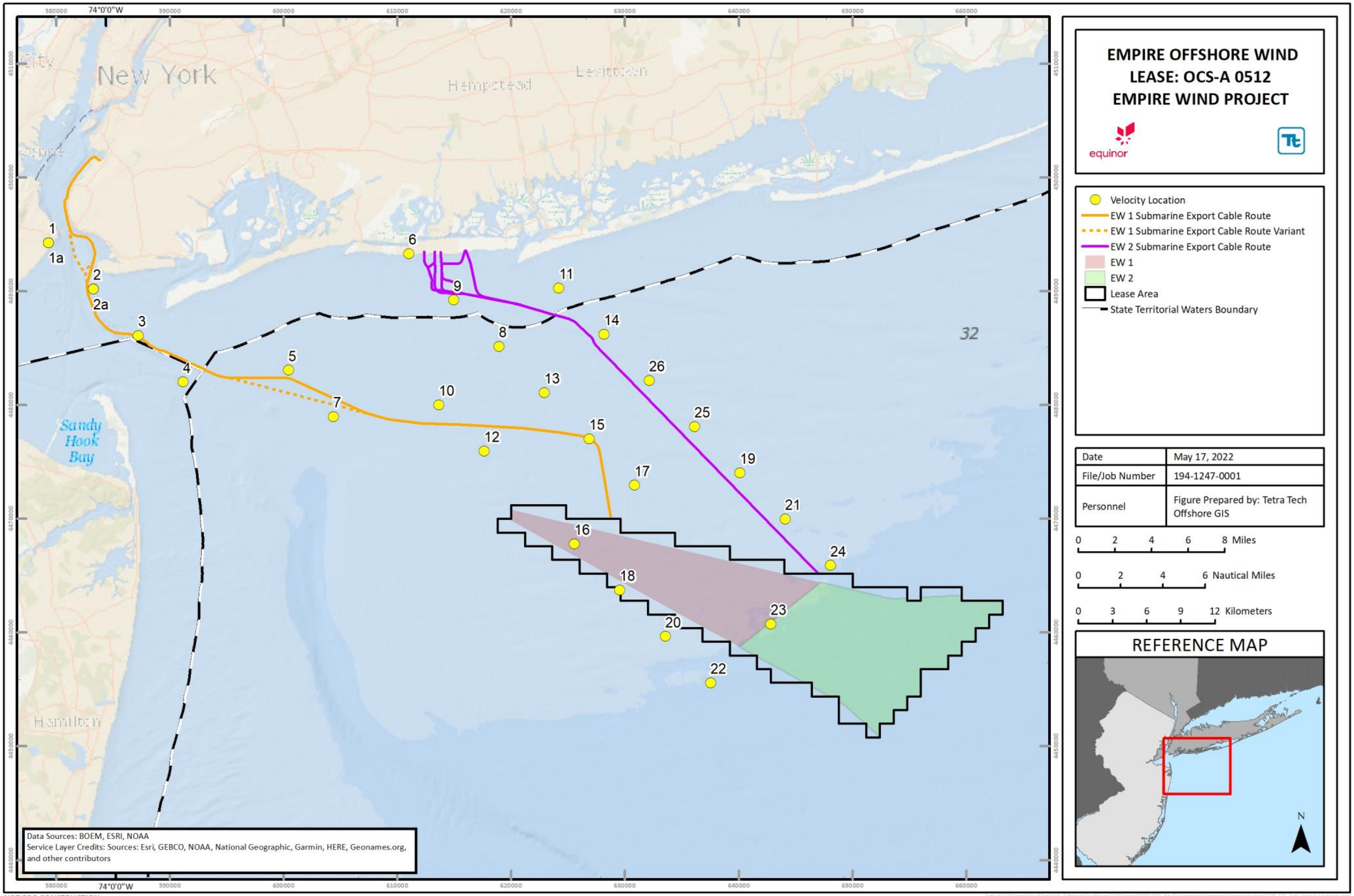

Figure J-3 Velocity Station IDs

Table J-2 Maximum Flood and Ebb Current Velocity from the ESPreSSO Model

Station ID	Longitude (W)	Latitude (N)	Depth (ft)	Flood Velocity (ft/s)	Ebb Velocity (ft/s)	Zone
1	-74.06	40.60	16	1.27	1.27	Riverine
1a	-74.06	40.60	16	1.27	1.27	Riverine
2	-74.02	40.56	20	1.20	1.19	Riverine
2a	-74.02	40.56	20	1.20	1.19	Riverine
3	-73.97	40.52	23	0.90	0.82	Riverine
4	-73.92	40.48	34	0.58	0.66	Non-Riverine
5	-73.82	40.49	60	0.24	0.44	Non-Riverine
6	-73.69	40.58	24	0.53	0.39	Non-Riverine
7	-73.77	40.45	81	0.35	0.38	Non-Riverine
8	-73.60	40.51	55	0.52	0.45	Non-Riverine
9	-73.64	40.55	37	0.57	0.44	Non-Riverine
10	-73.66	40.46	71	0.43	0.42	Non-Riverine
11	-73.53	40.55	36	0.54	0.48	Non-Riverine
12	-73.61	40.43	75	0.42	0.43	Non-Riverine
13	-73.55	40.47	69	0.47	0.46	Non-Riverine
14	-73.49	40.52	57	0.47	0.47	Non-Riverine
15	-73.50	40.43	78	0.43	0.45	Non-Riverine
16	-73.52	40.35	86	0.38	0.44	Non-Riverine
17	-73.46	40.40	87	0.41	0.45	Non-Riverine
18	-73.48	40.31	95	0.36	0.42	Non-Riverine
19	-73.35	40.41	97	0.43	0.45	Non-Riverine
20	-73.43	40.28	106	0.34	0.41	Non-Riverine
21	-73.30	40.37	105	0.44	0.46	Non-Riverine
22	-73.38	40.24	115	0.31	0.42	Non-Riverine
23	-73.32	40.28	114	0.38	0.45	Non-Riverine
24	-73.26	40.33	113	0.42	0.46	Non-Riverine
25	-73.40	40.44	85	0.42	0.46	Non-Riverine
26	-73.44	40.48	73	0.42	0.46	Non-Riverine

J.3.2 Sediment Characteristic Data

As Project-specific sediment density data and grain size distribution data were not available when the model was developed, Tetra Tech used publicly available Poseidon Project sediment data to inform the analytical sediment model (**Figure J-2**, ESS Group 2013). The Poseidon Project data included percent gravel, sand, and fines; specific gravity; and D50 data for 47 locations along a submarine electric cable route in Raritan Bay and the New York Bight. The Poseidon Project cable route covers approximately 70 percent of the submarine export cable route evaluation area, all within 3 nautical miles (5.56 km) of Long Island, New York.

Based on the sediment characteristics of the stations in the Poseidon Project, the Project Area was divided into two zones:

I. Riverine: For stations close to the river mouth, sediment characteristics were calculated by averaging all stations that were close to the river. These stations typically had high fine sediment content.

II. Non-Riverine: For stations not close to the river mouth, sediment characteristics were calculated by averaging all other stations. These stations typically had high sand content.

Other than percent gravel, the sediment data only provided percent sand and percent fines as the sediment breakdown, Tetra Tech made an assumption to divide the sediment equally into finer classes. The percent sand class was equally divided into percent coarse sand and percent fine sand. Fine sand was further equally divided into percent fine sand and percent very fine sand. The percent fines 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. Density values were calculated by averaging the density for the two different zones. **Table J-3** shows the fine sediment particle percentages for the two zones in the Project Area.

Table J-3 Project Area Sediment Particle Size Distributions

Sample	Density (kg/m^3)	Fine Sand (%)	Very Fine Sand (%)	Silt (%)	Clay (%)	Total Fine Sediment (%)
Riverine	2,746	9.38	9.38	30.87	30.87	80.49
Non-Riverine	2,692	21.93	21.93	4.79	4.79	53.44
Sandwave	2,746	40.00	40.00	0.00	0.00	80.00

When cables are buried using jet plowing, only fine sand and smaller particle sizes are suspended into the water column sufficiently to be transported away from the immediate trench. Larger particle sizes re-settle immediately into the trench. Therefore, the fine sand and smaller sediment particle classes were most appropriate to assess jet plowing impacts in the analytical sediment transport model and the percent gravel was not used.

MFE was simulated in New York state waters along the EW 1 submarine export cable route where standard cable burial methodologies cannot be employed due to deeper burial requirements or other challenges, such as vessel draft requirements, cable and pipeline crossings, and/or where pre-sweeping to remove megaripples is required. The MFE tool generates a large volume column of water that travels vertically down to the seabed fluidizing the sediments. Studies show the presence of sand deposits in the areas along the EW 1 submarine export cable route where MFE is proposed to be used (Coch 2016). For this process, only fine sand and very fine sand are assumed to be suspended into the water column and transported away due to ambient currents. A conservative estimate of 80% fine sediment is made, with the fine sediment equally divided between fine sand and very fine sand. This is in agreement with the percentage of fine sediment observed in the region (ESS Group 2013) and with the type of sediment present in the sandwaves (Coch 2016). MFE may be used in New York state waters along the EW 2 submarine export cable route in nearshore areas. This area is close to 50% fines, most of which is classified as fine sand and very fine sand (ESS Group 2013).

J.4 SEDIMENT TRANSPORT MODEL

This section describes the methodology followed to develop the conservative analytical sediment transport model to characterize the potential maximum sediment transport and deposition scenario for the jet plow and

MFE activities. Assumptions used to develop a PDE approach for the sediment transport analysis are listed in detail in Section J.4.1.

J.4.1 Model Setup and Parameterization

Jet plowing utilizes high-pressured water jets to fluidize soil as the machine traverses along a submarine export cable route. The submarine export 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.

MFE uses a device that draws in seawater from the side pipes and produces a downwards flow from a nozzle suspended a couple of meters above the seabed. The bed material is shifted and trenched with the force of the jet and flushed away. The overall volume of material released for each clearance operation varies, based on the site-specific conditions.

By design, coarser sediments settle immediately to fill the trench and bury the submarine export cable or settle in the immediate vicinity (typically within a foot) (Tetra Tech 2012, 2015; Vinhateiro et al. 2013). Earlier studies have shown that sediments coarser than 0.2 millimeter (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 height of the sediment plume above the seabed is dependent on local hydrodynamics, sediment size distribution, and the jet plow operating parameters. Previous studies have shown that the plume of sediment released during jet plowing reaches heights of roughly 7 ft (2 m) above the seabed (Tetra Tech 2012, 2015). The suspended sediment plume is then dispersed by local tidal currents and moves in the direction of the dominant current, which for this project could be northward during flood tides and southwards during ebb tides. Tidal conditions and currents will be dependent on current conditions during Project construction. The analytical sediment transport model simulated transport for both the maximum flood and 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). 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 (Van Rijn 2018; Swanson et al. 2015). 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 USGS study (USGS 2005). **Table J-4** lists the different sediment classes and the associated settling velocities used for the modeling.

Table J-4 Project Sediment Particle Diameter Classes and Settling Velocity

Sediment Class	Settling Velocity (cm/s)
Fine Sand	3.000
Very Fine Sand	1.000
Silt	0.126
Clay	0.023

J.4.2 Methodology

This section describes how the analytical sediment transport model was implemented to calculate the maximum suspended sediment water column concentrations and deposition depths. The approach assumes that the fine sediments released from the jet plow are released at a fixed height. The sediment particles are then transported by local tidal currents and settle down at fixed rates over the horizontal sea floor (Tetra Tech 2012, 2015; 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 focuses 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.

The expected sediment transport was calculated for each velocity location. It was assumed that these stations would be representative of the general conditions of the Lease Area and submarine export cable routes. Each station 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.

The travel speed of the jet plow was assumed at 656 ft per hour (200 m per hour). For the model analysis, it was assumed that 30 minutes of trenching activities were suspended at each time step. Based on the provided specifications, for most stations, the trench was assumed to be 328 ft (100 m) long[7], 3.5 ft (1 m) wide, and 8 ft (2.5 m) deep. Therefore, for each sediment location, the maximum volume of potential sediment fluidized in the water column was 8,830 cubic feet (250 cubic meters) if all of it is fine sand or smaller. For stations with a target burial depth of 18 ft (5.5 m), the volume of sediment fluidized in the water column was 19,423 cubic feet (550 cubic meters). This volume of sediment was assumed to be instantaneously suspended at time step 0 seconds in the analytical sediment transport model. This conservative assumption results 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. However, it does not impact deposition depths.

For MFE, it was assumed that the removal volume had a height of 6 ft (2 m). Based on the expected MFE removal procedures provided by Empire, at any given timestep, an 82-ft (25-m)-long and 82-ft (25-m)-wide corridor was cleared. The model assumes that the entire sediment volume (40,344 cubic feet) was instantaneously suspended in the water column. The sediment was blown to the edge of the 82-ft (25-m)-wide corridor and allowed to deposit starting at the edge of the corridor. It was also assumed that the 82-ft (25-m)-wide corridor will have the same suspended sediment concentration as that at the edge of the corridor.

The sediment concentration at the release location was determined based on the estimated bed 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 does not grow in the vertical direction and is 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

[7] As a conservative assumption, the model assumed that all the fine material dislodged by the jet plow during the 30 minute time interval would be dispersed into the water column at the same time.

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 point of deposition for each particle was calculated based on the settling velocity of each sediment class. Coarser sediments with higher settling velocity settle out of the water column faster and closer to the release point as compared to finer sediments. The finer sediment classes stay in the water column for longer periods of times and are advected further than the coarser sediments. In addition, the finer clay and silt sediment particles, which are typically cohesive, undergo enhanced settling due to flocculation and settle out of the water column with large-sized particles (Van Rijn 2018; Swanson et al. 2015). Sediments were assumed to settle out of the water column at a linear rate for each sediment particle class. This assumes that varying sized sediments within each class are evenly distributed within the plume. Sediment classes larger than medium silt all deposited within an hour, while fine silts and clays stayed in suspension for several hours. 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.

J.5 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 conservative analytical sediment transport model representing the two submarine export cable routes and Lease Area are provided at all locations with available velocity data.

