Virginia Joint Permit Application
and
Project Description
for
Gamesa G11X Offshore Wind Turbine Project

Lower Chesapeake Bay, Cape Charles, Virginia

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LIST OF ABBREVIATIONS

3D	Three-dimensional
AC	Alternating Current
AMSL	Above mean sea level
ANEC	A&N Electric Cooperative
APE	Area of Potential Effect
ASA	Applied Science Associates, Inc.
BCRR	Bay Coast Railroad
BPB	Below the present bottom
CCB	Center for Conservation Biology
DC	Direct Current
DGIF	Virginia Department of Game and Inland Fisheries
EFH	Essential Fish Habitat
FAA	Federal Aviation Administration's
GIS	Geographic information System
JMA	John Milner Associates, Inc.
m/s	Meters per second
mg/L	Milligrams per Liter
MLLW	Mean lower low water
MMPA	Marine Mammal Protection Act
mph	Miles per hour
MSL	Mean sea level
MW	Megawatt
MWhr	Megawatt hour
NAVD88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRHP	National Register of Historic Places
R&D	Research and Development
RCG&A	R. Christopher Goodwin & Associates, Inc.
ROW	Right-of-Way
SAV	Submerged Aquatic Vegetation
TSS	Total suspended sediment
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VADCR	Virginia Department of Conservation and Recreation
VADEQ	Virginia Department of Environmental Quality
VDHR	Virginia Department of Historic Resources
VMRC	Virginia Marine Resources Commission
WTG	Wind turbine generator

EXECUTIVE SUMMARY

Gamesa Energy USA, LLC in joint development with Newport News Shipbuilding (Gamesa) intends to install and operate a single 5-Megawatt (MW) offshore wind turbine generator (WTG) prototype and its supporting infrastructure approximately 3 miles southwest of Cape Charles Harbor in the nearshore waters of the lower Chesapeake Bay (Figure 1.0-1). The purpose of the project is to advance the demonstration of Gamesa's new offshore WTG technology, the G11X, specifically designed for deployment in offshore wind environments worldwide. Although the Project is just one single WTG, and is not principally intended as a supply resource an added benefit will be the production of up to 5 MW of clean renewable wind power to the local Virginia transmission grid for public use.

The structural components of the G11X WTG Project prototype include a steel monopile foundation pile driven approximately 98 feet (30 meters) below the present seabed bottom off Cape Charles Harbor, stone riprap scour protection at the seabed/monopile interface, a steel nacelle vertical support tower, a transition piece that joins the monopile foundation to the monopole tower, an intermediate voltage solid dielectric submarine cable installed approximately 6 feet below the seabed connecting the WTG to the local Cape Charles grid, the G11X generator nacelle, and the specially designed G11X turbine blades, as further described herein.

The Project Description and environmental impact assessments provided in this Application are submitted as part of the Virginia Standard Joint Permit Application to be reviewed by the Town of Cape Charles Wetlands Board, Virginia Marine Resource Commission, Virginia Department of Environmental Quality, and U.S. Army Corps of Engineers – Norfolk District. A Coastal Zone Consistency Statement is also included with the application to demonstrate compliance with the Virginia Coastal Zone Management Program. It should also be noted that since the Project's generating capacity is 5 MW or less, it does not require the issuance of a Virginia Department of Environmental Quality (VADEQ) Permit for the Construction and Operation of Small Wind Energy Projects as provided under Chapter 40 9VAC15-40-130, Part III of those regulations.

In order to bring this new technology into the worldwide commercial market deployment by 2015, the offshore WTG G11X and its supporting balance of plant systems must first undergo rigorous prototype testing and validation to ensure optimal performance characteristics and reliability. The development of offshore wind turbines with more efficiencies and greater generating capacity like the G11X will not only serve to advance the challenge of greater generating capacity and reliability of marinized WTGs, but also help to reduce costs to construct and operate per unit MW in more robust offshore wind environments.

The anticipated installation of the G11X WTG will be in the third quarter of 2013 with commissioning and in-service capability by September 2013. It is expected that prototype design development activities at Gamesa's Wind Energy Technology Center in Chesapeake, Virginia will continue through the first three quarters of 2012 with these typical activities transitioning to fabrication, installation, and commissioning support thereafter. Compound fabrication will commence in the latter part of 2012 and the first quarter of 2013. The installation of the turbine is scheduled for the summer of 2013. The expected design life of the Gamesa G11X WTG is anticipated to be 20 years or more. The submarine cable systems design life is estimated to be at least 100 years, given the armoring and other protective elements. If for some unlikely reason the G11X Test Site is no longer needed for new WTG technology efforts or renewable wind energy generation, the structural elements of the WTG will be decommissioned by Gamesa as may be required by state and federal permitting agencies.

As shown in Figure 1.0-1, the proposed location of the G11X will be sited approximately 3 miles offshore southwest of Cape Charles, Virginia on the eastern side of lower Chesapeake Bay. Figure 1.0-2 shows the proposed route of submarine cable system that will connect the offshore WTG to the upland grid at Cape Charles. The submarine cable interconnection will have a total length of approximately 3.2 miles, and will be buried to a minimum target depth of 6 feet below the present seabed bottom to minimize potential for mechanical damage by anchors or other marine or fishing activities that may occur in the area. The submarine cable system will make its landfall transition to upland cable at the shoreline property of Bay Coast Railroad. A portion of the existing deteriorated steel bulkhead and riprap armor at the shoreline landfall location will be replaced with a new steel bulkhead/cofferdam section. The cable system will be directly buried underground within Gamesa's existing right-of-way (ROW) easement where it will transition to an upland cable system approximately 150 feet landward of the shoreline landfall within an underground concrete transition vault. The upland cable component will be buried a minimum of 3 feet below existing grade along and within the Gamesa ROW easement that runs parallel to the existing Bay Coast Railroad tracks for approximately 0.6 miles from the landfall location. The buried upland cable will then connect to the existing A&N Electric Cooperative 25kV overhead electric transmission/distribution system at a new proposed substation to be constructed within this easement area on Bay Coast Railroad property adjacent to the existing overhead line ROW.

In order to determine the appropriate offshore location for the G11X Project in Virginia waters, several candidate sites and geopgraphic areas that met the project's siting criteria were evaluated from physical, environmental, geographic, and electrical connection perspectives. Selection of the proposed Cape Charles offshore site was determined to best meet the Project's siting and operational criteria. Although this is a single WTG project, Gamesa has also incorporated the use of low environmental impact technologies for the planned marine installations. These include use of a single pile (monopile) support foundation system, hydraulic jetting embedment technology for the submarine cable system, and conventional excavating/mechanical dredging techniques at the landfall transition. The upland cable system will be direct buried underground within previously developed upland areas. Direct project impacts to offshore areas of submerged aquatic vegetation (SAV), vegetated wetlands, coastal dunes and other sensitive coastal resource areas have been specifically avoided. Project-related impacts to the aquatic environment can best be characterized as negligible, temporary, and localized. No adverse impacts are expected for birds, coastal habitat or wildlife/fisheries activity disruption based on the low impact design and project mitigation planning where prudent. In-water construction activities for the project are expected to be completed within 4 to 8 weeks depending on weather and sea-state conditions at time of installation and commissioning.

As part of the WTG siting analysis, Gamesa also conducted extensive outreach and advisory pre-application consultations with the local community of Cape Charles, a variety of state regulatory agencies, federal regulatory and advisory agencies, and key local and regional stakeholder interests groups. These consultations resulted in general project acceptance pending completion of the rigorous regulatory permitting review process. The Virginia Pilots Association (VPA) expressed concern over siting the WTG too close or in proximity to uncharted commercial vessel mooring overflow area off Cape Charles associated with these vessels calling on the Port of Hampton Roads. As a result of the cooperative dialogue between Gamesa and VPA, Gamesa agreed to relocate its preferred location of the WTG to an area more south and east away from this active vessel mooring area. This was found to be generally acceptable to the VPA. Concern for avian community impacts have also been addressed in the application. Although not specifically required to do so for permitting reviews, Gamesa, has undertaken desktop and seasonal field observations data collection to validate a low to no impact standard of care for project effects on seasonal bird activity in the area.

In summary, construction and operation of the G11X offshore WTG prototype will result in only temporary and localized impacts to marine water quality, aquatic resources, commercial and recreational fishing activities, avian resources and commercial and general navigation and aviation. The project site location also avoids potential conflicts with local Department of Defense operations and installations. Its visual impacts are considered negligible as it is located almost 3 miles offshore of Cape Charles and north of the Chesapeake Bay Bridge Tunnel. The project design as proposed incorporates low impact installation techniques of relatively short duration using traditional marine construction equipment. The project site has been found to be ideal for siting and operation of the G11X from its geological, meteorological, oceanographic, and electric interconnection standpoints.

It is anticipated that once constructed, the project will have significant positive economic and environmental impacts to Virginia and the local area/economy. Clean renewable wind energy will be injected into the transmission grid that may likely offset some fossil fuel generation resulting in improved air quality conditions, it will help advance emerging eco-tourism and enhanced recreational fishing activities on the Eastern Shore, and will not impact commercial or recreational marine activities occurring around the WTG site area. The G11X Project will help advance Virginia's goal of being on the cutting edge of renewable technology development. It will also promote supply chain and construction job training and experience for skilled labor as well as catalyzing new marine construction technology capabilities for the Port of Hampton Roads.

1.0 INTRODUCTION

Gamesa Energy USA, LLC in joint development with Newport News Shipbuilding (Gamesa) proposes to install, maintain and operate a new G11X Prototype Offshore Wind Turbine Generator Project (the Project) in the waters and subaqueous tidelands of the Virginia lower Chesapeake Bay's Eastern Shore near Cape Charles, VA. The Project involves the construction and operation of one prototype G11X offshore wind turbine generator (WTG) off Cape Charles as a private research and development project to facilitate worldwide commercial deployment of this new technology by 2015. The prototype WTG will have an installed nominal nameplate capacity of 5 MW. The Project will also require the linear siting and installation of a 34.5kV solid di-electric submarine cable system that will be buried below the present seabed bottom and interconnect the WTG to the land-based electric transmission grid on the Eastern Shore of Virginia. The submarine cable will make landfall to its upland transition in Cape Charles Harbor at Bay Coast Railroad property. Operation of the G11X and state-of-the art monopile foundation system will be studied and monitored as part of a research and development program for future commercial application and deployment of the G11X in worldwide markets, including the east coast of the United States. It will also provide a clean renewable source of electricity to the Virginia mainland electric transmission grid.

It is expected that the Project design life once installed and operating will extend for approximately 20 years and will be used as a test site for the G11X and provide long term wind energy generating capacity to the mainland transmission grid.

The proposed location of the G11X will be sited approximately 3 miles offshore southwest of Cape Charles, Virginia on the eastern side of lower Chesapeake Bay (see Figure 1.0-1). The proposed submarine cable route extends from the WTG location easterly to its landfall terminus in Cape Charles Harbor, having a total length of approximately 3.2 miles. The submarine cable will be buried to a minimum depth of 6 feet below present bottom (BPB) or seabed except within the limits of Cape Charles City Harbor Federal Channel bottom where it will be installed 6 feet below authorized depth to minimize potential for mechanical damage by anchors or other marine or fishing activities that occur in the area. It will make its landfall transition to upland cable at the shoreline property of Bay Coast Railroad (see Figure 1.0-2). The submarine cable system will transition to an upland cable system approximately 150 feet landward of the shoreline landfall in a underground subsurface upland transition vault. The upland cable component will be buried a minimum of 3 feet below existing grade along and within a new Gamesa ROW easement that runs parallel to the existing Bay Coast Railroad tracks for approximately 0.6 miles from the landfall location to the substation. The buried upland cable will then connect to the existing A&N Electric Cooperative (ANEC) 25kV overhead electric transmission/distribution system at a new proposed substation to be constructed within this easement area on Bay Coast Railroad property adjacent to the existing ANEC 25kV overhead line ROW.

As further described herein, other Balance of Plant activities will also be required to complete construction. These include construction of rubble mounded stone riprap scour protection surrounding the water/seabed interface of the WTG monopile to protect the foundation against excessive scour due to local tidal currents, the placement of pre-cast concrete cable protection mats that will protect the cable at the WTG site and shoreline landfall transition where it exits the seabed, construction of a new section of steel bulkhead and structural backfill to replace a portion of the existing deteriorated bulkhead at the landfall transition location, and minor mechanical dredging with upland disposal at the shoreline landfall to facilitate the installation of the submarine cable's connection to the upland transition vault.

The purpose of this research and development Project is to prove out and verify the construction, operation, and performance characteristics of the new Gamesa G11X WTG with its marinized technology in an oceanic challenging marine environment. Gamesa's G11X prototype WTG will have a nameplate capacity of 5 MW and is specifically designed for offshore installation and operation in harsh marine environments. In order to bring this new technology into the commercial market by 2015, the WTG and its subsystems must first undergo rigorous prototype and validation to ensure optimal performance characteristics and reliability. The development of offshore wind turbines with more efficiencies and greater generating capacity like the G11X will not only serve to advance the challenge of greater generating capacity and reliability of marinized WTG's, but also help to reduce costs to construct and operate per unit MW in more robust offshore wind environments.

Through Gamesa's rigorous Alternative Siting Analysis, state-of-the-art design development and use of low impact construction methods and means, the G11X Offshore Prototype Project will minimize impacts to the surrounding environment, general navigation and other marine dependent uses of this area of the lower Chesapeake Bay. Moreover, Gamesa will not impose any water-dependent use restrictions of the watersheet area surrounding the offshore WTG except for temporary construction activities and operational safety and access to the WTG. The Project has been carefully sited and designed to avoid, minimize, and mitigate impacts to the waters and submerged lands of the United States within the Commonwealth of Virginia and environmental resources subject to review under state and federal regulations. As a result, the construction and operation of the Project will only have minor, unavoidable impacts upon the jurisdictional areas of the U.S. Army Corps of Engineers (USACE) as defined in 33 CFR 328.3 and Virginia Marine Resources Commission (VMRC) as per Chapter 12 of Title 28.2 of the Code of Virginia. Because the Project's generating capacity is 5 MW or less, a VADEQ Permit By Rule is not required, pursuant to statute and regulations for Small Renewable Energy Projects (Wind) under Chapter 40:90VAC15-40 through 9VAC15-40-140 of the Code of Virginia.

1.1 Project Area

The Project Area presented herein is the water, shoreline and land areas evaluated by Gamesa for the Project location and construction. The WTG siting area of interest is shown as a rectangular area offshore with dimensions of approximately 0.4 by 2.0 miles (0.6 kilometers by 3.2 kilometers) covering 512 acres, the cable route to shore and the route for the upland cable to the interconnection location with the existing electric system (see Figure 3.3-1). This includes a corridor 400 feet (122 meters) wide, centered on the proposed submarine cable route, which is 3.2 miles (5.1 kilometers) long. The upland transition cable corridor and easement, once the submarine cable makes landfall, is 15 feet wide and extends 0.6 miles (0.2 kilometers) from the landfall location to the upland substation where it will interconnect with the local grid. The planned area for the substation construction on Bay Coast Railroad property may be up to 7,000 square feet (650 square meters) in total depending on equipment and yard area needs.

1.2 Wind Turbine Generator and Balance of Plant Overview

1.2.1 Wind Turbine Generator

The proposed Project will involve the installation of the G11X, a prototype WTG designed for use in the marine environment, with a nameplate capacity of 5 MW. The nacelle (i.e. the component of the structure which houses the generator, gear boxes and electrical control systems) will be mounted on a monopole tower, which will be affixed to a monopile foundation system (see Figure 1.2-1). The center of the rotor hub will be attached to the nacelle at a height between 262 and 269 feet (80 and 82 meters) above mean sea level (MSL). With the rotor blades attached to the hub the rotor swept zone will be approximately 420 feet (128 meters) in diameter and have a maximum estimated height (assuming a 269 foot high hub) with the blade in the 12 o'clock position of 479 feet (146 meters) above MSL. The minimum estimated height above water (assuming a 262 foot high hub), with the blade in the 6 o'clock position, will be 52.5 feet (16 meters) above MSL. The monopile foundation structure will have a diameter of approximately 16.4 feet (5 meters) and will be installed into the seabottom approximately 98 feet (30 meters). A transition piece will be attached to the top of the monopile foundation and a monopole tower structure will be installed onto the transition piece. The diameter of the monopole tower tapers from bottom to the top ranging from approximately 19.4 feet

(5.9 meters) at its base on the transition piece down to approximately 12.8 feet (3.9 meters) at the top.

1.2.2 WTG Electric Transmission System

The electric transmission system for the Project will consist of two distinct segments; a 3.2 mile single circuit 34.5 kV solid di-electric Alternating Current (AC) submarine cable running from the WTG tower to the shore-based transition vault on the coastal upland, with an upland cable system extending from the transition vault to a newly constructed substation where the power will be transformed from 34.5 kV to 25 kV and interconnected to an existing ANEC 25kV overhead electric transmission line approximately 0.6 miles away. Two fiber optic cables will also be bundled with the submarine and upland cable systems such that the WTG can communicate with the land-based substation..

1.2.2.1 Submarine Cable System

The submarine cable will consist of a single three-phase solid dielectric AC cable with integrated fiber optic communication cables (see Figure 1.2-2). The proposed WTG will be connected to the local and regional transmission grid system via a 34.5 kV/60Hz AC medium voltage submarine cable. This three-core, cross linked polyethylene cable will have armoring protection using 5-millimter galvanized steel band wrap making up the final outside layer. Two fiber optic cables will be integrated into the cable bundle for data transfer and communication purposes between the WTG and the substation. The submarine cable has a diameter of approximately 4 inches and will be buried to a target depth of 6 feet BPB or seabed except within the limits of Cape Charles City Harbor Federal Channel bottom where it will be installed 6 feet below authorized depth. Within approximately 40 feet of the bulkhead, the burial depth will transition to 3 feet BPB. Pre-cast concrete protection mats will be placed on the seabed over the embedded cable at its connection to the WTG tower and at its inner harbor landfall transition to minimize potential for anchor or other mechanical damage (see Figure 1.2-3).

The submarine cable will be installed using minimally intrusive low impact hydraulic jetting methods as described in Section 1.3.3 and via mechanical dredging and trenching methods at the Cape Charles landfall to the upland transition vault. Hydraulic jetting embedment of the submarine cable system to 6 feet BPB in predominantly sand-sized sediments along the proposed route represents the most efficient and effective installation method for the submarine cable system. It is a hydraulically operated jetting device that uses seawater under pressure to fluidize *in situ* marine sediments to burial depth while the dead weight of the cable settles in the trench and the fluidized sediment settles almost immediately back into the trench cut, naturally burying the cable at depth with minimal and short term associated water column turbidity (See Figure 1.3-2).

1.2.2.2 Upland Cable

The 0.6-mile (1.0-kilometer) upland cable system will consist of three standard 34.5 kV underground cross linked polyethylene transmission cables and two fiber optic cables. The submarine cable will terminate within the upland transition vault located within approximately 150 feet of the shoreline at the proposed landfall (Figure 1.2-3) within an easement from Bay Coast Railroad to Gamesa. The upland cables, which are spliced within the transition vault to the submarine cable, will exit the vault and run within a 15-foot wide easement within the existing Bay Coast Railroad ROW along the northern side of the track, crossing beneath the track approximately 200 feet before passing under the elevated roadway, and run along the southern side of the tracks to an existing ANEC overhead 25 kV line where the buried cable will enter a newly proposed substation to allow interconnection to the existing ANEC overhead electric transmission line for distribution to the transmission grid.

1.2.3 Substation for Overhead Transmission Line Interconnection

A new medium voltage electric substation will be constructed to facilitate the underground upland cable connection to the existing overhead ANEC public electric transmission line. Preliminary assessments indicate this new substation will likely occupy up to 7,000 square feet of upland area, and will be located adjacent to the intersection of the existing Bay Coast Railroad ROW and the ANEC 25kV ROW within Gamesa's designated easement area. The substation will contain a step-down 34.5/25kV transformer, circuit breakers, switch gear, relaying, metering, communication and control equipment. The station will be enclosed in a fence to control access and provide security.

1.3 Construction and Installation Methodology

Construction of the single offshore WTG and its submarine cable are expected to utilize traditional marine construction including low impact hydraulic jetting device technology as presented below. Low impact marine construction methods such as pile driving, riprap stone placement, and hydraulic jetting are proven and reliable construction methods that minimize noise, turbidity, direct disturbance of the seabed and aquatic resources in this estuarine/marine environment. This equipment and methods have been routinely approved by local, state, and federal regulatory agencies for work in the marine environment. Specific details of methods and equipment may be modified as appropriate once final design and selection of the preferred marine contractor has been completed. It is anticipated that the construction and installation methodologies for the project will be as follows:

1.3.1 Wind Turbine Generator

Installation of the proposed WTG will involve several components including:

- Installation of the monopile foundation and its transition piece;
- Erection of the four-piece monopole WTG support tower;
- Installation of the pre-assembled Nacelle;
- Installation of the WTG Blades;
- Interconnection of the submarine cable system to the WTG; and
- Installation of riprap stone scour protection at the seabed/monopile foundation interface.

Major WTG component assembly, subassembly, and construction staging and transfer activities in support of the offshore construction will take place at existing port facilities at the Portsmouth Marine Terminal in Portsmouth, Virginia. The foundation and WTG components will likely be manufactured, fabricated, and assembled in Europe and transferred in bulk for further assembly at Portsmouth Marine Terminal facility. The existing Portsmouth Marine Terminal facility does not require any waterfront construction upgrades or overhaul to complete this project. Properly equipped flat barges, jack-up barges, heavy lift cranes, and various installation support vessels will be utilized to transport WTG components to the offshore installation site. Construction personnel and materials will be ferried by crew boats depending upon weather conditions and other factors.

The monopile foundation installation is expected to take approximately one day depending on local weather and sea state conditions at the time of construction. Prior to installation, the monopile will be loaded onto a transport barge from Portsmouth Marine Terminal for delivery to the offshore installation site. During installation activities, it is estimated that several vessels would be present in the general vicinity to facilitate pile driving, setting, and installation. Most of these vessels will be stationary (anchor, spud, or jack-up) or slow moving barges and tugs conducting or supporting the installation activities.

These installation vessels are anticipated to travel at 10 knots (19 km/hour) or below and may range in size from 90 to 400 feet (27.4 to 122 meters). A specialized jack-up barge with a large crane and pile driving equipment is expected to be utilized for the actual installation of the monopile. The specialized barge will have 3, 4, or 6 legs with pads that will be lowered to the seabed in order to create a stable platform for heavy lifting and pile driving. The crane will lift the monopile from the transport barge that is held in place with an attendant tug and place it into position.