J.5.1 Suspended Sediment Concentrations

Table J-5 and **Table J-6** 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 J-4** through **Figure J-7** show the estimated maximum suspended sediment concentrations at two representative stations, Station 2 and Station 18 for maximum ebb and flood tides. **Figure J-8** through **Figure J-13** show the expected maximum instantaneous suspended sediment concentrations along the two different submarine export cable routes at any given time step along the submarine export cable siting corridors[8]. 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 submarine export cable routes and Lease Area would be disturbed at any given time during Project construction and that is why the model used the volume of sediment put into suspension in 1 hour of jet plow travel (200-meter trench length). In addition, due to the depth of water within the Project Area, the plume should not be visible from the surface. The plume concentrations are typically lower at all Non-Riverine stations due to lesser fine sediment content, plume dispersion and sediment deposition.

J.5.1.1 Riverine Stations

In the Riverine area, submarine export cables had two target burial depths: 8 ft (2.5 m) (Stations 1 through 3) and 18 ft (5.5 m) (Stations 1a and 2a). Maximum plume horizontal distances varied between 1,150 and 3,280 ft

[8] **Figure J-8** through **Figure J-13** represent the instantaneous maximum suspended sediment concentrations at any given point of time predicted for the EW 1 and EW 2 submarine export cable routes. These concentrations do not occur at all locations simultaneously. Due to jet plow speed, only small sections of the submarine export cable siting corridor and Lease Area would be disturbed at any given time during Project construction.

(350 m and 1,000 m) (**Table J-5** and **Table J-6**). Suspended sediment travelled farther at Stations 1 and 1a due to the velocity distribution in the longitudinal and lateral direction at those stations.

Suspended sediment concentrations were typically below 500 milligrams per liter (mg/L) at a distance of 1,640 ft (500 m) from trench centerline during flood and ebb tides. Studies have shown suspended sediment concentrations of anywhere from 50 to 1,000 mg/L at distances around 1,000 ft (305 m) from the centerline (Tetra Tech 2012, Tetra Tech 2015). The sediment plume was confined near the substrate layer and is not expected to reach the surface. Data collected in the Riverine Area at Stations 2, 2a and 3 indicated that plume travel distances would be around 1,640 ft (500 m) during flood tides and around 1,150 ft (350 m) during ebb tides. Stations 1 and 1a had a maximum plume distance of 3,280 ft (1,000 m) during both flood and ebb tides. This is due to the high current velocity at Stations 1 and 1a. Expected maximum suspended sediment concentrations were between 0 and 1,661 mg/L at 1,640 ft (500 m) from the trench centerline. Station 1a and Station 2a had higher suspended sediment concentrations compared to the other Riverine stations due to the deeper burial depths (18 ft [5.5 m] as opposed to 8 ft [2.5 m]).

The potential maximum suspended sediment concentrations were dependent on the burial depth and total percent fines at each sampling location. Stations with deeper burial depths or 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. Assuming a trench depth of 8 ft (2.5 m), slightly over 4 ft (1.25 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. For Riverine stations, which had 80 percent fine sediments, nearly all of the material disturbed by the jet plow would be released into the water column (**Table J-5** and **Table J-6**). These stations were located at the mouth of the river, and the conservative sediment transport model predicted that maximum suspended sediment concentration would be greater than $2.7*10^6$ mg/L at the release point during flood and ebb conditions for stations with a trench depth of 8 ft (2.5 m). For Station 1a and 2a, with have a trench depth of 18 ft (5.5 m), the potential maximum suspended sediment concentration at the release point was determined to be $6.1*10^6$ mg/L.

The plumes were predicted to travel 1,148 to 1,640 ft (350 to 500 m) from the trench centerline for Stations 2, 2a, and 3. The suspended sediment concentrations were typically very low at these distances; for flood tides the suspended sediment concentration decreased below 300 mg/L at a distance of 1,148 ft (350 m), and for ebb tides the concentrations decreased below 100 mg/L at a travel distance of 1,148 ft (350 m). At Stations 1 and 1a, the sediment plume travelled more than 3,280 ft (1,000 m). Station 1 had a concentration of 1,032 mg/L at a distance of 1,148 ft (350 m) for the flood tide and a concentration of 1,843 mg/L at a distance of 1,148 ft (350 m) for ebb tide. Station 1a had a concentration of 2,270 mg/L at a distance of 1,148 ft (350 m) for the flood tide and a concentration of 4,054 mg/L at a distance of 1,148 ft (350 m) for ebb tide. Sediments at stations in the Riverine area were dominated by silts and clays. Silts and clays stay in suspension for several hours and are therefore transported further due to currents. Due to the higher percentage of very fine sediment, expected maximum concentrations were high, around $4*10^4$ mg/L within 328 ft (100 m) of the trench centerline, and 1,600 mg/L within 1,640 ft (500 m) of the trench centerline (**Table J-5** and **Table J-6**).

J.5.1.2 Non-Riverine Stations

At the Non-Riverine stations, which are comprised of sandier bed sediments, maximum plume distances were typically between 328 and 1,640 ft (100 and 500 m). The plume travelled further distances during the flood tide as compared to the ebb tide. The total distance the sediment plumes traveled was dependent on the current velocities. Suspended sediment concentrations were always below 500 mg/L at a distance of 1,150 ft (350 m) from trench centerline during flood and ebb tides. Results for Stations 4 through 26 indicated that the plume would travel to a maximum distance of 3,280 ft (1,000 m) during the flood tide, although the maximum suspended sediment concentrations at that distance would be typically less than 30 mg/L. During ebb tides, the maximum plume distance travelled is typically around 1,640 ft (500 m). Expected maximum suspended sediment concentrations drop to anywhere between 0 to 268 mg/L at 1,640 ft (500 m) from the trench centerline. Maximum plume distance at any station depends on the current velocity and its components perpendicular and parallel to the direction of trench movement.

The sediment transport model predicted that maximum suspended sediment concentrations would be around $1.79*10^6$ mg/L for Non-Riverine stations at the release point during flood and ebb conditions. The plumes were predicted to travel 1,640 to 3,280 ft (500 to 1,000 m) from the trench centerline. For flood tides, the suspended sediment concentration averaged around 200 mg/L at a distance of 1,148 ft (350 m), and for ebb tides, the concentrations averaged around 70 mg/L at a travel distance of 1,148 ft (350 m). The type of fine sediments at each station impacted the maximum plume concentrations. Fine sand, the coarsest fine sediment particle class that was modelled, has a settling velocity of 3 cm/s and remains in suspension for approximately one minute. Therefore, at Non-Riverine stations, suspended sediment concentrations decreased by close to 75 percent within one minute of jet plowing operations and within 33 ft (10 m) of the trench centerline (**Figure J-6**, and **Figure J-7** for Station 18; considered representative). 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 16 ft (5 m) of the trench centerline. Concentrations decreased to around $2.1*10^4$ mg/L within 328 ft (100 m) of the trench centerline and 100 mg/L within 1,640 ft (500 m) of the trench centerline (**Table J-5** and **Table J-6**,).

J.5.1.3 General Observations

While the maximum suspended sediment concentrations were relatively high for both Riverine and Non-Riverine 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, 2015; Vinhateiro et al. 2013). **Table J-7** and **Table J-8** presents the time varying suspended sediment concentrations for flood and ebb tides respectively for both Riverine and Non-Riverine stations. The concentrations decreased rapidly with time, and water column concentrations are expected to return to ambient conditions within 4 hours (7,200 seconds).

Mass Flow Excavation

Based on the analysis, the maximum suspended sediment concentration would be $5.49*10^6$ mg/L. The plume was predicted to travel up to 82 ft (25 m) in the New York Harbor area called the Narrows at Station 1 during flood tide and 164 ft (50 m) during ebb tide. Near Gravesend Bay the plume was predicted to travel around 16 ft (5 m) during both flood and ebb tide (**Table J-9**, **Table J-10**). The plume travels for much shorter distance as compared to jet plowing because of the difference in sediment composition of the upper layer of sediment compared to the deeper seabed sediment. Fine sand and very fine sand settle out quickly in comparison to silt and clay. The suspended sediment concentration drops by 50 percent within 60 seconds of suspension in the water column. If MFE were used along the EW 2 submarine export cable route, the MFE results would likely be similar to the jet plowing results because the sediment compositions are the same throughout.

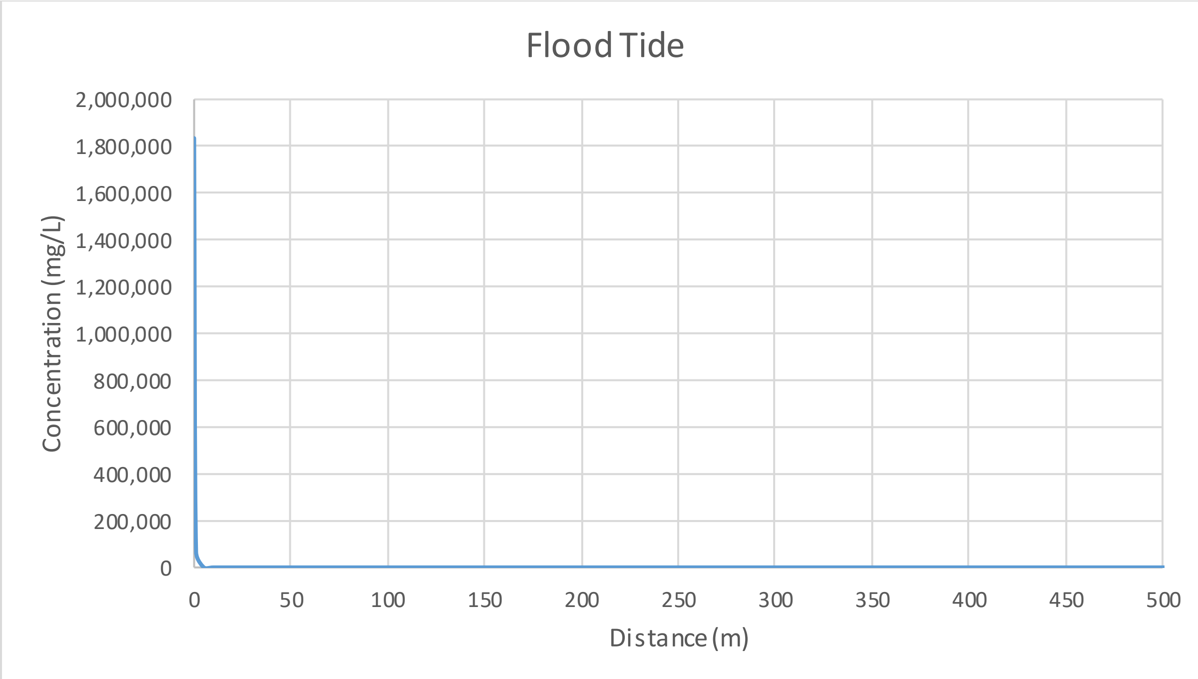

Figure J-4 Maximum Flood Tide Suspended Sediment Concentrations at Riverine Station 2

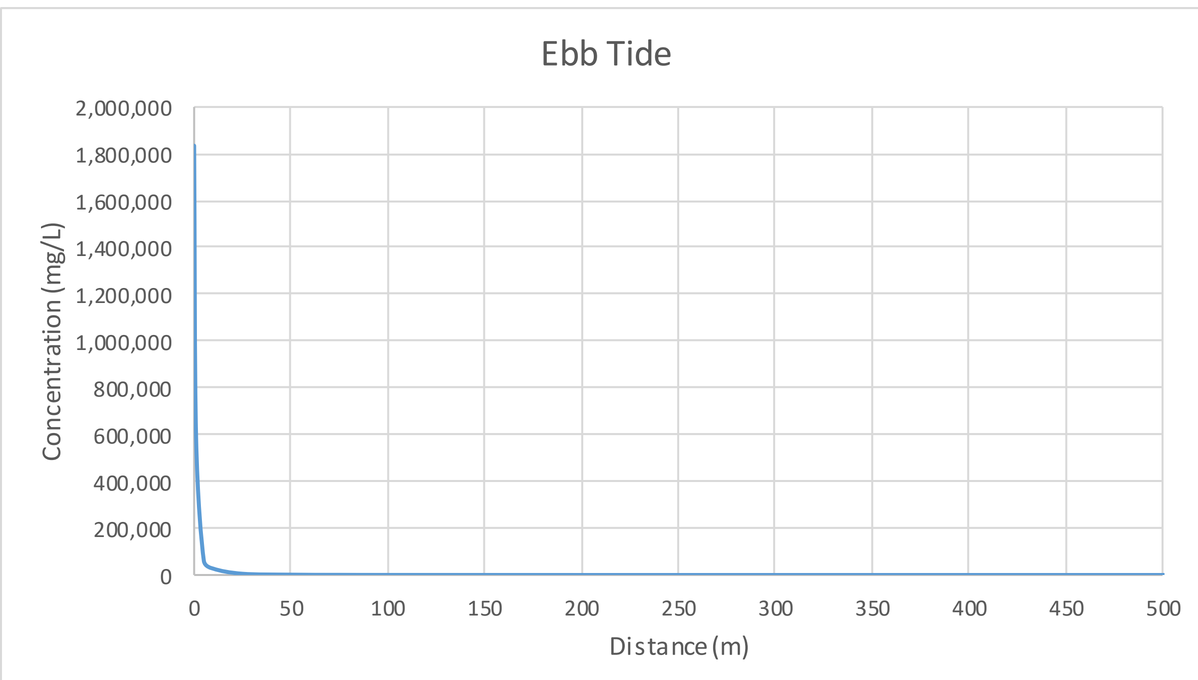

Figure J-5 Maximum Ebb Tide Suspended Sediment Concentrations at Riverine Station 2

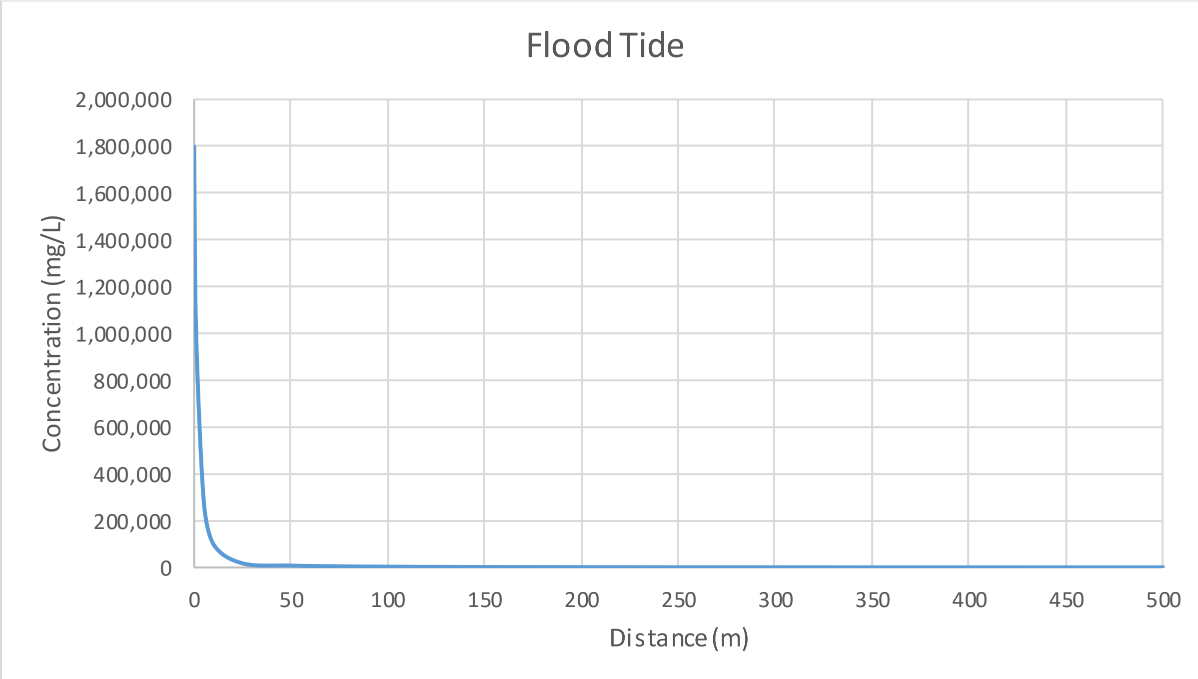

Figure J-6 Maximum Flood Tide Suspended Sediment Concentrations at Non-Riverine Station 18

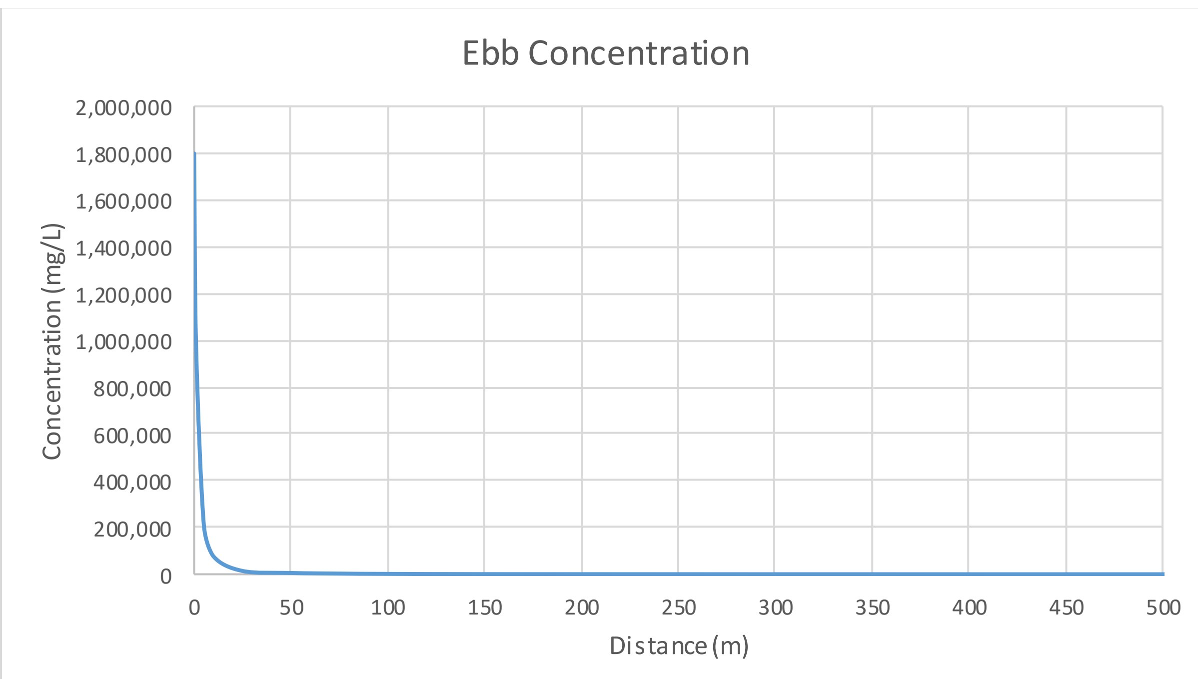

Figure J-7 Maximum Ebb Tide Suspended Sediment Concentrations at Non-Riverine Station 18

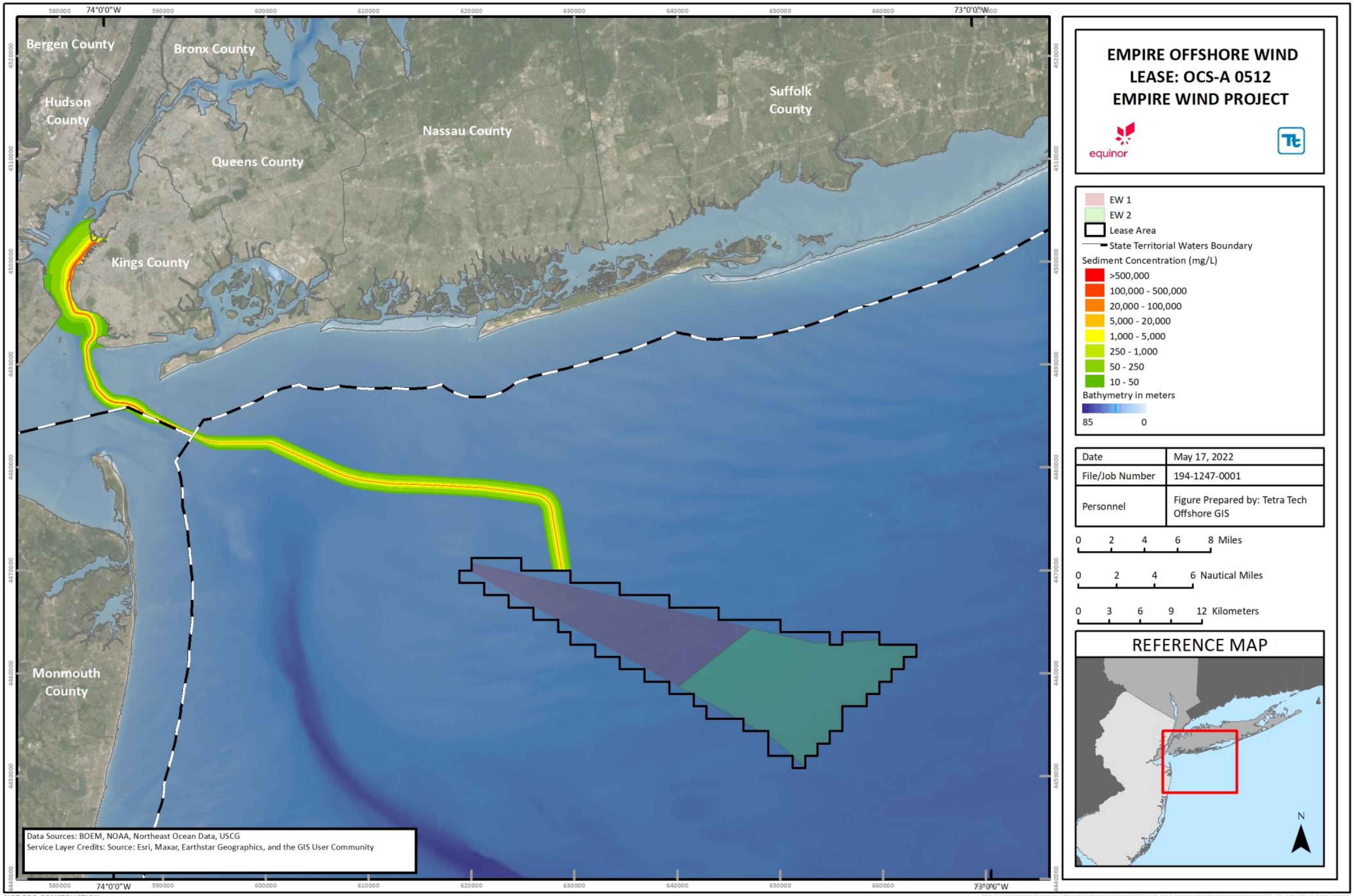

Figure J-8 Maximum Flood Tide Suspended Sediment Concentrations along the EW 1 Submarine Export Cable Route[8]

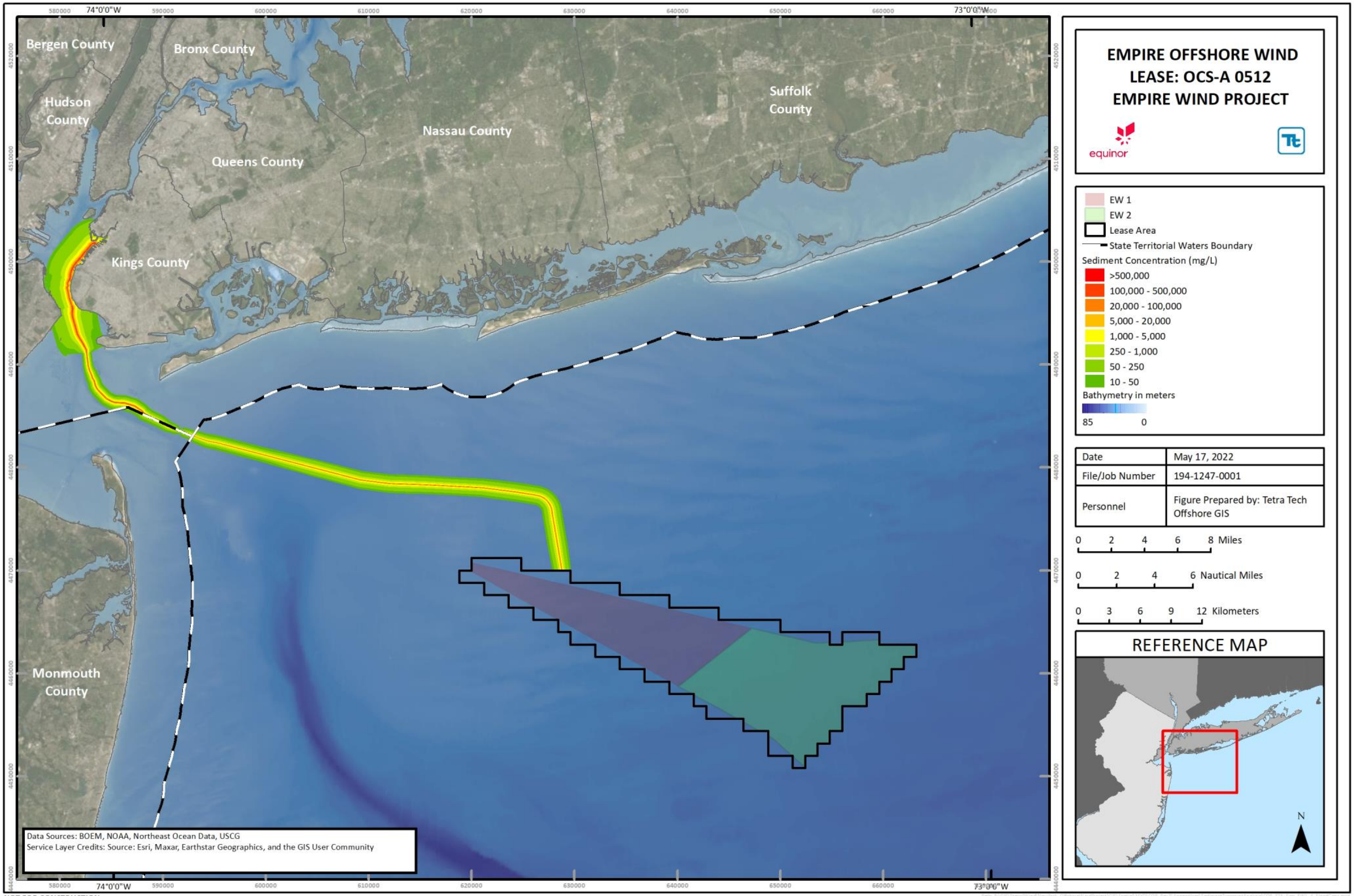

Figure J-9 Maximum Flood Tide Suspended Sediment Concentrations along the EW 1 Submarine Export Cable Route Variant[8]