The monopile will be installed into the seabed by means of a pile driving hammer or vibratory head to an approximate depth of 98 feet (30 meters) BPB into the seabed. The monopile will have a total length of approximately 164 feet (50 meters) and will be installed in water depths of approximately 50 feet (15.2 meters) below Mean Lower Low Water (MLLW). The monopile foundation system has been specifically designed to accept the loading capacity of the G11X using natural soil conditions to embedment depth. No pre-augering or drilling for the monopile is anticipated. Since the monopile is hollow, the sediment column will inject into the piling core as it is driven into the seabed such that no residual sediment removal will be required.

Once the monopile foundation is in place, and the accompanying transition piece to support the WTG tower is installed, the balance of the wind turbine components will be erected in the order previously described. These components, which include the transition piece, four tower sections, nacelle, hub and rotor blades will be transported to the site either by barge or on a specialized installation vessel with heavy lift capacity. The vessels would transit from the onshore staging area to the work site as described above and locate adjacent to the previously installed monopile. A jacking system will then stabilize the vessel in the correct location. The vessel will deploy jacking legs which will raise the vessel to a suitable working elevation. The crane will raise the transition piece and place it onto the monopile, where it will be leveled and set at the precise elevation for the tower. This piece will be a fabricated steel structure complete with a turbine tower flange, “J” tubes for cable connections and a boat landing device. The transition piece is attached in place to the foundation monopile. Following the attachment of the transition piece the crane will next place the lower section of the tower onto the transition piece. Once this piece is secured, the middle tower section is raised and bolted to the lower section, and finally the upper section is raised and bolted to the middle section. In order, the nacelle, hub and blades are raised to the top of the tower by crane and secured.

1.3.2 Monopile Foundation Scour Protection

Because the proposed offshore WTG site location is located near the entrance to the Chesapeake Bay and is flanked by a relict deepwater channel, Gamesa deployed wave and current meters in this hydrodynamic area to evaluate the likelihood of potential erosional scour of the load bearing section of the monopile at the seabed/water column interface. These data indicate that the wave and current regimes measured at the WTG location may have the potential to cause some natural scour around the monopile by mid depth and near bottom tidal currents, hence potential loss of its load bearing capacity to support the WTG. To address this concern, stone riprap scour protection will have to be placed around the monopile foundation as shown in the application.

To prevent excess scour riprap rock armor will be placed around the monopile foundation. The rock armor and filter material will be placed on the seabed using a clamshell bucket or other effective methods. The proposed scour control design based on Gamesa’s hydrodynamic modeling assessment and methods in the Coastal Engineering Manual USACE (2002) is shown in Figure 1.3-1a/b.

1.3.3 Submarine Cable System

In conjunction with the installation of the WTG structure, the submarine cable system from the WTG to shore will be installed using low impact hydraulic jetting embedment methods. The bundled submarine cable system will be installed in the seabed in a single jetted trench that will backfill itself with the natural sediments temporarily suspended within the limits of the vertical trench by the jetting device. The submarine cable has a diameter of approximately 4 inches and will be buried via hydraulic jetting embedment to a target depth of 6 feet BPB along its designated route to shore except within the limit of Cape Charles City Harbor Federal Channel bottom where it will be installed 6 feet below authorized depth. In the event that target burial depth can not be achieved, secondary means of submarine cable protection shall be used. Secondary means of protection may include installing protective sleeves (cast-iron or polyurethane) on the cable or placement of concrete mattresses on the seafloor as needed. The cable will be connected to the WTG via a J-tube connection prior to the installation of the riprap scour protection around the monopile.

Jetting embedment methods for submarine cable installations are considered to be the most effective and least environmentally damaging when compared to traditional mechanical dredging and trenching operations. This method of laying and burying the cables simultaneously ensures the placement of the submarine cable system at the target burial depth with minimum bottom disturbance and with the fluidized sediment settling back into the trench. For these reasons, it is the installation methodology that appears to be preferred by state and federal regulatory agencies based on review of past precedent-setting projects. Jetting involves the use of a specially designed cable laying vessel and a hydraulically powered, jetting device. Jetting devices are available as remotely operated vehicles, towed jetting devices, or movable track. Additionally, diver assisted hand jetting can be utilized in areas unsuitable for larger vessels and equipment. Gamesa anticipates that a hydraulic jetting device will be feasible for the majority of cable installation except where the cable comes back up to the surface for interconnection with the WTG and the landfall transition at the shore. In the more shallow areas along the submarine cable route, limited mechanical dredging or hand jetting may be required to achieve proper installation depths.

The hydraulic jetting device that would be utilized for the Project will be specifically designed and configured for submarine cable installations. While jetting technology has also been used in the oil and gas industry, the equipment and process is significantly different. Hydraulic jetting installation of a 4” cable allows for the fluidizing of sediments and the simultaneous laying and covering of the cable, with the fluidized sediments settling back into the trench immediately. Jetting involved with the installation of a 24” oil or gas pipeline is designed to open a much larger trench, which remains open with the sediments in effect sidecast until the pipeline is completed at a later date and rolled into the trench.

The hydraulic jetting device that will be used for the cable installation uses pressurized sea water from on-board water pump systems on the cable laying vessel to fluidize marine sediments. The jetting device is typically fitted with hydraulic pressure nozzles that create a direct downward and backward “swept flow” force inside the trench. This provides a down and back flow of re-suspended sediments within the trench, thereby “fluidizing” the in situ sediment column as it progresses along the predetermined submarine cable route such that the submarine cable settles into the trench under its own weight to the planned depth of burial. The jetting device’s hydrodynamic forces do not work to produce an upward movement of sediment into the water column since the objective of this method is to maximize gravitational replacement of re-suspended sediments within the trench to bury or “embed” the cable system as it progresses along its route. The pre-determined deployment depth of the jetting blade controls the cable burial depth.

Due to the relatively shallow water depths in the middle of the proposed submarine cable route, shallow draft vessels/barges which typically use anchors for positioning are most likely to be used for installation. Deeper draft vessels equipped with dynamic positioning thrusters are less likely to be utilized in shallow water locations. Some amount of diver assisted hand jetting may also be necessary.

The cable-laying barge is specifically designed for installations of submarine cable. It is used for both transport and installation. The submarine cable is installed in continuous length, delivered from the cable factory and loaded directly onto a revolving turntable on the vessel. The cable system location and burial depth will be recorded during installation for use in the preparation of as-built location plans. The jetting device is equipped with horizontal and vertical positioning equipment that records the laying and burial conditions, position, and burial depth of the cable. This information is monitored continually on the installation vessel, which will be forwarded to appropriate agencies and organizations as required for inclusion on future navigation charts. The jetting device has no propulsion system of its own and depends on the cable laying vessel for propulsion. For burial, the cable barge tows the jetting device at a safe distance as the laying/burial operation progresses. The cable system is deployed from the vessel to the funnel of the jetting device. The jetting blade is lowered onto the seabed, pump systems are initiated, and the jetting device progresses along the pre-selected submarine cable route with the simultaneous lay and burial operation (see Figure 1.3-2). It is anticipated that, to install the cable system to the required depth providing a minimum of 6 feet (1.8 meters) of cover in the sediments that are generally found along the proposed submarine transmission line route into Cape Charles Harbor, the jetting tool will fluidize a pathway approximately 2 feet (0.6 meters) wide at the seabed and 8 feet (2.4 meters) deep into which the cable system settles through its own weight (see Figure 1.3-3).

The geometry of the trench is typically described as trapezoidal with the trench width gradually narrowing with depth. Temporarily re-suspended in situ sediments are largely contained within the limits of the trench wall (approximately 70% of the fluidized volume), with only a minor percentage of the re-suspended sediment having the potential to become re-suspended outside the vertical walls of the trench into the near-bottom water column (approximately 30% of the fluidized volume). Any re-suspended sediments that leave the trench tend to settle out quickly in areas immediately flanking the trench depending upon the sediment grain-size, composition, and hydraulic jetting forces imposed on the sediment column necessary to achieve desired burial depths. Gamesa has conducted extensive sediment transport and turbidity modeling for the WTG submarine cable installation as a predictive means to assess potential project impacts to water quality. Given that the sediment type for which the cable system will be jetted into is predominantly sand-sized sediment, short term turbidity effects are predicted to be negligible and well within the range of natural variability of the site location and its surrounding shoal areas.

The submarine cable is approximately 3.2 miles in length (5.1 kilometers). The installation of the submarine cable via a hydraulic jetting device is anticipated to take approximately two weeks to complete. As the jetting device progresses along the route, the water pressure at the jetting device nozzles will be adjusted as sediment types and/or densities change to achieve the required minimum burial depth. Prior to initiating the cable installation activities, the installer will likely prove the cable route is clear of debris by towing a de-trenching grapnel along the route prior to jetting activites.

The submarine cable installation will commence at the landfall (as described below) after the cable is partially floated into shore and secured in an upland transition vault. It is anticipated that minor mechanical dredging of a small area of harbor sediments will be required at the landfall shoreline in Cape Charles Harbor to facilitate pulling the cable from sea to land. Moving seaward, the submarine cable will be embedded by means of towing the jetting device along the cable route from the installation barge. The cable and jet hose will be supported by cable floats to maintain control of cable slack and the amount of hose out. When the cable embedment has proceeded into deeper water and nears the barge, the jetting device setback will be secured approximately 20 to 30 feet (6.1 to 9.1

meters) behind the stern chute, the barge will lift its spuds and begin winching along the cable route, with the six-point mooring system (which will utilize mid-line buoys) towing the jet and feeding cable off the barge and into the jetting device's funnel as it moves along the route at a rate equal to the barge movement.

The installation vessel will either have dynamic positioning capability where no anchor systems are used to keep the vessel on the cable route alignment, or a flat barge configuration that will propel itself along the route with the forward winches, and the other moorings holding the alignment of the route. A barge-deployed six-point mooring system allows a support tug to move anchors while the installation and burial proceeds uninterrupted on a 24-hour basis. When the barge nears the WTG, it will be secured in place for the final float and pull operation to interconnect with the WTG to shore. The submarine cable will be pulled into and through a J-tube conduit at the transition piece and terminated at the switchgear in the base of the WTG tower.

If a flat barge operation is used for some or all of the submarine cable installation, an anchor spread corridor of 400 feet, centered on the submarine cable route alignment, is considered to be the Area of Potential Effect for the submarine cable installation activity. As stated above, up to 6 anchors may be used by the cable laying barge to hold station and advance along the proposed route in a gradual and steady manner (approximately 1.5 knots).

1.3.4 Landfall Transition

The transition of the interconnecting 34.5 kV submarine cable system from the seabed to the adjacent upland will occur at a specific location at the existing steel bulkhead fronting the Bay Coast Railroad property on Cape Charles Harbor (see Figure 1.2-3).

As the submarine cable system traverses along the northern edge of the Cape Charles Harbor within Bay Coast Railroad's privately owned submerged lands property and approaches the bulkhead, the burial depth of the cable will transition from 6 feet to 3 feet BPB close to the bulkhead. Once the submarine cable system is within approximately 40 feet of the shoreline, the cable will be laid within a mechanically dredged or land based excavated trench to a bottom elevation of approximately 13 feet below MLLW at the shoreline. The bottom width of the trench will be approximately 10 feet and the sides of the trench will be sloped at 3(H):1(V). After the submarine cable system is laid, the trench will be backfilled using clean sand and covered with two 20-foot-long by 8-foot-wide articulated concrete mattresses comprised of 12-inch by 12-inch concrete blocks connected with fiber rope.

To maintain the structural stability of the shoreline at the landfall location, a section of the existing deteriorated steel sheet pile bulkhead will be replaced with a new structurally independent steel sheet pile bulkhead and cofferdam cell that will be constructed to allow the cable landfall transition to be made without disturbing the flanking existing steel bulkhead. The dimension of the bulkhead section for replacement will be determined in the field, based on existing conditions of the bulkhead. All connections between the existing and the new bulkhead sheeting will be structurally secure and water tight to prevent outflanking of the new structure should the existing seawall fail.

The existing soils material within the limits of the new sheet pile cofferdam cell will be excavated on land to a depth below the invert of the submarine cable conduit contained in the cofferdam cell using conventional excavation equipment and, if necessary a hydraulic ietting device. Small openings will be cut through the new bulkhead's seaward face and a pipe sleeve with watertight seals will be installed to allow the submarine cable to be pulled through the cofferdam cell to the nearby upland transition vault. Once the submarine cable is pulled through and landward of the cofferdam, it will then be buried in the upland natural soils through traditional open trench cut and cover methods until reaching the proposed underground transition vault. Within the transition vault, the submarine cable will then be pulled and spliced to connect with the upland transmission cable.

Construction of the upland electric export cable system will consist of the installation of approximately 0.6 miles (1 kilometer) of upland underground 34.5 kV transmission cable, including splices at the transition vault and terminations at the proposed substation. It is anticipated to take approximately one week to complete.

The upland cable system, which is comprised of 3 single conductor cables and 2 fiber optic cables, will be installed from the transition vault at the landfall to the proposed substation location at the crossing of an existing 25 kV overhead transmission line, via direct burial duct bank arrangement utilizing standard excavation equipment. The cable system will be installed in a single trench along the existing Bay Coast Railroad ROW within a 15-foot-wide easement at a minimum 3 feet below grade and backfilled with thermal fill to original grade. A warning tape will be placed approximately 1 foot below the surface of the trench opening for dig-in protection. Most excavation will be performed with typical construction equipment, including excavators and backhoes, with the exception of one crossing of the railroad bed which will be accomplished by pipe jacking. All work will be performed in accordance with local, state, and/or federal safety standards.

The cable will run along the northern side of the existing tracks, crossing underneath approximately 200 feet before passing under the elevated roadway (see Figure 1.0-2). Pipe jacking will be employed at this location to avoid the disturbances caused by standard construction methods and avoid the need to remove track to make the crossing. A starting pit will be excavated to initiate the advancement of a casing or carrier pipe. The casing is then advanced by simply pushing the casing pipe through the soil. A receiving pit is also excavated at the receiving end to accept the casing or carrier pipe. The cable will be pulled beneath the railroad bed without disturbing the bed's structural integrity or disrupting its use. The cable will continue from this point along the southern side of the existing tracks to an existing ANEC overhead 25 kV line where the cable will enter a proposed substation to allow interconnection to the existing electric grid.

The upland soils along the route will be pre-characterized to allow for a determination if they can be used as thermal backfill of the trench, reused on site or sent offsite for approved disposal. It is estimated that approximately 3,685 cu yds of excavated soil will be removed from the upland trench and will be temporarily stored adjacent to the work site, reused, or transported off-site as appropriate. Where soil is stored in the Project Area, it will be stabilized with erosion and sedimentation controls in accordance with Virginia Stormwater Management Program Permit Regulations. Following the completion of the installation of the cable system, the excavation will be backfilled and returned to original grade, loamed and seeded. Stormwater run-off and erosion and sedimentation controls will be in place prior to initiation of all excavations. Once construction is completed, all equipment and construction debris will be removed from the Project Area and the area will be returned to its pre-construction condition.

To minimize the potential for erosion during construction, mitigation measures required as part of the Virginia Stormwater Control Permit, such as hay bales and silt fences will be placed, as appropriate, around disturbed areas and any stockpiled soils. Prior to commencing construction activities, erosion control devices will be installed between the work areas and any downslope water bodies or wetlands that may exist to reduce the risk of soil erosion and siltation. Erosion control measures will also be installed downslope of any temporarily stockpiled soils in the vicinity of waterbodies and wetlands.

1.3.5 Schedule

The anticipated operation date for the turbine is the third quarter of 2013. Research and design activities will continue through the first three quarters of 2012 with component fabrication in the latter part of 2012 and the first quarter of 2013. The installation of the turbine is scheduled for the July/August time period in 2013.

1.4 Wind Turbine Generator Operation and Maintenance

WTGs are designed to operate without daily onsite attendance by qualified operators. Performance monitoring is typically conducted remotely via a Supervisory Control and Data Acquisition system. Operational monitoring within the turbine's nacelle includes not only the electrical performance of the generator, but also its associated mechanical and electrical equipment operation. Sensors may include thermal, visual (web-cams), audio (microphones), vibrations (accelerometers) and a host of electrical measurements which combine to provide an accurate picture of the operating state of the turbine. The fiber optic cable associated with the submarine cable system will interconnect with the WTG and the Upland Substation to allow for real-time performance monitoring. A land-based Operations Center in Cape Charles will likely be established by Gamesa to remotely monitor all aspects of the G11X's operations over time.

The WTG maintenance program typically includes routine and periodic preventive and emergency maintenance functions including shore based predictive maintenance analysis of the G11X. The maintenance operation facility will likely be based in Cape Charles and will likely involve dock space for a maintenance / crew vessel and a small parts storage facility. Because this is a prototype project it is difficult to predict the need for WTG maintenance activities, however, based on both offshore and onshore WTG operational experience, five days per year per turbine has been established as the minimum anticipated scheduled maintenance interval. These visits cover three to four days of planned or preventative maintenance, and one or two days of corrective maintenance scheduled to be performed during the same maintenance campaign. It is also probable that two or three short visits (a few hours each) per year to the WTG may be required, for unscheduled maintenance. Additional visits related to testing and research / development are likely. The G11X design is based on a twenty year operating life and all components have been analyzed to meet this design life criterion. Offshore weather and sea-state conditions will also have an influence on the maintenance operations of the G11X. Scheduled outages for maintenance will be planned for summer months when winds are low and sea states are minimal.

1.4.1 Material Management and Disposal

The G11X generating unit will utilize petroleum-based and synthetic lubricants, non-toxic cooling fluids, and other maintenance materials, all of which will be located in secured containment in the operating nacelle. The G11X has been designed to provide primary containment storage for these non-hazardous materials to ensure safe usage and proper handling and storage. The nacelle contains approximately 132 gallons (500 liters) of non-toxic hydraulic oil and 211 gallons (800 liters) of gear oil. Transformers within the nacelle contain approximately 621 gallons (2,350 liters) of biodegradable dielectric cooling fluid. Glycol or similar cooling transfer liquid will be used in the nacelle equipment to cool mechanical and moving components. A reservoir will contain approximately 46 gallons (175 liters) of the glycol coolant and be provided with secondary containment.

Primary and secondary petroleum-based fluids containment is designed into the WTG and consists of a circular steel pan structure that is located directly below the nacelle inside the tower. It is sized to contain the largest amount of any single system's fluid volume Additionally, in the unlikely event that the containment pan maximum capacity is exceeded (multiple system losses), a secondary, or back-up fluid containment structure is provided in the structure supporting the wind turbine tower in the form of a solid floor welded to the inside of the transition piece structure.

Non-hazardous solid wastes generated during operation and maintenance of the G11X may include used office materials, oil, solvents, wire, fastening hardware, light bulbs, empty material containers and other spent or surplus supplies. Non-hazardous solid wastes will be transported to shore on the marine support vessel and stored at the maintenance operation facility.

1.4.2 Submarine Cable System Repair

Submarine cable system failure due to natural processes or maritime activity has historically been very rare (less than 1% failure rate worldwide), however as a precautionary measure the 100- to 150-foot wide designated cable area corridor will be inspected from time to time to ensure sediment overburden coverage depths are adequate and whether scour, natural erosion, seabed movement or other surficial features are evident that would reduce or potentially effect its structural integrity.

The potential for an electrical fault occurring in a submarine cable system is also very rare based on industry experience. Nevertheless, a submarine cable repair plan will be developed in the event it may be necessary to repair or replace sections of the cable if necessary.as appropriate.

1.5 WTG Decommissioning

The expected design life of the Gamesa G11X WTG is anticipated to be 20 years or more. The submarine cable systems design life is estimated to be at least 100 years, given the armoring and other protective elements. If the G11X WTG is no longer needed for research and development (R&D) efforts or renewable wind energy generation, the structural elements of the WTG will be removed from the site by Gamesa. Decommissioning the Project is largely the reverse of the installation process. It is anticipated that decommissioning would include removal of the WTG and its components and cutting the monopile foundation off at the mudline and removal/recycling.

It is anticipated that the submarine cable would be cut to 6 feet below the seabed in the vicinity of the G11X and left in place rather than recovered, as would the riprap scour protection, so as to minimize the seabed disturbance during decommissioning activities. Additionally, by leaving the cable in place, a future project in the area could potentially utilize this cable and avoid potential seabed impacts from another transmission cable to shore. The lifecyle design for the submarine cable is estimated to be greater than 100 years, given sufficient burial of the cable in the seabed, cable armoring and other protective elements used to ensure adequate system protection and detection systems.

The scour protection system will also be left in place following decommissioning of the WTG. After 20 years, the riprap will have been colonized by local marine organisms and represent an important benthic habitat for the area. Additionally, recovering of the riprap would likely induce unnecessary impact to the surrounding seabed.

1.6 Regulatory Permits and Approvals Required

The permits and approvals that are required for construction and operation of the Project are described in this section. The regulatory authority for each federal, state, and local agency along with the associated applicability determination for the project is described below.

1.6.1 Federal

1.6.1.1 U.S. Army Corps of Engineers – Norfolk District

The USACE – Norfolk District regulates activities in Virginia waters of the United States, including wetlands, under Section 404 of the Clean Water Act (33 U.S.C. §1344) and Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. §403). Section 10 regulates work and structures that are located in, or that affect, navigable waters of the United States, which applies to the installation of the monopile foundation, scour protection and installation of the submarine cable system. Furthermore, Section 404 of the Clean Water Act under USACE purview regulates discharges of dredge or fill material into waters of the United States. These discharges of dredged or fill material may result as a consequence of installation activities associated with the monopile foundation, scour protection, submarine cable system, and sheet pile bulkhead/cofferdam construction at the Cape Charles shoreline.

As the lead federal agency for the Project, USACE will conduct a review of the Project in accordance with the National Environmental Policy Act (NEPA) of 1969. Pursuant to NEPA, the USACE – Norfolk District engineer will review the application package provided herein and determine if one of the following should be prepared: (1) an Environmental Assessment resulting in a Statement of Findings and Finding of No Significant Impact; or (2) an Environmental Impact Statement, resulting in a Record of Decision. Based on the findings of the NEPA documentation, the District Engineer will determine, in accordance with the public record and all other applicable regulations, whether or not to issue or deny a permit. Based on the scale and negligible impacts associated with the proposed project, it is likely that only a NEPA Environmental Assessment will be required resulting in a Finding of No Significant Impact for federal approval of the Project. In fact, the Project as proposed may even be eligible for Nationwide Permit approval as may be judged by the USACE – Norfolk District.