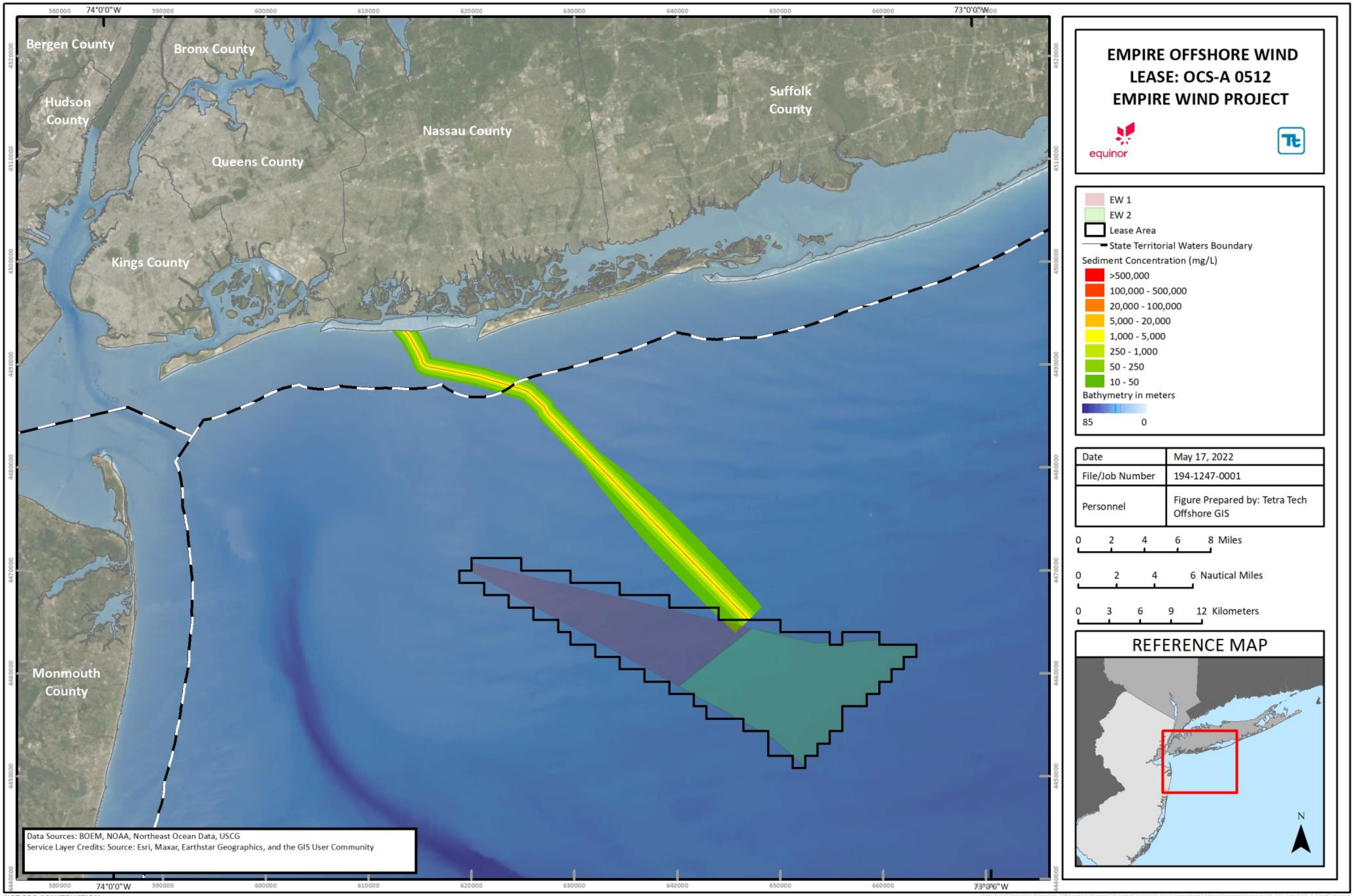

Figure J-10 Maximum Flood Tide Suspended Sediment Concentrations along the EW 2 Submarine Export Cable Route[8]

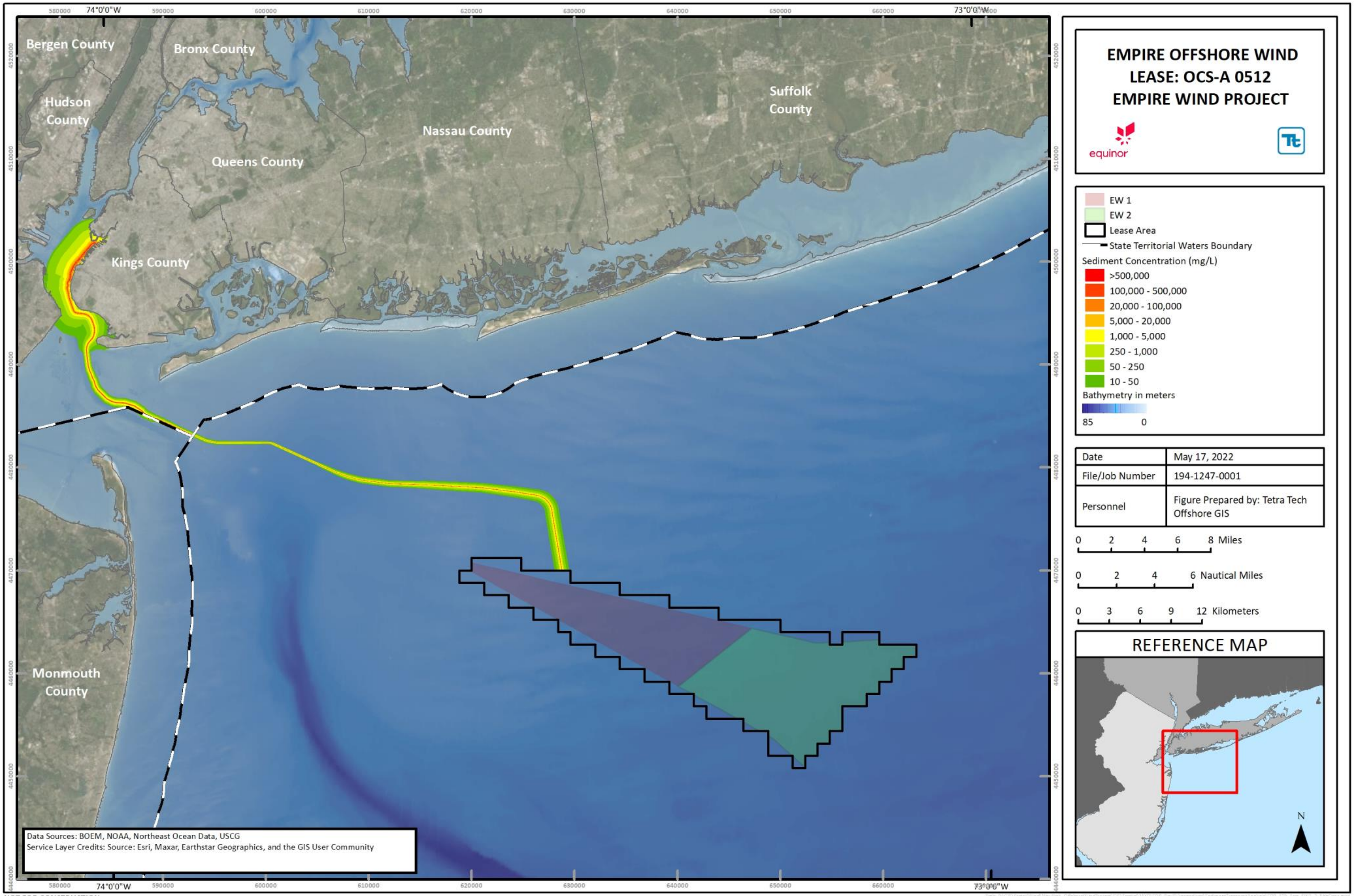

Figure J-11 Maximum Ebb Tide Suspended Sediment Concentrations along the EW 1 Submarine Export Cable Route[8]

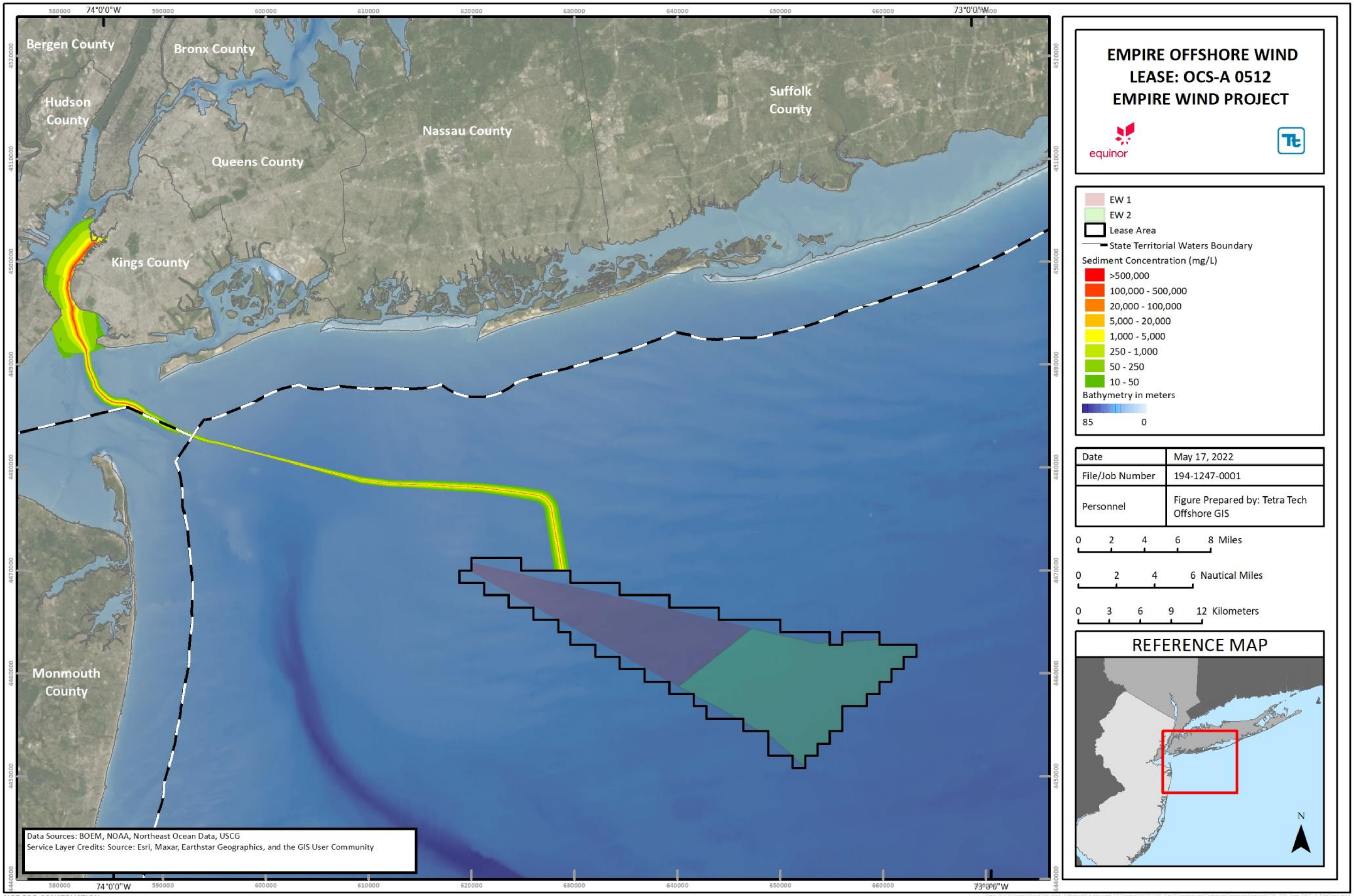

Figure J-12 Maximum Ebb Tide Suspended Sediment Concentrations along the EW 1 Submarine Export Cable Route Variant[8]

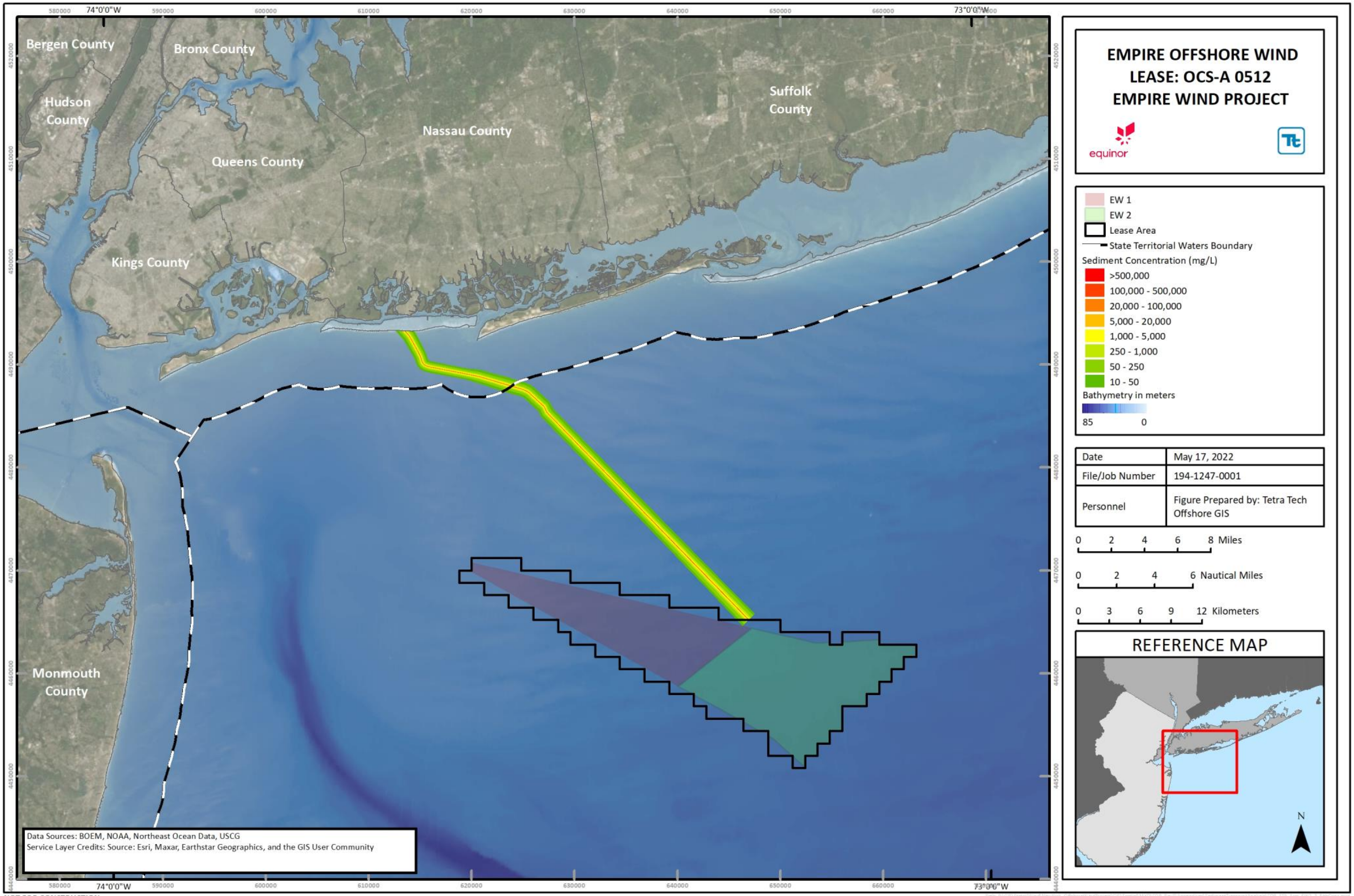

Figure J-13 Maximum Ebb Tide Suspended Sediment Concentrations along the EW 2 Submarine Export Cable Route[8]

Table J-5 Project Maximum Suspended Sediment Concentrations for Flood Conditions (With Distance)