For projects located in Virginia Waters of the United States, the USACE Application for a Section 10/404 Individual or Nationwide Permit is part of the Standard Joint Permit Application as provided herein, where regulatory review is conducted jointly by federal and state agencies, including the Virginia Marine Resources Commission.

1.6.1.2 U.S. Coast Guard

Pursuant to the 33 CFR Part 66.0, Subpart 66.01, the U.S. Coast Guard (USCG) must authorize the construction of any private aids to navigation in the navigable waters of the United States. The G11X is a fixed structure and considered a private aid to navigation. The USCG will define a marking and lighting scheme as part of the PATN Permit to be issued for the WTG structure. It is also likely that once the submarine cable system is installed and operating that the National Oceanic and Atmospheric Administration (NOAA) and its Hydrographic Charting Office will designate a “Cable Area Corridor” on the next edition of their published hydrographic charts to advise mariners of its location and seabed condition.

The application for a USCG Private Aid to Navigation permit will be submitted in concert with other applicable approval requests.

1.6.1.3 Federal Aviation Administration

The Federal Aviation Administration’s (FAA) authority to promote the safe and efficient use of the navigable airspace, whether concerning existing or proposed structures, is predominantly derived from 49 United States Code, Section 44718. Title 14, Code of Federal Regulations, Part 77, Objects Affecting Navigable Airspace, was adopted to establish notice criteria for proposed construction or alteration that would protect aircraft from encountering unexpected structures. According to the regulations, any vertical structure greater than 200 feet in height must have FAA approval. The G11X will have a maximum estimated height of 479 feet above sea level and is therefore subject to FAA approval.

Within 5 days after the construction of the offshore WTG reaches its greatest height, Gamesa will file a Notice of Actual Construction or Alteration (Form 7460-2, Part II).

It should also be recognized that on March 15, 2011, a Notice of Proposed Construction or Alteration (Form 7460-1) was filed on behalf of Gamesa with the FAA for a preliminary offshore turbine location, approximately 1 mile northwest of the proposed turbine location. The FAA issued a Determination of No Hazard to Air Navigation on May 10, 2011. A supplemental Notice of Proposed Construction or Alteration for the proposed turbine location was filed with the FAA on November 17, 2011 and is currently pending its review and approval.

1.6.1.4 National Marine Fisheries Service

NOAA's National Marine Fisheries Service (NMFS) Office of Protected Resources is tasked with implementation of Sections 101(a)(5)(A) and (D) of the Marine Mammal Protection Act (MMPA) (16 U.S.C. 1361 et seq.), which allow, upon request, the incidental, but not intentional, taking of marine mammals by United States citizens. Construction activities associated with the Project, most notably monopile installation, may generate acoustical impacts that have the potential to impact marine mammals.

1.6.2 State

1.6.2.1 Virginia Marine Resources Commission

The VMRC regulates activities on state-owned submerged lands and tidal wetlands under Code of Virginia Title 28.2, Chapters 12 and 13. Pursuant to the authority described above, Gamesa is applying for a Marine Resource Commission Submerged Lands Permit as part of this Joint Permit Application. The VMRC will only consider tidal wetlands in the event of an appeal to the Local Wetland Board determination (see Section 1.6.3.1). The application for a state-owned submerged lands and tidal wetlands Permit is part of the Standard Joint Permit Application submitted herein.

The G11X WTG and the majority of the submarine cable will be located in or on state-owned submerged lands of the Virginia Chesapeake Bay The Bay Coast Railroad owns the submerged lands within Cape Charles Harbor and therefore the segment of the submarine cable route associated with this area (as shown in Figure 1.0-2) is non-jurisdictional to the VMRC. Gamesa has obtained an easement from the railroad to occupy the privately held submerged lands within the harbor.

1.6.2.2 Virginia Department of Environmental Quality

The VADEQ is responsible for issuing the state water quality certification, pursuant to Section 401 of the Clean Water Act, for activities that require a federal permit, license, or approval. In Virginia, the State Water Control Board issues 401 water quality certifications, under the authority established by the Virginia Water Control Law (Code of Virginia Title 62.1), pursuant to the Virginia Water Protection Permit Program Regulations 9VAC25-210. The 401 certification will be issued by the State Water Control Board upon determination that the Project meets the requirements of the Virginia Water Protection regulation based on the required permits and approvals listed below in Section 1.6.3.1.

The VADEQ recently (2010) established and now administers the Small Renewable Energy Permit by Rule program under authority of Article 5 (§ 10.1-1197.5 et seq.) of Chapter 11.1 of Title 10.1 of the Code of Virginia. In accordance with Part III of the regulation (9VAC15-40-130), a Permit by Rule is not required for the Project because the rated capacity of the G11X does not exceed 5 MW.

The VADEQ is also the lead agency in Virginia for Coastal Zone Management Consistency Review and determinations. All activities located within Virginia's designated coastal management area (Tidewater Virginia) requiring a federal permit, license, or approval must be consistent with Virginia's Coastal Zone Management Program. The entire Project Area is located within Tidewater Virginia requiring a Coastal Zone Management Consistency Determination, and issuance of the USACE federal permit for the project also requires this certification.

The application for a 401 Water Quality Certification is part of the Standard Joint Permit Application and is submitted herein. A statement of Coastal Zone Management Consistency is filed herein.

1.6.2.3 Virginia Department of Conservation and Recreation

The Virginia Department of Conservation and Recreation (VADCR) regulates storm water discharges from construction sites (4 VAC 50-60 et seq) in accordance with Section 402 of the Federal Clean Water Act. This Act established the National Pollutant Discharge Elimination System to limit pollutant discharges into streams, rivers, and bays. VADCR administers stormwater permits under the Virginia Stormwater Management Program Permit Regulations, authorized by the Virginia Stormwater Management Act. All upland construction activities associated with the Project will be subject to the requirements of the Virginia Stormwater Control Permit.

An application for a Stormwater Permit will be submitted in concert with other applicable permit applications.

1.6.3 Local

1.6.3.1 Cape Charles Wetland Board Review

The Town of Cape Charles Wetlands Board is responsible for regulating activities in tidal wetlands and adjacent areas pursuant to the Code of Virginia Title 28.2, Chapters 13. Proposed in-water and shoreline construction activities at the submarine cable landfall will be subject to review by the Cape Charles Wetlands Board. It will determine whether the proposed work activities at the Cape Charles Harbor shoreline will require a Wetlands Permit as a component of the local By-Law and associated VMRC review.

The application for a Wetlands Permit for consideration by the Town of Cape Charles Wetlands Board is part of this Joint Permit Application review process and is submitted herein.

2.0 PROJECT SITING AND ALTERNATIVES ANALYSIS

Project siting and construction alternatives that were considered as part of the project design include WTG siting alternatives, construction technology alternatives, and submarine cable routing and installation methods alternatives. In addition, a “no action” alternative is provided to establish a future baseline in relation to which the Project and its alternatives can be described and analyzed, and its potential environmental impacts and mitigation measures can be assessed.

As described in Section 1.0, the Preferred Alternative proposed in the Joint Permit Application is the installation of a G11X WTG approximately 3 miles to the southwest of the Town of Cape Charles (the Town), on the eastern shore of Virginia. The WTG that will generate up to 5 MW of clean renewable wind energy will be connected to the shore and the existing public electric transmission system at Cape Charles by way of a 34.5 kV AC submarine cable system that will make landfall at the Bay Coast Railroad (BCRR) property’s shoreline area in Cape Charles Harbor. The submarine cable will then connect with an upland cable in a below-grade transition vault in the vicinity of the landfall. The upland cable will be an underground cable that will run along Gamesa’s ROW easement directly adjacent to BCRR railroad tracks. It will then connect to a new medium voltage substation located adjacent to an existing ANEC 24.5 kV overhead transmission line. At the substation, a step-down transformer will convert the 34.5 kV power coming from the WTG transmission line to 24.5 kV, 60 Hz to match the existing line and distribution system’s distribution voltage.

2.1 No-Action Alternative

Under the No Action Alternative, the Gamesa G11X Offshore Wind Turbine Project would not be built. As a consequence, the economic and environmental benefits to the community of Cape Charles and the Commonwealth of Virginia would not be realized, which includes material economic stimulus to Tidewater area businesses and skilled labor during the construction and operation of the Project. Potential project benefits to recreational and commercial fishing interests or eco-tourism economies will not be realized. Additionally, potential job opportunities for associated workforce and supply chain needs as well as labor force training for this emerging industry would not be advanced for the Port of Hampton Roads. Although not significant in scale, the emission reduction benefits and the associated environmental and human health benefits from the renewable wind power generation serving the existing load demand for electricity in the ANEC service territory would not be realized. These attributes combined with anticipated net positive environmental impacts associated with Project construction and operation markedly offset any potential negative environmental or socio-economic effects of Project construction. Accordingly, a No Action alternative is not preferred by the Applicant.

2.2 WTG Siting and Development Alternatives

2.2.1 Project Area Alternatives

The Project is best characterized as a single wind turbine R&D project to support future commercial worldwide deployment of Gamesa's new marinized offshore G11X technology in order to meet growing worldwide demand for offshore machines that can generate wind energy at higher output levels (5 MW) with more mechanical/electrical efficiency. As part of the R&D program, the prototype turbine must be installed in "oceanic like" conditions yet have reasonable shore-based access for frequent visits to closely monitor the G11X system and technology performance. The Project Area for the G11X installation also needs to have suitable subsurface geological conditions and water depths to accommodate its monopile foundation structure and the structural loads imposed on it from its wind energy generation trials. Also, the site location area would need to be located in an offshore location that is in close proximity to shore and could then easily interconnect with an onshore public electric transmission system for renewable energy distribution. The site area should also present minimum conflicts with general navigation and existing water-sheet uses as well as minimize potential environmental impacts to aquatic and avian resources that may utilize the site area from time to time in their life-cycle or migratory activities.

In order to achieve the project's siting criteria and its aggressive deployment schedule, certain project design and permitting milestones have been set such that the G11X can be installed mid 2013.

Accordingly, an Alternative Analysis for the G11X siting was conducted as well as a Site Suitability and Critical Issues Assessment for several coastal states and specific geographic locations in those states that would meet Gamesa's project siting criteria. This siting, constructability, environmental, regulatory and socio-economic assessment focused on the Mid-Atlantic Region, and particularly Delaware, Virginia, and North Carolina. The requirement to locate the offshore turbine in minimum water depth of 50 feet as well as assessment and ranking using the specific project siting criteria resulted in the following geographic areas that received serious considerations.

The following potential Project Areas were identified as a short-list of candidate sites for the Gamesa G11X Offshore Wind Turbine Project based on the screening criteria described above:

- Cape Charles, Virginia
- Gong Buoy Area near Hungars Creek, Virginia
- Tangier Island, Virginia
- Bay Bridge Tunnel/Hampton Roads Area, Virginia
- Virginia Beach Area, Virginia
- Lewes, Delaware

These candidate locations were evaluated in terms of various environmental criteria including wind resource capacity, visual and avian resources, proximity to existing transmission, compatibility with existing marine-dependent uses, host community acceptability, and favorable regulatory permitting regimes that could meet the Project's aggressive schedule.