Sample	Project Element	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
1	Riverine	80%	2,762,705	1,632,896	582,726	297,957	104,409	41,557	23,480	15,032	7,442	2,553	1,032	499	166	89	0	0
1a	Riverine	80%	6,077,951	3,592,371	1,281,997	655,506	229,699	91,425	51,657	33,070	16,373	5,616	2,270	1,097	366	197	0	0
2	Riverine	80%	2,762,705	1,535,461	433,317	187,011	48,383	12,070	4,191	2,316	912	202	29	0	0	0	0	0
2a	Riverine	80%	6,077,951	3,378,013	953,298	411,424	106,442	26,555	9,221	5,096	2,006	444	64	0	0	0	0	0
3	Riverine	80%	2,762,705	1,585,919	490,370	237,221	72,941	24,232	10,847	5,400	2,145	684	271	64	0	0	0	0
4	Non-Riverine	53%	1,798,287	718,041	63,447	27,628	6,382	1,360	591	297	84	0	0	0	0	0	0	0
5	Non-Riverine	53%	1,798,287	947,432	178,949	64,405	15,065	6,233	3,262	1,812	923	373	167	38	0	0	0	0
6	Non-Riverine	53%	1,798,287	1,009,568	280,454	97,486	17,514	6,884	3,954	2,534	1,204	400	214	98	24	7	0	0
7	Non-Riverine	53%	1,798,287	990,215	243,991	87,950	15,919	7,064	4,056	2,569	1,136	479	257	111	12	0	0	0
8	Non-Riverine	53%	1,798,287	1,009,778	280,905	97,703	17,658	6,935	3,996	2,568	1,226	410	220	102	25	7	0	0
9	Non-Riverine	53%	1,798,287	1,015,346	291,471	100,685	20,766	7,014	4,072	2,641	1,294	416	226	107	29	11	0	0
10	Non-Riverine	53%	1,798,287	1,001,847	266,066	93,963	15,909	7,079	4,096	2,631	1,233	455	246	112	22	1	0	0
11	Non-Riverine	53%	1,798,287	1,012,834	286,759	99,446	19,398	7,027	4,078	2,641	1,284	423	230	108	28	9	0	0
12	Non-Riverine	53%	1,798,287	997,642	257,948	91,418	15,681	6,876	3,919	2,479	1,119	418	221	97	16	0	0	0
13	Non-Riverine	53%	1,798,287	1,004,748	271,436	95,184	15,751	6,949	3,996	2,557	1,199	421	225	102	22	4	0	0
14	Non-Riverine	53%	1,798,287	1,007,908	277,609	97,232	16,736	7,166	4,182	2,715	1,313	462	254	119	28	7	0	0
15	Non-Riverine	53%	1,798,287	1,004,042	270,326	95,322	16,044	7,201	4,203	2,724	1,302	480	263	123	26	4	0	0
16	Non-Riverine	53%	1,798,287	995,797	254,613	90,889	15,943	7,097	4,096	2,617	1,195	473	256	114	18	0	0	0
17	Non-Riverine	53%	1,798,287	1,005,273	272,939	96,576	16,414	7,535	4,491	2,970	1,475	570	328	161	38	6	0	0
18	Non-Riverine	53%	1,798,287	991,389	246,226	88,570	15,925	7,072	4,065	2,580	1,149	478	257	112	13	0	0	0
19	Non-Riverine	53%	1,798,287	1,010,643	283,582	100,270	18,756	8,049	4,966	3,402	1,823	747	474	268	88	28	0	0
20	Non-Riverine	53%	1,798,287	986,784	237,448	86,121	15,892	7,034	4,022	2,532	1,094	480	256	108	7	0	0	0
21	Non-Riverine	53%	1,798,287	1,012,140	286,429	101,038	19,638	8,040	4,960	3,399	1,827	734	462	260	86	30	0	0
22	Non-Riverine	53%	1,798,287	975,980	216,765	80,051	15,593	6,751	3,761	2,292	993	434	221	83	0	0	0	0
23	Non-Riverine	53%	1,798,287	1,002,499	267,830	95,521	16,658	7,758	4,685	3,133	1,580	664	399	207	50	3	0	0
24	Non-Riverine	53%	1,798,287	1,009,731	281,784	99,672	18,179	7,978	4,899	3,339	1,769	719	449	248	77	23	0	0
25	Non-Riverine	53%	1,798,287	1,008,224	278,850	98,751	17,251	7,899	4,824	3,268	1,708	693	426	230	67	17	0	0
26	Non-Riverine	53%	1,798,287	1,007,207	276,629	97,610	16,507	7,553	4,511	2,991	1,499	569	328	163	41	9	0	0

Table J-6 Project Maximum Suspended Sediment Concentrations for Ebb Conditions (With Distance)

Sample	Project Element	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)															
1	Riverine	80%	2,762,705	1,639,153	597,165	314,071	113,544	47,801	27,826	18,582	9,910	3,905	1,843	755	281	165	0	0
1a	Riverine	80%	6,077,951	3,606,136	1,313,763	690,957	249,797	105,162	61,216	40,880	21,802	8,591	4,054	1,661	619	363	0	0
2	Riverine	80%	2,762,705	1,509,432	410,125	173,942	41,417	8,949	3,442	1,838	668	102	0	0	0	0	0	0
2a	Riverine	80%	6,077,951	3,320,750	902,276	382,673	91,117	19,687	7,572	4,044	1,470	225	0	0	0	0	0	0
3	Riverine	80%	2,762,705	1,550,091	459,102	207,807	59,798	16,585	5,869	3,335	1,375	334	68	0	0	0	0	0
4	Non-Riverine	53%	1,798,287	656,110	57,874	24,939	5,018	1,073	437	204	42	0	0	0	0	0	0	0
5	Non-Riverine	53%	1,798,287	427,949	51,009	18,917	2,891	616	151	1	0	0	0	0	0	0	0	0
6	Non-Riverine	53%	1,798,287	954,412	180,125	66,617	13,831	5,333	2,652	1,430	623	224	95	24	0	0	0	0
7	Non-Riverine	53%	1,798,287	572,921	59,409	26,087	5,000	1,252	490	206	10	0	0	0	0	0	0	0
8	Non-Riverine	53%	1,798,287	941,252	172,559	58,909	12,933	4,695	2,199	1,106	504	168	65	12	0	0	0	0
9	Non-Riverine	53%	1,798,287	955,276	179,997	66,689	13,545	5,142	2,529	1,355	577	204	86	22	0	0	0	0
10	Non-Riverine	53%	1,798,287	854,144	129,115	33,835	10,415	2,953	1,189	693	286	60	1	0	0	0	0	0
11	Non-Riverine	53%	1,798,287	976,992	218,313	78,591	14,231	5,690	2,969	1,715	664	254	118	42	0	0	0	0
12	Non-Riverine	53%	1,798,287	899,541	151,564	37,002	11,670	3,788	1,529	853	383	106	28	0	0	0	0	0
13	Non-Riverine	53%	1,798,287	938,474	171,058	57,368	12,797	4,600	2,132	1,058	488	161	61	10	0	0	0	0
14	Non-Riverine	53%	1,798,287	967,156	199,783	73,068	13,844	5,386	2,730	1,524	611	225	100	31	0	0	0	0
15	Non-Riverine	53%	1,798,287	951,791	178,003	64,645	13,315	4,978	2,412	1,271	547	190	79	19	0	0	0	0
16	Non-Riverine	53%	1,798,287	965,628	196,924	72,494	13,981	5,476	2,786	1,556	635	235	105	32	0	0	0	0
17	Non-Riverine	53%	1,798,287	966,194	197,985	72,720	13,939	5,449	2,769	1,546	627	232	103	32	0	0	0	0
18	Non-Riverine	53%	1,798,287	979,462	223,104	80,526	14,678	6,027	3,217	1,897	745	295	141	52	0	0	0	0
19	Non-Riverine	53%	1,798,287	984,702	233,001	83,296	14,748	6,095	3,282	1,959	771	300	146	56	3	0	0	0
20	Non-Riverine	53%	1,798,287	979,433	223,069	80,602	14,737	6,072	3,250	1,920	758	301	145	53	0	0	0	0
21	Non-Riverine	53%	1,798,287	992,769	248,382	87,970	15,103	6,392	3,527	2,162	915	337	170	69	9	0	0	0
22	Non-Riverine	53%	1,798,287	976,438	217,377	78,858	14,591	5,953	3,154	1,843	733	287	136	48	0	0	0	0
23	Non-Riverine	53%	1,798,287	991,697	246,381	87,481	15,137	6,417	3,543	2,171	915	342	172	70	8	0	0	0
24	Non-Riverine	53%	1,798,287	998,029	258,467	91,090	15,366	6,615	3,713	2,318	1,026	368	190	81	14	0	0	0
25	Non-Riverine	53%	1,798,287	972,889	210,591	76,418	14,161	5,627	2,912	1,664	657	248	114	38	0	0	0	0
26	Non-Riverine	53%	1,798,287	962,643	191,314	70,620	13,716	5,283	2,646	1,455	596	216	94	28	0	0	0	0

Table J-7 Project Maximum Suspended Sediment Concentrations (mg/L) for Flood Conditions (With Time)

Sample	Project Element	Total Fines (%)	Time (s)															
			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)															
1	Riverine	80%	2,762,705	1,086,991	655,051	457,460	220,761	139,449	98,851	74,257	39,156	28,715	9,561	2,293	825	175	14	0
1a	Riverine	80%	6,077,951	2,391,380	1,441,113	1,006,412	485,673	306,788	217,473	163,365	86,143	63,173	21,035	5,044	1,815	385	31	0
2	Riverine	80%	2,762,705	2,064,762	1,619,268	1,311,253	781,404	540,393	402,319	311,385	171,309	127,133	42,889	10,212	3,651	766	60	0
2a	Riverine	80%	6,077,951	4,542,477	3,562,389	2,884,757	1,719,088	1,188,864	885,102	685,048	376,880	279,693	94,356	22,467	8,032	1,685	133	0
3	Riverine	80%	2,762,705	1,808,793	1,317,278	1,018,190	565,963	380,680	280,025	215,719	119,040	88,964	31,183	7,795	2,861	622	50	0
4	Non-Riverine	53%	1,798,287	1,408,618	1,115,788	888,303	437,365	271,176	185,720	126,118	49,575	38,596	15,159	4,173	1,605	371	31	0
5	Non-Riverine	53%	1,798,287	1,133,211	784,722	570,326	241,372	139,479	92,129	61,410	23,932	18,847	8,210	2,768	1,244	387	43	0
6	Non-Riverine	53%	1,798,287	877,659	542,370	369,121	141,545	77,939	49,906	32,507	12,065	9,269	3,677	1,085	441	112	10	0
7	Non-Riverine	53%	1,798,287	983,606	636,871	444,979	177,637	99,940	64,985	42,862	16,395	12,813	5,457	1,793	791	236	25	0
8	Non-Riverine	53%	1,798,287	876,886	541,792	368,729	141,444	77,922	49,922	32,535	12,095	9,301	3,706	1,101	450	115	11	0
9	Non-Riverine	53%	1,798,287	841,254	512,039	345,737	131,159	71,875	45,890	29,829	11,026	8,454	3,331	974	394	99	9	0
10	Non-Riverine	53%	1,798,287	924,873	583,630	401,933	157,045	87,409	56,428	37,010	13,978	10,848	4,491	1,412	601	167	16	0
11	Non-Riverine	53%	1,798,287	858,269	526,217	356,710	136,119	74,828	47,883	31,183	11,578	8,900	3,543	1,052	429	110	10	0
12	Non-Riverine	53%	1,798,287	945,615	601,872	416,347	163,573	91,199	58,903	38,632	14,570	11,293	4,642	1,441	608	165	16	0
13	Non-Riverine	53%	1,798,287	907,312	568,023	389,386	150,991	83,654	53,809	35,182	13,180	10,179	4,127	1,257	523	138	13	0
14	Non-Riverine	53%	1,798,287	890,708	553,954	378,523	146,278	81,002	52,125	34,108	12,819	9,924	4,071	1,263	533	145	14	0
15	Non-Riverine	53%	1,798,287	913,659	573,920	394,331	153,656	85,462	55,166	36,190	13,685	10,632	4,426	1,405	603	170	17	0
16	Non-Riverine	53%	1,798,287	956,859	612,329	425,017	168,027	94,087	60,990	40,134	15,274	11,905	5,017	1,621	705	204	21	0
17	Non-Riverine	53%	1,798,287	909,438	570,657	392,076	153,054	85,356	55,261	36,362	13,877	10,847	4,647	1,550	693	213	23	0
18	Non-Riverine	53%	1,798,287	978,161	631,830	440,859	175,641	98,721	64,152	42,293	16,161	12,623	5,365	1,757	773	229	24	0
19	Non-Riverine	53%	1,798,287	881,608	547,297	374,175	145,445	81,168	52,667	34,757	13,403	10,554	4,697	1,686	807	298	43	0
20	Non-Riverine	53%	1,798,287	998,980	651,221	456,759	183,374	103,448	67,381	44,499	17,067	13,356	5,719	1,894	841	254	27	0
21	Non-Riverine	53%	1,798,287	872,201	539,311	367,936	142,589	79,457	51,506	33,965	13,074	10,285	4,557	1,623	771	278	39	0
22	Non-Riverine	53%	1,798,287	1,041,946	692,158	490,681	199,990	113,550	74,220	49,121	18,898	14,802	6,341	2,095	927	279	30	0
23	Non-Riverine	53%	1,798,287	926,668	586,048	404,515	159,150	89,195	57,978	38,286	14,753	11,601	5,111	1,793	839	290	38	0
24	Non-Riverine	53%	1,798,287	886,636	551,502	377,401	146,835	81,949	53,162	35,072	13,507	10,626	4,704	1,671	792	284	39	0
25	Non-Riverine	53%	1,798,287	895,086	558,658	382,947	149,288	83,362	54,082	35,674	13,726	10,790	4,756	1,674	786	274	36	0
26	Non-Riverine	53%	1,798,287	898,334	561,040	384,496	149,563	83,272	53,856	35,411	13,492	10,537	4,499	1,493	665	203	22	0

Table J-8 Project Maximum Suspended Sediment Concentrations (mg/L) for Ebb Conditions (With Time)