Based on this rigorous site alternatives assessment, Gamesa selected offshore Cape Charles, Virginia as the preferred site as it best met Gamesa's project specific siting criteria. These include among other things:

- Favorable wind capacity resources of the lower Chesapeake Bay to meet prototype testing needs;
- Accessible offshore location in state waters;
- Minimal impacts to aquatic, avian, and wetland/tideland resources;
- Minimal potential to impact existing navigation and local area water-sheet uses;
- Relatively short submarine cable route and overland run to facilitate interconnection with the existing onshore public transmission grid;
- Favorable environmental and load bearing capacity of subsurface marine geologic conditions;
- A receptive Host Community; and
- Favorable Virginia Regulatory Agency permitting reviews and timelines.

2.2.2 Submarine Cable Route – Landfall Location Site Alternatives

To provide an electric transmission interconnection from the offshore WTG to the local Eastern Shore transmission grid, a desktop siting assessment was conducted to identify potential suitable landfall locations for the submarine cable from the WTG to connect with land-based upland transmission systems in order to distribute this wind energy generation to the public grid. The assessment evaluated potential shoreline areas within and around Cape Charles Harbor.

Potential suitable locations were identified based on distance to existing upland electric transmission infrastructure, minimal upland cable routing obstacles, and low risk of use conflict (i.e. public beaches were not considered for landfall locations) with Town, private or public uses of the waterfront areas considered. The following locations were identified and evaluated (see Figure 2.2-1):

- Bay Coast Railroad Property, Cape Charles Harbor
- Bayshore Concrete Products Facility Property, Cape Charles

The Bayshore Concrete Products Facility landfall location was identified as a potential location for the cable landfall and overland transmission interconnection to the local grid, however, it was not available for the Project.

The BCRR property, located on the northern side of Cape Charles Harbor, was also considered as a suitable landfall location for the submarine cable system. This harborfront location offered several advantages. The site area has ample waterfront access and frontage, it has sufficient available private land area to accommodate Gamesa easements, ROWs and site construction access for a relatively simple overland transmission interconnection, and is currently in commercial/industrial use on previously developed waterfront land owned by BCRR. The site area's waterfront consists of existing steel sheet pile bulkhead and riprap cap which affords the opportunity to utilize more standardized cable installation techniques. BCRR also owns the property from the landfall to the substation location which is also currently cleared and in commercial use. Because of the long period of railroad activity, the cable route alignment will occur in previously developed land area. Therefore potential environmental and land-use impacts from the cable installation activity from the shoreline to the overhead transmission line interconnection are expected to be negligible. As a result of the optimal site availability and conditions, Gamesa and BCRR have already completed commercial easement agreements that will allow the upland component of the Project to proceed as planned.

2.2.3 Offshore WTG – Site Location Alternatives.

Using the established Project siting criteria, a desktop micro-siting assessment was conducted to determine the most suitable offshore location for the WTG west of Cape Charles in the lower Chesapeake Bay. Through preliminary discussions with local maritime user interests – the USCG, Virginia Port Authority and the Virginia Pilots Association – it was determined that the G11X should be sited either to the north or south of Cape Charles Harbor and outside of the deeper channel areas in order to minimize potential impact to commercial shipping activities that from time to time utilize these deeper channel areas for transit and temporary mooring activities for large vessels waiting to make call at the Port of Hampton Roads. There is also a charted vessel quarantine area to the northwest of Cape Charles used by US Customs and other agencies to pre-screen or hold vessels for clearance prior to entry to the Port of Hampton Roads. In addition, the Virginia Pilots Association requested siting consideration to the south and east of the deeper channel areas to avoid potential navigational and vessel mooring conflicts.

As a result of these concerns, Gamesa's initial offshore site areas of interest were eliminated from consideration, and further study for alternative locations identified two WTG siting areas, which were to the south and west of the Cherrystone Inlet Channel to the southwest of Cape Charles for more detailed site compatibility and use studies. These studies consisted of technical siting evaluations and field studies to assess the suitability and constructability characteristics of the selected site areas. Field studies included extensive remote sensing geophysical surveys, *in situ* geotechnical boring sampling, marine biological sampling surveys, marine mammal and reptile observations, avian community studies, noise and visual impact studies, and cultural/historical resource impact studies. Each of the two siting areas was approximately 0.4 by 2 miles, and located on opposite sides (to the north and south) of the federally maintained Cherrystone Inlet channel which provides USACE controlled navigational access to Cape Charles Harbor (see Figure 2.2-1). Results from the field investigation indicated that the hydrographic, biological and geological conditions at each location were essentially similar in their siting characteristics.

Based on the inability to land the cable at the Bayshore Concrete Products Facility (to the south of the Cape Charles City Harbor Federal Channel) and the subsequent easement agreement with BCRR, the northern WTG siting area was selected as the most suitable and preferred offshore location for the G11X WTG installation. The northern siting area is northwest of the Cape Charles navigation channel and therefore the submarine cable route can make the proposed landfall without crossing the federally maintained navigation channel. Additionally, the northern siting area is closer to Cape Charles and therefore provides the shortest distance for the submarine cable route. A precise location within the northern WTG siting area was selected along the 50-foot contour based on the results of the geophysical survey of existing bottom and subsurface geology conditions and geotechnical studies and borings to confirm the load bearing capacity of the subsurface sediments to adequately support the monopile foundation system and the WTG components.

2.2.4 Submarine Cable Route Alternatives

The submarine cable route was evaluated after the proposed landfall and the proposed G11X WTG offshore locations were selected. The desktop routing analysis identified several important siting issues to be considered. Areas of shallow water exist toward the north side and outside of Cape

Charles Harbor. It is desirable to avoid these areas to the extent possible because of installation considerations regarding the use of hydraulic techniques and need for barges and vessels to work in the shallow water. Also, in routing the cable, it is preferred although not required, to avoid placement within the federally maintained navigation channel to minimize concerns over potential mechanical damage due to commercial fishing and vessel activities and existing and planned water-sheet uses. Finally, The Town has permitted the installation of an offshore gapped breakwater system at the entrance to the harbor to minimize the potential for storm wave and tide damage to the harbor's waterfront area. This breakwater system is constructed of concrete and stone riprap material. In 2009, the Town installed two of five permitted segmented breakwaters at the mouth of Cape Charles Harbor. The Town has expressed plans and their intent (subject to funding) to construct the three remaining rubble mound breakwaters that would extend known distances south or north of the existing breakwater structures at some point in the future, although the timeframe for this construction is presently not known (Cape Charles Town Planner, pers. comm., 2011)

Three cable routes were considered in order to determine the best way to address the fact that only two out of five breakwaters had been built and there was no certainty about if or when the other breakwaters would be built (see Figure 2.2-1). Option 1 (the preferred alternative), was to route the submarine cable from the WTG to its landfall between the southern most permitted (but not yet built) breakwater and the navigation channel. Option 2 was to route the cable a safe distance from the southern existing breakwater, with the understanding that at some point in the future a breakwater could be built in very close proximity to the cable which could present a threat of damage to the cable or hinder the ability to retrieve the cable should repair of a fault ever be required in this vicinity. Option 3 was to route the submarine cable through the gap in the existing breakwaters which was determined to be too restrictive for constructability reasons due to limited access in the vicinity of the breakwater gap and due to future maintenance or repair activities of the structure. Consequently, Option 1 is the preferred submarine cable route because it simply avoids installation and operational conflicts with the existing and future breakwater structures.

Site characterization studies were then conducted and finalized on the preferred submarine cable routes during several field investigations. These studies indicate very favorable subsurface geologic conditions suitable for hydraulic jetting installation from the WTG to the Project landfall location in Cape Charles Harbor.

2.3 Technology Alternatives

2.3.1 Foundation Technology Alternatives

The marketing motivations of the Project were such that the WTG should be sited in approximately 50 feet of water, in wind and wave conditions that simulate open ocean conditions Based upon these siting and fundamental engineering constraints, which include heavy structural loads from the tower and the WTG operating unit only three foundation types were considered for foundation support for the G11X:

- Monopile Foundation
- Gravity Foundation
- Tripod (or Lattice Type) Foundation

2.3.1.1 Monopile Foundation

The monopile foundation type has been selected as the preferred design for the proposed G11X, based upon optimal offshore geologic conditions and geotechnical engineering requirements. Monopile-type foundations constructed of structural steel are the most tested and successful foundation type currently used in offshore WTG construction in Europe. This foundation type consists of an open-ended steel conical tube (pile) that allows *in situ* marine sediment to be encased within the monopile as it is driven into the seabed. In addition to the support provided by the seabed sediments surrounding the outside of the monopile, the encased sediments inside the pile provide additional structural support. The monopile is installed using a special high impact hammer that provides adequate energy to force the tip of the pile to the target depth below the seabed. It is anticipated that the monopile would be driven into the seabed to a depth of approximately 98 feet (30 meters) BPB.

The monopile foundation system has been designed and engineered by Newport News Shipbuilding to meet the stringent tolerance and dynamic loading requirements established by Gamesa to support and effectively operate the G11X WTG aloft. The monopile will have an approximate diameter of 5 meters (16.4 feet), will be impact driven into the seabed to a depth of approximately 98 feet BPB at the proposed offshore location at Cape Charles based upon water depths, subsurface conditions, and the anticipated loads for the G11X.

The monopile foundation for the G11X has been selected as the preferred design approach to support the G11X WTG.

2.3.1.2 Gravity Foundation

Gravity-type foundations that essentially rest on a prepared seabed and are not driven into the bottom were also considered by Newport News Shipbuilding and Gamesa but were ultimately rejected due to the relative scale of the structure, complicated installation methods, and lack of worldwide application for similar structures to support G11X technology deployment.

The environmental impacts from gravity foundation installation are also considered greater than that of a monopile foundation. Given the extreme weights of a concrete gravity foundation, it must be placed on a suitable and prepared seabed requiring dredging and filling within the foundation's gravity footprint. The geophysical site characterization studies conducted for the Project indicated that the seabed slopes such that dredging would be required to establish a suitably flat bottom for the foundation structure. Preliminary designs suggested the depth of materials to be removed via dredging could be on the order of 15 to 30 feet BPB, which equates to approximately 26,000 to 39,000 cubic yards (20,000 to 30,000 cubic meters) of material. Newport News Shipbuilding design evaluations indicate that a gravity foundation base sufficient to support the G11X WTG will require a diameter of approximately 65 to 80 feet (20 to 24 meters).

In addition to environmental concerns, the constructability requirements for this type of structure pose numerous challenges due to the need of a dry dock or suitable waterfront construction yard capable of supporting such a structure, cranes capable of moving the structure as necessary, vessels capable of guiding and lowering the structure, and dredging equipment required to prepare the foundation site.

For these primary reasons a gravity-based foundation design was rejected for further consideration.

2.3.1.3 Tripod (Lattice Structure) Foundation

The use of tripod or lattice structure-type foundations in the offshore industry (for wind turbines and other offshore applications alike) has typically been reserved for WTG installation in much deeper waters (greater than 100 feet) due to their increased structural stiffness, but at significantly higher costs relative to a gravity structure or monopile solution. Unlike a monopile foundation, a tripod foundation would consist of driving three smaller-diameter piles (5- to 8-feet in diameter), as opposed to one large diameter pile into the seabed along with strap or lattice type structural frame supports.

For these primary reasons a tripod foundation type was rejected for further consideration for the Project.

2.3.2 Submarine Cable Technology Alternatives

Based on the relatively short distance from the G11X to the shore as well as its rated generating capacity of 5 MW, a solid di-electric AC cable system is the proposed technology for the submarine cable electric transmission technology. Solid di-electric medium voltage submarine cables are a proven reliable technology and have sufficient worldwide availability to service the transmission needs of the G11X Project. They do not contain any cooling fluids or other materials that could be released to the marine environment and are well armored and protected from possible mechanical damage. They are durable, flexible in their application and can be custom designed and manufactured to meet project needs and schedule.

2.3.3 Installation Methodology Alternatives

2.3.3.1 Non-Burial

A submarine cable can be installed directly on the seabed or “surface laid” without needing to be embedded at depth. This was the “old school” installation approach when submarine cable technology was not well developed, hence requiring sometimes frequent access to and field splicing, and hydraulic jetting device technology was not well-advanced as it is today. In general, submarine electric cables are now buried to depth in order to protect them from mechanical damage from external strikes from objects such as anchor drag, vessel movement, heavy fishing gear, etc. Non-burial of the submarine cable presents a level of risk to the mechanical and electrical integrity of the cable system that can cost approximately $1.5 million per mile to fabricate and install. In cases where the seabed substrate does not lend itself to cable burial by hydraulic jetting, such as rocky or hard bottom substrates, external protective measures such as concrete mats or other protective armoring can be used to help minimize the potential for mechanical damage to the cable system.

The installation alternative of a surface laid submarine cable system for the Project was rejected to avoid or minimize potential mechanical damage to the cable system once installed and because of the suitability of the local geology for hydraulic jetting embedment.

2.3.3.2 Hydraulic Jetting

The use of jetting for submarine cable installation is considered to be the least environmentally damaging and most effective method when compared to traditional techniques such as mechanical dredging and trenching. This process achieves the placement of the Submarine Cable system at the appropriate burial depth while allowing fluidized sediment which escaped into the water column to settle back into the installation trench and thereby minimizes bottom disturbance. A comprehensive review of the potential environmental impacts resulting from hydraulic jetting is provided in Section 3 of this document.

Jetting involves the use of a specially designed cable laying vessel and a hydraulically powered, jetting device. Jetting devices are available as remotely operated vehicles, towed jetting devices, or tractors. Jetting equipment uses pressurized seawater from water pump systems based on board the cable laying vessel to fluidize sediments. The jetting device’s stinger, which is placed into the sediment bed, is typically fitted with hydraulic pressure nozzles that create a direct downward and backward “swept flow” force inside the trench that limits the upward movement of sediments into the water column and maximizes the gravitational replacement of sediments onto the cable to provide protective cover. Jetting devices can be used to simultaneously lay and bury cables or for post-lay embedment where the cable is laid on the bottom followed by the jetting device embedding the cable as a separate operation. The jetting device moves along the planned cable route and fluidizes the sediment column such that the Submarine Cable settles into the trench under its own weight to the planned depth of burial (see Figure 1.3-2).

Depending upon the composition of the sediments and the type of jetting device used, jetting devices are capable of fluidizing a single trench of approximately 12 to 24 inches (0.3 to 0.6 meters) wide to a depth of 6 to 16.5 feet (1.8 to 5.1 meters) BPB. In many cases, a jetting device is modified to suit the requirements of a given installation. Jetting devices are equipped with horizontal and vertical positioning equipment that records the laying and burial conditions, position, and burial depth to allow “as-laid” plans of the cable system to be generated.

The hydraulic jetting installation methodology has been accepted by state and federal regulatory agencies across the United States. Examples of recent submarine cable licensing decisions, including the TransBay Project, Bayonne Energy Center Project, Long Island Replacement Cable Project, and the Cape Wind Offshore Wind Project that have utilized this technology is a clear indication of acceptance by various regulatory agencies throughout the United States of this technology.

Hydraulic jetting can also be accomplished by divers using hand-operated jetting tools. The use of diver jetting for cable installation is typically limited to locations where submarine cables cross waters that are too shallow for remotely operated vehicles or towed jetting devices.

The hydraulic jetting methodology was selected by Gamesa as the preferred technology for the installation of the submarine cable portion of the Gamesa G11X Offshore Wind Turbine Project because of its ability, as demonstrated during other submarine cable installations in United States waters, to achieve the desired burial depth; to result in minimal environmental impacts to sensitive aquatic resources and water quality; and to avoid the need to remove and manage sediments along the route. Because of the shallow waters found along the route of the submarine export cable between the proposed location for the G11X and the Cape Charles Landing, it is likely that some combination of mechanical jetting device and diver operated jetting tools will be used to install the submarine export cable.

2.3.3.3 Horizontal Directional Drill

Horizontal Directional Drilling (HDD) methods are used to install cable in areas where it is desirable to avoid direct disturbance of sensitive near shore resources or structures as it allows the cable to pass underneath these areas a sufficient distance from sea to shore that results in no impacts to the shoreline landfall transition area, particularly if it is a natural barrier beach, wetland, or coastal dune area. HDD methods require a push-pull drill and wash set up from sea to shore to install high-density polyethylene conduit at depth such that the submarine cable can be pulled through the conduit, thereby avoiding direct disturbance of the sensitive natural shoreline. It is also useful in crossing beneath streams and rivers to avoid impacts associated with other methods such as open trench cutting, In these situations, the added cost and complexity of the HDD is warranted and in most cases preferred. However, at the Cape Charles Harbor landfall location the shoreline/water interface consists of an old deteriorating steel bulkhead likely built circa 1945 along with dumped stone and concrete materal behind the bulkhead to prevent further storm overwash erosion of the adjacent fastland. Consequently, traditional open cut trenching and clean backfill along with a segment of the steel bulkhead being replaced where the cable will make landfall is the preferred construction methodology. The use of HDD installation techniques and the additional costs over traditional open cut trench installation is not necessary or warranted for the Project.

2.3.3.4 Mechanical Plow

Mechanical plowing relies on the physical displacement of the seabed surface sediments to create a trench to the planned depth of burial, into which the cable is then laid. This technology utilizes a mechanical plow on heavy skids that uses gravity (weight) to displace surface sediments, and is towed behind a robust service vessel. Mechanical plowing has far more potential for significant environmental and water quality impacts to the marine environment than the proposed method of hydraulic jetting for a number of reasons including: the weight applied to the plow results in furrow depth and surface sediment displacements that remain on either side of the trench; the extensive area of seabed directly disturbed; the environmental impacts associated with greater turbidity; and trench side casting and backfilling. Moreover, the trench depression would likely require backfilling with large volumes of imported clean sediment material. Consequentially, these activities result in increased direct impacts to the seabed, water quality, and navigation as compared to the preferred hydraulic jetting methodology. Mechanical plowing is typically used where shallow embedment depths of 3 to 5 feet (0.9 to 1.5 meters) are required.

Due to its limited burial depth capabilities and relatively greater environmental impacts to the benthic environment, water quality, and navigation as compared to hydraulic jetting, mechanical plowing was considered undesirable for the Gamesa G11X Offshore Wind Turbine Project, and therefore eliminated as an alternative.

2.3.3.5 Mechanical Dredging

Mechanical dredging entails the physical removal and disposal of sediments from the trench footprint. The use of mechanical dredging is capable of installing the cable to the required depths; however, it would require the mobilization of a large dredge plant operation for an extended duration with significantly greater environmental impacts than the preferred hydraulic jetting method. As compared to the preferred method, dredging would involve direct impacts to much greater areas of the seabed and significantly larger volumes of sediments, and would significantly increase suspended sediment concentrations and turbidity in the water column. For these reasons, mechanical dredging was eliminated as a viable alternative for installation of the submarine cable.

Once at the landfall, mechanical trenching will be utilized to make the transition from the marine/estuarine environment to the upland parcel. It is estimated that approximately 40 linear feet of mechanical trenching will be necessary to allow for the cable transition.

3.0 ENVIRONMENTAL CONDITIONS

3.1 Avian and Bat Communities

ESS Group, Inc. (ESS) and the College of William & Mary's Center for Conservation Biology (CCB) conducted an initial desktop study using existing information and data bases to assess the presence and habits of avian and bat populations near the proposed G11X location. This assessment produced avian and bat baseline information describing the area's known avian and bat species composition, the relative abundance of documented species, avian and bat habitat characteristics, and the regional ecology of these animals. Where applicable, the conservation status of documented species is addressed.

It should be recognized that because the G11X WTG has a generating capacity of less than 5 MW, the Project is not subject to potential avian community studies, monitoring, or mitigation requirements under the VADEQ Small Wind Energy Projects – Permit By Rule Regulations or Guidance pursuant to Chapter 40 Part 1 of the code of Virginia. Nevertheless, Gamesa has completed recent baseline studies of the

Project Area as approved by state and federal agencies to make certain conclusions regarding Project effects on the surrounding avian community in support the Joint Permit Application review. This information and observations will also serve as a technical data baseline for future studies, if necessary, while taking advantage of the proper seasonality for these observations in 2011 and 2012.

The data compiled and analyzed for this effort was obtained from a number of different sources including state and federal natural resource agencies, Geographic information System (GIS) data clearinghouses and bird and bat conservation organizations, including but not limited to, the U.S. Fish and Wildlife Service (USFWS), Virginia Department of Environmental Quality, VADCR's Natural Heritage Program, Virginia Department of Game and Inland Fisheries (DGIF), Virginia Marine Resources Commission, and Audubon Society of Virginia. The results of this data compilation and review are provided in the following sections.

Gamesa developed two avian survey protocols to collect data near the WTG site in consultations with the DGIF and USFWS, and received their concurrence to proceed. One study involves conducting 10 seasonally based aerial surveys between May 2011 and 2012 to map the distribution of birds near the proposed location for the G11X. The second is a seabird survey conducted from land between fall 2011 to early spring 2012. Initial findings from the aerial surveys conducted in 2011 are provided below. Together these two data sources will provide a better understanding of the avian distribution and behavior near the proposed offshore location for the G11X. Reports of the seasonal avian surveys will be prepared and submitted as supplemental information, as may be required.

3.1.1 Existing Conditions

The geographic scope of this assessment of existing conditions with respect to local avian and bat community activity near the WTG site was established by an ecological boundary rather than a political boundary or arbitrarily assigned survey area around the project location. Scoping the study in this fashion provides allowances for consideration of the highly mobile nature of birds and bats in this geographic area. The avian community study area chosen by Gamesa includes the Delmarva Peninsula and Tidewater area of the eastern Chesapeake Bay, which is classified by the VADCR's Natural Heritage Program as the Outer Coastal Plain physiographic province. Physiolographic provinces in Virginia are defined generally by their relative elevation, relief, geologic structure, and lithology. In the case of this outer region of the coastal plain, it is considered to be relatively flat and contains many sounds, embayments, and flatwoods (VADCR, 2011).

3.1.1.1 Avian Resources

The Project Area is located approximately 3 miles southwest of Cape Charles, which is roughly 11 miles north of the mouth of the Chesapeake Bay and 2 miles west of the closest point of land on the lower Delmarva Peninsula. The literature search provides substantial information on avian resources associated with the Delmarva Peninsula with much less information on avian resources data over Chesapeake Bay. The Delmarva Peninsula contains documented migratory staging areas and wintering areas utilized by a wide diversity of bird species, including species of importance at the federal and global levels (Watts, 2006). The entire Delmarva Peninsula is characterized as an important bottleneck along the Atlantic Flyway where birds migrating along the Atlantic Coast pass through (mostly on the eastern (ocean) side of the peninsula away from the proposed offshore location for the G11X, and/or congregate in large numbers (Watts, 2006 and Watts pers. comm., 2011).