Sample	Project Element	Total Fines (%)	Time (s) 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)															
1	Riverine	80%	2,762,705	926,964	539,333	371,333	177,000	111,761	79,434	59,891	31,969	23,627	8,105	2,007	735	159	13	0
1a	Riverine	80%	6,077,951	2,039,321	1,186,533	816,933	389,399	245,874	174,754	131,760	70,332	51,979	17,831	4,416	1,617	351	28	0
2	Riverine	80%	2,762,705	2,155,432	1,739,434	1,437,617	888,742	626,871	472,480	368,772	205,808	153,548	52,396	12,552	4,497	946	74	0
2a	Riverine	80%	6,077,951	4,741,951	3,826,754	3,162,758	1,955,231	1,379,117	1,039,456	811,299	452,778	337,805	115,272	27,615	9,892	2,080	164	0
3	Riverine	80%	2,762,705	2,038,321	1,589,055	1,283,802	767,132	534,960	402,275	314,596	178,274	134,644	48,459	12,348	4,571	1,004	81	0
4	Non-Riverine	53%	1,798,287	1,439,011	1,158,474	934,010	471,472	296,494	204,823	139,853	55,363	43,144	16,840	4,561	1,735	394	33	0
5	Non-Riverine	53%	1,798,287	1,531,108	1,298,560	1,094,634	612,159	414,059	302,268	215,612	93,548	76,052	33,574	10,122	4,062	992	86	0
6	Non-Riverine	53%	1,798,287	1,107,295	756,441	544,531	226,019	128,773	84,033	55,397	20,951	16,199	6,504	1,927	784	199	18	0
7	Non-Riverine	53%	1,798,287	1,472,781	1,208,949	991,119	520,362	337,048	238,471	166,164	69,020	55,183	23,609	7,101	2,872	715	63	0
8	Non-Riverine	53%	1,798,287	1,140,927	791,164	574,491	241,200	137,883	90,019	59,291	22,298	17,160	6,733	1,926	764	187	16	0
9	Non-Riverine	53%	1,798,287	1,103,110	751,815	540,251	223,372	126,874	82,567	54,292	20,391	15,699	6,193	1,790	716	177	16	0
10	Non-Riverine	53%	1,798,287	1,296,323	969,353	739,914	337,439	200,999	134,493	90,043	34,789	27,033	10,822	3,125	1,244	304	27	0
11	Non-Riverine	53%	1,798,287	1,029,979	679,124	478,580	192,231	107,762	69,601	45,539	16,962	13,018	5,096	1,464	584	144	13	0
12	Non-Riverine	53%	1,798,287	1,229,373	889,277	663,532	291,029	169,919	112,323	74,591	28,431	21,986	8,713	2,505	996	243	21	0
13	Non-Riverine	53%	1,798,287	1,147,715	798,357	580,813	244,529	139,940	91,407	60,219	22,645	17,422	6,823	1,945	771	187	16	0
14	Non-Riverine	53%	1,798,287	1,064,946	713,202	507,127	206,325	116,292	75,326	49,369	18,428	14,150	5,535	1,585	631	154	14	0
15	Non-Riverine	53%	1,798,287	1,112,623	761,503	548,544	227,530	129,361	84,202	55,357	20,763	15,968	6,263	1,795	714	175	15	0
16	Non-Riverine	53%	1,798,287	1,071,181	719,610	512,737	209,412	118,337	76,812	50,436	18,917	14,566	5,764	1,677	674	168	15	0
17	Non-Riverine	53%	1,798,287	1,068,938	717,309	510,727	208,314	117,614	76,290	50,062	18,748	14,422	5,685	1,646	659	163	14	0
18	Non-Riverine	53%	1,798,287	1,022,794	672,658	473,557	190,269	106,866	69,188	45,386	17,039	13,144	5,263	1,562	637	163	15	0
19	Non-Riverine	53%	1,798,287	1,000,929	651,857	456,312	181,776	101,666	65,642	42,971	16,062	12,364	4,911	1,443	584	148	13	0
20	Non-Riverine	53%	1,798,287	1,023,289	673,199	474,061	190,596	107,112	69,385	45,538	17,121	13,219	5,314	1,587	650	167	15	0
21	Non-Riverine	53%	1,798,287	965,948	619,682	430,236	169,503	94,397	60,824	39,777	14,859	11,442	4,562	1,351	550	140	13	0
22	Non-Riverine	53%	1,798,287	1,034,475	683,885	482,902	194,867	109,663	71,079	46,662	17,541	13,538	5,428	1,614	659	169	15	0
23	Non-Riverine	53%	1,798,287	971,405	624,738	434,386	171,551	95,671	61,711	40,393	15,122	11,660	4,674	1,394	571	147	13	0
24	Non-Riverine	53%	1,798,287	941,246	597,578	412,603	161,403	89,661	57,714	37,730	14,101	10,868	4,356	1,301	533	138	13	0
25	Non-Riverine	53%	1,798,287	1,045,644	694,366	491,374	198,631	111,701	72,291	47,369	17,698	13,603	5,354	1,548	620	154	14	0
26	Non-Riverine	53%	1,798,287	1,079,969	728,227	519,922	212,828	120,300	78,055	51,216	19,157	14,722	5,773	1,657	660	162	14	0

Table J-9 Project Maximum Suspended Sediment Concentrations (mg/L) for MFE (With Distance)

Sample	Project Element	Tide Condition	Total Fines (%)	Distance from Edge of Corridor (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)															
MFE 1	Narrows	Flood	80%	5,492,000	4,750,715	2,688,438	1,294,060	218,867	0	0	0	0	0	0	0	0	0	0	0
MFE 2	Gravesend Bay	Flood	80%	5,492,000	3,817,707	633,268	0	0	0	0	0	0	0	0	0	0	0	0	0
MFE 1	Narrows	Ebb	80%	5,492,000	4,807,249	2,919,960	1,619,011	326,791	28,849	0	0	0	0	0	0	0	0	0	0
MFE 2	Gravesend Bay	Ebb	80%	5,492,000	3,902,752	737,686	0	0	0	0	0	0	0	0	0	0	0	0	0

Table J-10 Project Maximum Suspended Sediment Concentrations (mg/L) for MFE (With Time)

Sample	Project Element	Tide Condition	Total Fines (%)	Time (s) 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)															
MFE 1	Narrows	Flood	80%	5,492,000	4,012,764	2,945,690	2,160,629	781,623	368,924	195,133	92,568	0	0	0	0	0	0	0	0
MFE 2	Gravesend Bay	Flood	80%	5,492,000	4,716,891	3,985,883	3,305,049	1,586,242	907,002	548,123	285,895	0	0	0	0	0	0	0	0
MFE 1	Narrows	Ebb	80%	5,492,000	3,812,315	2,707,325	1,942,631	680,965	318,552	168,354	80,052	0	0	0	0	0	0	0	0
MFE 2	Gravesend Bay	Ebb	80%	5,492,000	4,756,330	4,054,380	3,391,952	1,671,714	979,356	604,348	320,768	0	0	0	0	0	0	0	0

J.5.2 Sediment Deposition Rates

Table J-11 and **Table J-12** list the deposition thicknesses at locations perpendicular to the trench centerline for all stations under the maximum flood and ebb currents. **Figure J-14** through **Figure J-19** show the maximum predicted sediment deposition along the different submarine export cable routes[9]. 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 the of 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 16 ft (5 m) of the trench, and deposition depths decreased rapidly. For example, Station 4 has a fine sand content of 53% and the maximum observed deposition depth during flood tides was 14.23 inches (in, 36.15 centimeters [cm]) at the trench, but deposition decreased to 0.19 in (0.48 cm) within 82 ft (25 m) of the trench. For the jet plow, the highest predicted deposition thickness was 22.12 in (56.19 cm) at Station 5, which was dominated by fine sands, during ebb tides. Deposition depth decreased to 0.03 in (0.07 cm) within 82 ft (25 m) of the trench. At stations that were dominated by clays and silts, such as Station 1, sediment deposition was predicted to be 0.27 in (0.69 cm) at 82 ft (25 m) from the trench centerline during flood conditions and 0.22 in (0.57 cm) at 82 ft (25 m) during ebb conditions.

For MFE, the highest predicted deposition thickness was 32.80 in (83.32 cm) during flood tide and 28.5 in (72.39 cm) during ebb tide for the Narrows (**Table J-13**). The thickness reduced to 7.18 in (18.26 cm) within 82 ft (25 m) during flood tide and to 6.25 in (15.89 cm) within 82 ft (25 m) during ebb tide. For Gravesend Bay, the highest predicted deposition thickness was 79.25 in (201.31 cm) during flood tide and 86.16 in (218.85 cm) during ebb tide (**Table J-13**). It dropped down to 24.65 in (62.63 cm) within 16 ft (5 m) during flood tide and to 28.29 in (71.86 cm) within 16 ft (5 m) during ebb tide. For both locations, the deposition thickness fell below 0.004 in (0.01 cm) within 246 ft (75 m) during both flood and ebb tides. 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 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.

[9] **Figure J-14** though **Figure J-19** represent the instantaneous maximum sediment deposition at any given point of time. These depositions do not occur at all locations simultaneously. Due to jet plow speed, only small sections of the submarine export cable route and Lease Area would be disturbed at any given time during Project construction.

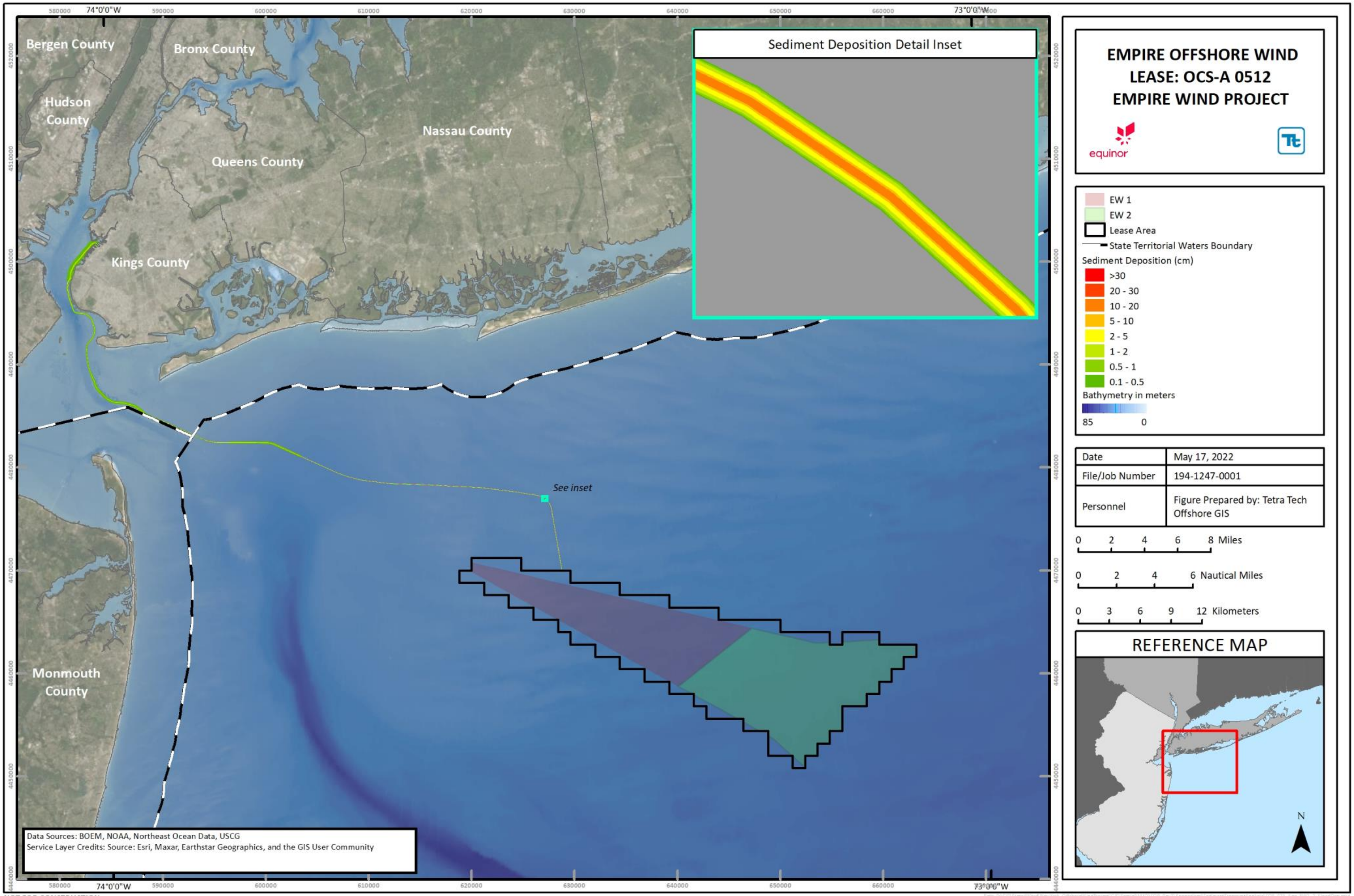

Figure J-14 Maximum Flood Tide Sediment Deposition along an EW 1 Submarine Export Cable Route[9]

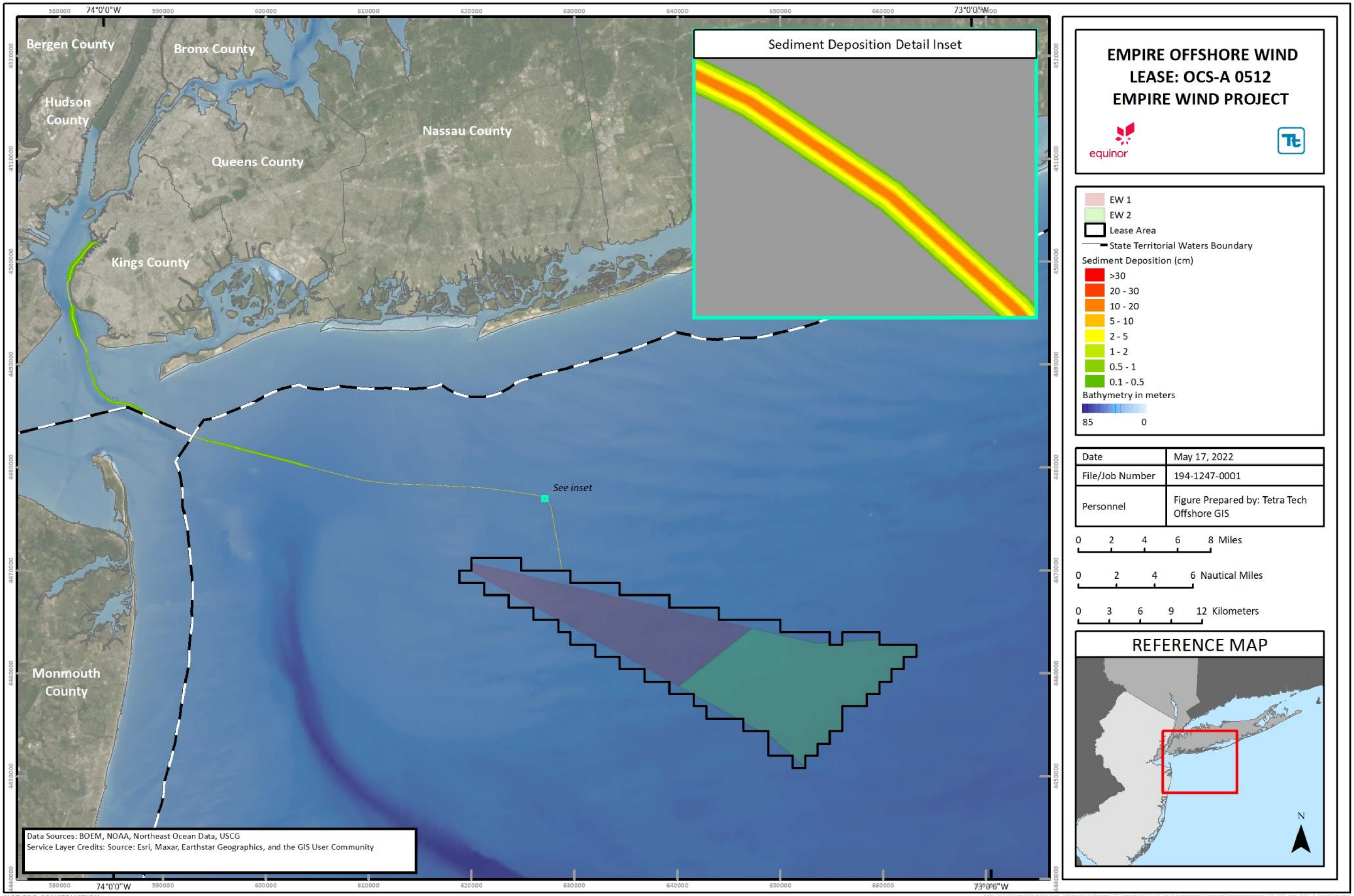

Figure J-15 Maximum Flood Tide Sediment Deposition along the EW 1 Submarine Export Cable Route Variant[9]

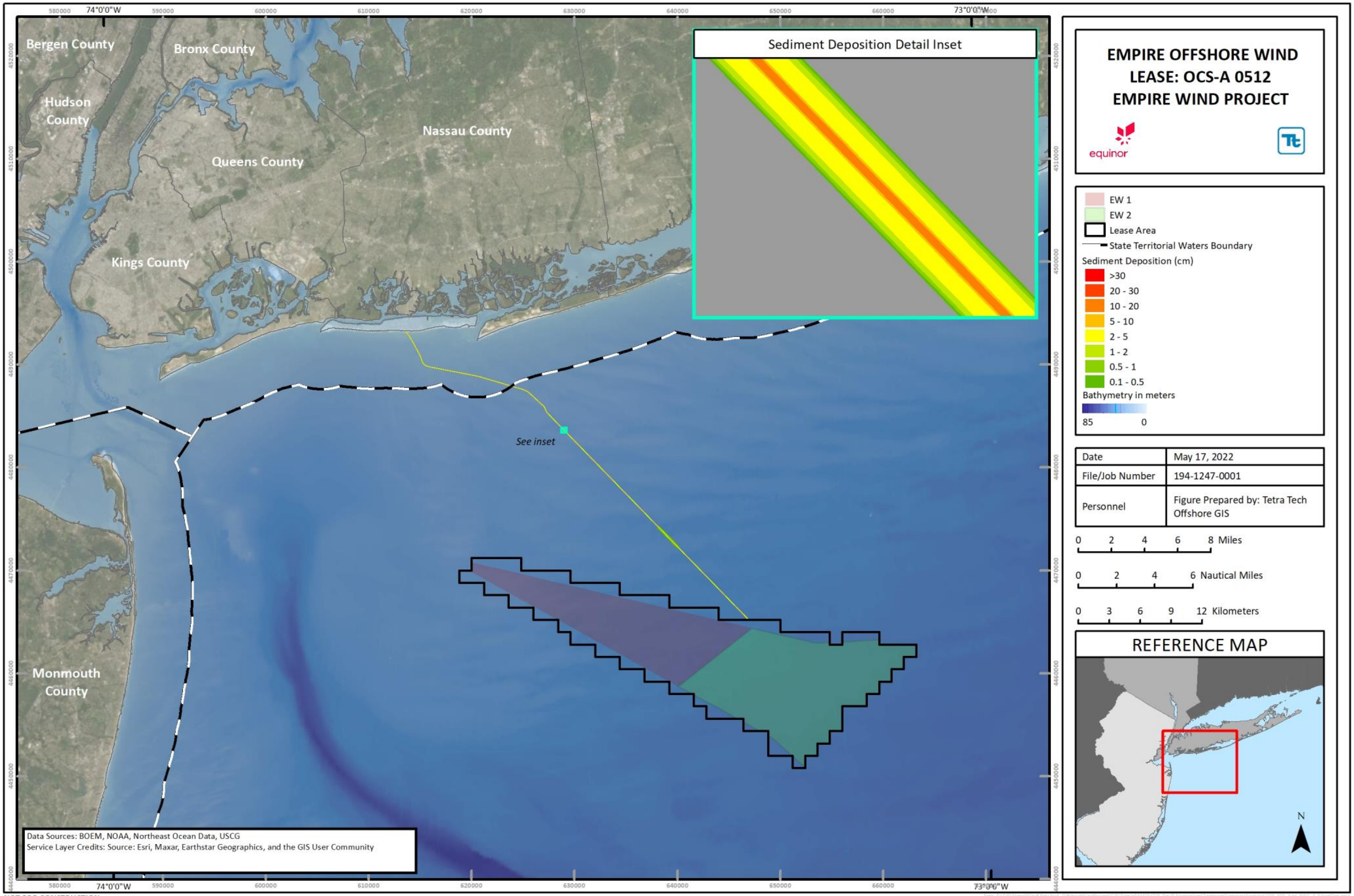

Figure J-16 Maximum Flood Tide Sediment Deposition along the EW 2 Submarine Export Cable Route[9]

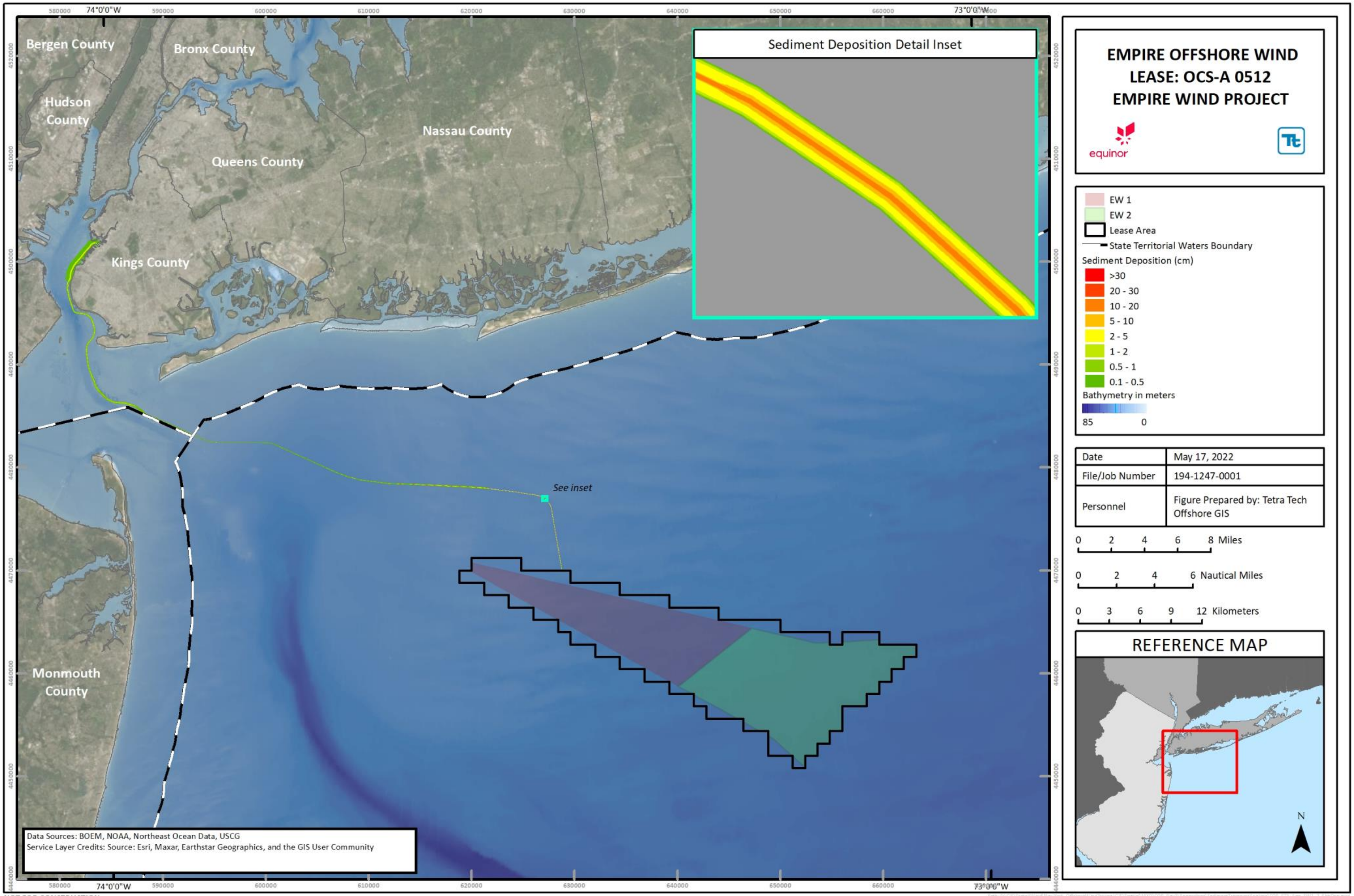

Figure J-17 Maximum Ebb Tide Sediment Deposition along the EW 1 Submarine Export Cable Route[9]

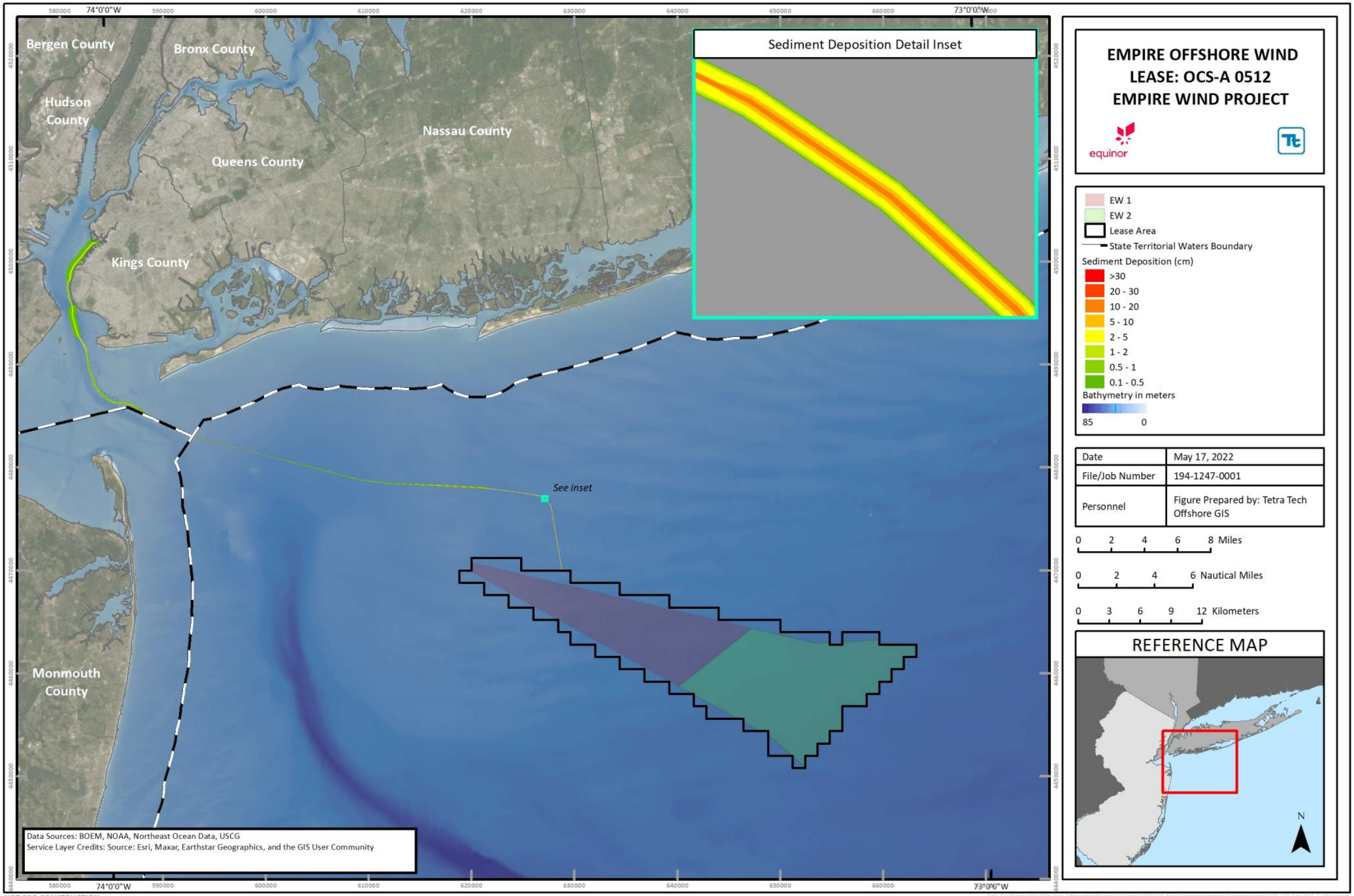

Figure J-18 Maximum Ebb Tide Sediment Deposition along the EW 1 Submarine Export Cable Route Variant[9]

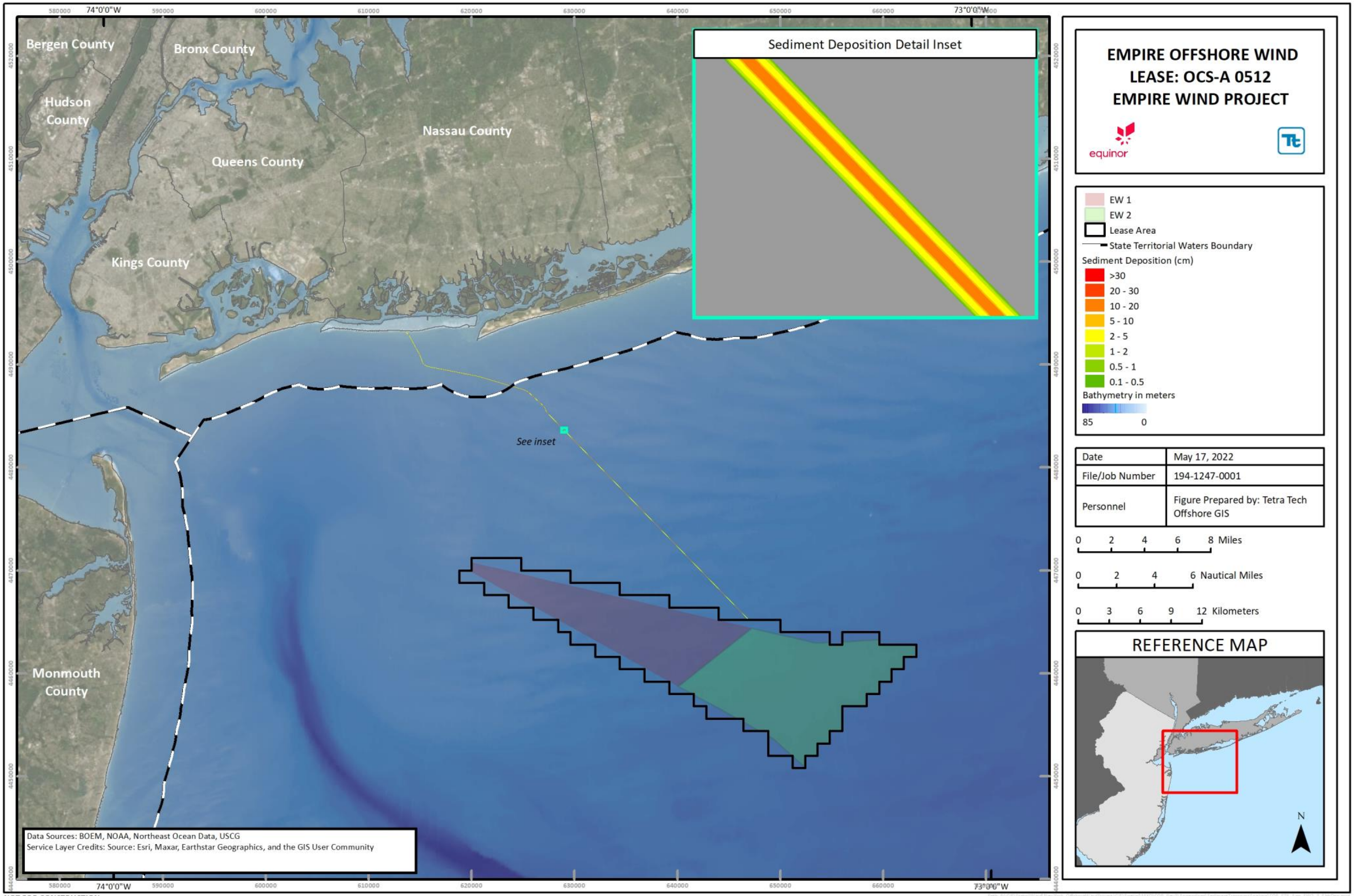

Figure J-19 Maximum Ebb Tide Sediment Deposition along the EW 2 Submarine Export Cable Route[9]

Table J-11 Project Deposition Depths for Flood Conditions

Sample	Project Element	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)															
1	Riverine	80%	2.69	2.69	2.69	2.69	0.69	0.10	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00
1a	Riverine	80%	5.93	5.93	5.93	5.93	1.53	0.22	0.22	0.22	0.22	0.22	0.01	0.01	0.01	0.01	0.00	0.00
2	Riverine	80%	10.27	10.27	3.01	0.44	0.44	0.44	0.02	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00
2a	Riverine	80%	22.60	22.60	6.61	0.96	0.96	0.96	0.04	0.04	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00
3	Riverine	80%	7.34	7.34	2.12	2.12	0.34	0.34	0.34	0.34	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
4	Non-Riverine	53%	36.15	36.15	11.19	0.19	0.19	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Non-Riverine	53%	18.95	18.95	5.45	5.45	0.15	0.15	0.15	0.15	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
6	Non-Riverine	53%	10.59	10.59	10.59	2.78	2.78	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Non-Riverine	53%	13.61	13.61	13.61	3.75	0.09	0.09	0.09	0.09	0.09	0.01	0.01	0.01	0.01	0.00	0.00	0.00
8	Non-Riverine	53%	10.59	10.59	10.59	2.78	2.78	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	Non-Riverine	53%	9.77	9.77	9.77	2.54	2.54	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Non-Riverine	53%	11.90	11.90	11.90	3.20	0.07	0.07	0.07	0.07	0.07	0.01	0.01	0.01	0.01	0.01	0.00	0.00
11	Non-Riverine	53%	10.17	10.17	10.17	2.66	2.66	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	Non-Riverine	53%	12.40	12.40	12.40	3.34	0.07	0.07	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	Non-Riverine	53%	11.37	11.37	11.37	3.03	0.06	0.06	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	Non-Riverine	53%	11.03	11.03	11.03	2.94	2.94	0.06	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	Non-Riverine	53%	11.64	11.64	11.64	3.14	0.07	0.07	0.07	0.07	0.07	0.01	0.01	0.01	0.01	0.01	0.00	0.00
16	Non-Riverine	53%	12.81	12.81	12.81	3.50	0.08	0.08	0.08	0.08	0.08	0.01	0.01	0.01	0.01	0.00	0.00	0.00
17	Non-Riverine	53%	11.65	11.65	11.65	3.18	0.08	0.08	0.08	0.08	0.08	0.01	0.01	0.01	0.01	0.01	0.00	0.00
18	Non-Riverine	53%	13.44	13.44	13.44	3.70	0.09	0.09	0.09	0.09	0.09	0.01	0.01	0.01	0.01	0.00	0.00	0.00
19	Non-Riverine	53%	11.13	11.13	11.13	3.08	3.08	0.10	0.10	0.10	0.10	0.02	0.02	0.02	0.02	0.02	0.00	0.00
20	Non-Riverine	53%	14.09	14.09	14.09	3.90	0.10	0.10	0.10	0.10	0.10	0.01	0.01	0.01	0.01	0.00	0.00	0.00
21	Non-Riverine	53%	10.89	10.89	10.89	3.00	3.00	0.10	0.10	0.10	0.10	0.01	0.01	0.01	0.01	0.01	0.00	0.00
22	Non-Riverine	53%	15.45	15.45	15.45	4.31	0.11	0.11	0.11	0.11	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
23	Non-Riverine	53%	12.20	12.20	12.20	3.38	0.10	0.10	0.10	0.10	0.10	0.01	0.01	0.01	0.01	0.01	0.00	0.00
24	Non-Riverine	53%	11.23	11.23	11.23	3.10	3.10	0.10	0.10	0.10	0.10	0.01	0.01	0.01	0.01	0.01	0.00	0.00
25	Non-Riverine	53%	11.41	11.41	11.41	3.15	3.15	0.10	0.10	0.10	0.10	0.01	0.01	0.01	0.01	0.01	0.00	0.00
26	Non-Riverine	53%	11.37	11.37	11.37	3.09	3.09	0.08	0.08	0.08	0.08	0.01	0.01	0.01	0.01	0.01	0.00	0.00

Table J-12 Project Deposition Depths for Ebb Conditions

Sample	Project Element	Total Fines (%)	Distance from Trench (m) / Maximum Sediment Deposition (cm): 0	1	5	10	25	50	75	100	150	250	350	500	800	1,000	2,500	5,000
1	Riverine	80%	2.17	2.17	2.17	2.17	0.57	0.57	0.09	0.09	0.09	0.09	0.09	0.00	0.00	0.00	0.00	0.00
1a	Riverine	80%	4.78	4.78	4.78	4.78	1.26	1.26	0.19	0.19	0.19	0.19	0.19	0.01	0.01	0.01	0.00	0.00
2	Riverine	80%	11.92	11.92	3.61	0.54	0.54	0.54	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
2a	Riverine	80%	26.22	26.22	7.94	1.18	1.18	1.18	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00
3	Riverine	80%	10.33	10.33	3.18	0.54	0.54	0.54	0.54	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00
4	Non-Riverine	53%	39.47	39.47	0.21	0.21	0.21	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Non-Riverine	53%	56.19	20.48	0.48	0.48	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Non-Riverine	53%	17.39	17.39	4.79	4.79	0.09	0.09	0.09	0.09	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
7	Non-Riverine	53%	45.35	45.35	0.34	0.34	0.34	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Non-Riverine	53%	18.57	18.57	5.11	5.11	0.09	0.09	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	Non-Riverine	53%	17.11	17.11	4.67	4.67	0.09	0.09	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Non-Riverine	53%	26.95	26.95	7.90	0.15	0.15	0.15	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
11	Non-Riverine	53%	14.56	14.56	14.56	3.90	0.07	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	Non-Riverine	53%	22.82	22.82	6.48	6.48	0.12	0.12	0.12	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
13	Non-Riverine	53%	18.84	18.84	5.19	5.19	0.09	0.09	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	Non-Riverine	53%	15.70	15.70	15.70	4.23	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	Non-Riverine	53%	17.44	17.44	4.76	4.76	0.09	0.09	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	Non-Riverine	53%	15.98	15.98	15.98	4.34	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	Non-Riverine	53%	15.88	15.88	15.88	4.30	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	Non-Riverine	53%	14.47	14.47	14.47	3.91	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	Non-Riverine	53%	13.77	13.77	13.77	3.69	0.07	0.07	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	Non-Riverine	53%	14.51	14.51	14.51	3.92	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	Non-Riverine	53%	12.80	12.80	12.80	3.41	0.07	0.07	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	Non-Riverine	53%	14.84	14.84	14.84	4.02	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	Non-Riverine	53%	12.97	12.97	12.97	3.47	0.07	0.07	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	Non-Riverine	53%	12.17	12.17	12.17	3.24	0.06	0.06	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	Non-Riverine	53%	15.09	15.09	15.09	4.06	0.07	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	Non-Riverine	53%	16.23	16.23	16.23	4.40	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table J-13 Project Deposition Depths for MFE

Sample	Project Element	Tide Condition	Total Fines (%)	Distance from Edge of Corridor (m) / Maximum Sediment Deposition (cm): 0	1	5	10	25	50	75	100	150	250	350	500	800	1,000	2,500	5,000
MFE 1	Narrows	Flood	80%	83.32	83.32	83.32	83.32	18.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFE 2	Gravesend Bay	Flood	80%	201.31	201.31	62.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFE 1	Narrows	Ebb	80%	72.39	72.39	72.39	72.39	15.89	15.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFE 2	Gravesend Bay	Ebb	80%	218.85	218.85	71.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J.6 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 submarine export cables. The modeling was conducted using existing available data and a PDE approach to evaluate the effects of proposed submarine export 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. 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;
- For jet plow during 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 80 percent fine particles, maximum concentrations at the trench line are approximately $2.7*10^6$ mg/L for a trench depth of 8 ft (2.5 m) and $6.1*10^6$ mg/L for a trench depth of 18 ft (5.5 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 16 ft (5 m) of the trench centerline. The typical concentration at 328 ft (100 m) is about 3,000 mg/L above background concentration for flood tides and about 2,700 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 $8.8*10^5$ mg/L for flood tide and $1.03*10^6$ mg/L for ebb tide. Average concentration at two minutes is $1.5*10^5$ mg/L for flood tide and $1.8*10^5$ mg/L for ebb tide;
    - The plume suspended sediment concentrations are higher for locations with high very fine sediment contents, defined as sediments in the silt and clay classes. The Riverine stations are dominated by very fine sediment classes;
    - The deposition thicknesses were predicted to be greatest closest to the centerline trench. The maximum expected sediment deposition thickness under simulated conditions is 22.12 in

(56.19 cm) at 0 m from the trench centerline. On average, deposition thicknesses were approximately 6.29 in (16 cm) 0 m from the trench centerline;

- Deposition thicknesses were predicted to decrease rapidly away from the trench. Average deposition thicknesses were less than 0.48 in (1.22 cm) within 82 ft (25 m) of the trench centerline for flood tides and less than 0.09 in (0.23 cm) within 82 ft (25 m) of the trench centerline for ebb tides. Deposition thicknesses were less than 0.004 in (0.01 cm) at all stations within 3,280 ft (1,000 m) of the trench centerline; and
- Stations that had high silt and clay contents had thicker deposition further from the trench centerline; and

- For MFE during peak flood and ebb tides:
  - The initial maximum concentration was $5.49*10^6$ mg/L. The plume was predicted to travel to 82 ft (25 m) in the Narrows during flood tide and 164 ft (50 m) during ebb tide. Near Gravesend Bay the plume was predicted to travel around 16 ft (5 m) during both flood and ebb tide;
  - The suspended sediment concentration dropped by 50 percent within 60 seconds of suspension in the water column because the sediment was comprised of fine sand and very fine sand, which settle out quicker;
  - The highest predicted deposition thickness was 32.80 in (83.32 cm) during flood tide and 28.5 in (72.39 cm) during ebb tide for the Narrows. For Gravesend Bay, the highest predicted deposition thickness was 79.25 in (201.31 cm) during flood tide and 86.16 in (218.85 cm) during ebb tide; and
  - For both locations, the deposition thickness fell below 0.004 in (0.01 cm) within 246 ft (75 m) during both flood and ebb tides.

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