The diversity of avian species frequenting the vicinity of the proposed location for the offshore G11X WTG was first assessed by searching federal and state databases for rare, threatened, and endangered species occurrences within the study area and region. These data sets provide the names of species considered unique or exemplary[1] rare to these parts of Virginia (VADCR, 2011). The Virginia Natural Heritage Program Database was searched by physiographic province (i.e., Outer Coastal Plain) as this area covers the broad area of the offshore WTG Site location. This list includes those species that are believed to be sufficiently rare or threatened to merit an inventory of their status and locations according to the Virginia Natural Heritage Program and is presented in Table 3.1-1 below. For the purposes of cross-referencing, the USFWS protected species database was also consulted to confirm if any federally listed[2] endangered or threatened bird species were included in this list. Data base information shows that approximately thirty rare avian species have documented occurrences within this broad region (Table 3.1-1), however the USFWS has reviewed the proposed project location and stated that the agency does not have any records of federally listed avian species occurring in the Project Area (USFWS, 2011). Similarly, the VADCR's Natural Heritage Program also reported that it does not have any records of rare, threatened or endangered avian species near the proposed offshore WTG location (VADCR, 2011b).

Table 3.1-1 Rare Bird Species with Documented Occurrences in the Coastal Plain Physiographic Province of Virginia according to the Virginia Natural Heritage Program (2011a)

Common Name	Scientific Name	Federal Status	State Status
Saltmarsh Sharp-tailed Sparrow†	*Ammodramus caudacutus*		
Gadwall	*Anas strepera*		
Great Egret	*Ardea alba*		
Short-eared Owl‡	*Asio flammeus*		
Piping Plover†	*Charadrius melodus*	LT	LT
Wilson's Plover	*Charadrius wilsonia*		LE
Northern Harrier	*Circus cyaneus*		
Sedge Wren	*Cistothorus platensis*		
Wayne's Black-throated Green Warbler	*Dendroica virens waynei*		
Little Blue Heron	*Egretta caerulea*		
Snowy Egret	*Egretta thula*		
Tricolored Heron	*Egretta tricolor*		
White Ibis	*Eudocimus albus*		
Peregrine Falcon	*Falco peregrinus*		LT
Gull-billed Tern	*Gelochelidon nilotica*		LT
Bald Eagle	*Haliaeetus leucocephalus*		LT
Black-necked Stilt	*Himantopus mexicanus*		
Caspian Tern	*Hydroprogne caspia*		

[1] Natural Heritage Resources, or "NHRs", are rare plant and animal species, rare and exemplary natural communities, and significant geologic features. The criterion for ranking NHRs is the number of populations or occurrences, i.e., the number of known distinct localities; the number of individuals in existence at each locality or, if a highly mobile organism (e.g., sea turtles, many birds, and butterflies), the total number of individuals; the quality of the occurrences, the number of protected occurrences; and threats.

[2] Federally listed species are protected by the Endangered Species Act of 1973, as amended. The U.S. Department of the Interior's Fish and Wildlife Service administers the Act, listing and protecting federally endangered and threatened species.

Common Name	Scientific Name	Federal Status	State Status
Black Rail†	*Laterallus jamaicensis*		
Swainson's Warbler	*Limnothlypis swainsonii*		
Yellow-crowned Night-heron	*Nyctanassa violacea*		
Brown Pelican	*Pelecanus occidentalis*		
Glossy Ibis	*Plegadis falcinellus*		
Sora	*Porzana carolina*		
King Rail‡	*Rallus elegans*		
Virginia Rail	*Rallus limicola*		
Black Skimmer	*Rynchops niger*		
Least Tern	*Sternula antillarum*		
Royal Tern	*Thalasseus maximus*		
Sandwich Tern	*Thalasseus sandvicensis*		
Roseate tern	*Sterna dougallii*	LE	LE

Notes:
LE: Listed-endangered
LT: Listed-threatened
†: Audubon Society and American Bird Conservancy Red Watchlist
‡: Audubon Society and American Bird Conservancy Yellow Watchlist

The Audubon Society along with other participating state wildlife resource agencies[3] have designated two Important Bird Areas (areas C and D) within 6 miles of the proposed location of the offshore G11X as a result of a science-based process (see Figure 3.1-1). The lower Delmarva Important Bird Area is located on the Chesapeake Bay side of the lower Delmarva Peninsula (Cape Charles) and approximately 2 miles east from the WTG location. The lower Delmarva Peninsula geographic area typically serves as a stopover for migratory birds, including passerines that breed in northeastern North America and winter in the Caribbean as well as temperate migrants that winter in the southeastern U.S. Over 10 million neotropical and temperate migrating passerines are estimated to pass through the Delmarva Penninsula each fall. Passerine migrants use the area as a stopover to rest and refuel before migrating north or south. Similarly, migrating raptors (birds of prey) have been counted in numbers reaching 80,000 during the fall season, and have been known to use the lower Delmarva as a stopover point to search for prey during their transit south (Audubon, 2010).

The Barrier Island/Lagoon Important Bird Area is located 6 miles from the offshore G11X WTG location on the opposite (Atlantic Ocean) side of the Delmarva Peninsula. Due to the higher tide ranges and direct open ocean exposure, the ocean- side of the peninsula consists of coastal barrier island and back marsh complexes, successional maritime forests, extensive salt marshes and tidal creek systems, inter-tidal mudflats and open water. The oceanside side area is considered to have some of the most pristine bird habitat of its kind along the Atlantic coast and has been noted as one of the most important bird areas along the Atlantic Coast of North America (Audubon 2010a).

[3] The Virginia Important Bird Area Program, like its national affiliate, is organized and run by the Aubudon Society. In Virginia, several statewide agencies and organizations participate: Coastal Zone Management Program, VA Department of Game and Inland Fisheries, Virginia Society of Ornithology, and the Center for Conservation Biology.

Much of the region in the vicinity of the proposed location for the offshore G11X is delineated by the Commonwealth of Virginia as Coastal Avian Protection Zones[4]. The proposed location for the G11X is designated as CAP Zone 6. CAP Zones were created by the Commonwealth to assist in siting small renewable energy projects and their potential to impact avian communities present in the vicinity of a project site's area, whether it be a land- or sea- based facility. Location of a project within a particular CAP Zone requires a certain level of study and reporting on avian community impacts as part of the recently enacted Small Renewable Energy Permit by Rule standards. It should be recognized, however, that the Gamesa G11X R&D Project does not meet the threshold requirements for these studies under the Permit by Rule review standards since it generates 5 MW or less of wind energy. Nevertheless, Gamesa in consultation with the VADEP, DGIF and USFWS has designed and is currently implementing a prudent avian community study of this area of Cape Charles and the lower Delmarva Peninsula to set a baseline for future monitoring efforts for the G11X project, if required by others.

The CCB has characterized the waters in southeastern Chesapeake Bay as having continental importance for birds due to the large number of species and individuals that migrate and overwinter in the area (VMRC, 2010). This characterization is not considered to be based on offshore avian data, but rather upon expert opinion and is very broad in nature (Watts, pers., comm., 2011). There is little published data on sea duck winter habitat use in the lower Chesapeake Bay. Ross and Luckenback (2009), recently published a study examining Surf Scoters and Long-tailed Ducks in Chesapeake Bay in comparison with coastal lagoons on the eastern shore of the Delmarva Peninsula. The Chesapeake Bay study area was roughly 50 kilometers north of the proposed WTG. The shallow water environment in the southeastern region of Chesapeake Bay appears to be important winter foraging habitats for Surf Scoters and Long-tailed Ducks (Ross and Luckenback, 2009, U.S. Geological Survey [USGS], 2011). Chesapeake Bay is also thought to be an important wintering area for Common and White-winged Scoters (Perry and Berlin, 2012).

Although the proposed turbine location is near the Delmarva Peninsula, a significant avian habitat, it does not mean that the same concentration of birds or environmental conditions that occur on land occur on water. The avian studies being conducted for the Project (and described below) are designed to provide location specific data that will help verify avian density in the Project Area and evaluate any potential effects from the Project.

Field Surveys

ESS and CCB have already commenced Project-specific avian field surveys to assess avian species presence, spatial distribution, and frequency within and around the project location. As previously stated, ESS and the CCB met with the DGIF and USFWS on March 16, 2011 to develop and confirm avian field survey protocols and seasonal bird observation schedules. The consensus protocol includes aerial surveys and land-based offshore shorebird surveys in the spring, fall, and winter. Methods and initial findings are provided below.

Aerial Surveys

ESS has been conducting aerial surveys from a fixed wing Cessna 172 aircraft (see Figure 3.1-2). Survey methods followed standard practices and at sea aerial survey methods that have been used in other pre-construction studies for offshore wind development projects. The survey

[4] As defined and described in the Virginia Department of Environmental Quality, Permit by Rule for Construction and Operation of Small Wind Energy Projects (Chapter 40: 9VAC15-40 through 9VAC15-40-140).

protocols were developed by ESS and Dr. Bryan Watts of the CCB in consultation with representatives from the Virginia DGIF and USFWS.[5]

Based on the original proposed location of the wind turbine just south of Cape Charles Harbor, the initial survey route consisted of five, 7-kilometer long transects, spaced 2 kilometers apart, which was generally consistent with the aerial survey methodology used for the Cape Wind project, Rhode Island Ocean Special Area Management Plan, (Paton et al., 2010; Perkins et al., 2004a; Perkins et al., 2004b; Sadoti et al., 2005a; Sadoti et al., 2005b; USACE, 2004) and recommended by Camphuysen et al., (2004). The original study area extended 65 square kilometers.

The position of the proposed offshore WTG was revised in August 2011, due to changes in the cable landfall location described earlier to a location north and west of its original proposed location. Therefore, the aerial survey area was modified to be centered on the relocated turbine area (see Figure 3.1-3). In the revised survey area, the five original transects were retained and extended 1.34 kilometers seaward to account for the western shift in the proposed wind turbine location. Additionally, two new survey transects (A and B) were added at 2-kilometer intervals on the northern periphery of the survey area to account for the more northerly position of the proposed wind turbine. The revised study area is approximately 108 square kilometers.

During surveys, the airplane flies along each pre-determined transect at a height of approximately 152 meters (500 feet), with a bird observer positioned on each side of the airplane. The 76-meter (250-foot) flight altitude originally proposed was considered unsafe when flying near stall speed by W. Carter Crabbe Aviation, as well as discussions with other pilots. A benefit of the 152-meter (500-foot) survey altitude is that the entire vertical plane of the WTG's rotor-swept zone (40–120 meters) could be examined. A higher altitude also reduces the possibility of flushing birds to another part of the Bay and potentially recounting the birds in a subsequent transect.

Each observer recorded bird observations within 200 meters (656 feet) on either side of the airplane, for a total transect width of 400 meters (1,312 feet) (see Figure 3.1-4). The 400-meter survey width covered approximately 20% of the total study area, and was generally consistent with survey widths used in other aerial surveys (e.g., Camphuysen et al., 2004; ESS, 2007; Paton et al., 2010; Perkins et al., 2004a; Perkins et al., 2004b; Sadoti et al., 2005a; Sadoti et al., 2005b; USACE, 2004). The total transect width does not include the approximately 176 meters (578 feet) directly under the airplane, which are not visible to observers (see Figure 3.1-4). The area sampled in the first two spring surveys (spring 2011) was 14 square kilometers (5.4 square miles). Because of the change in the offshore WTG turbine location from south to north of Cape Charles Harbor, the area surveyed was subsequently increased to 24 square kilometers (9.3 square miles) with the addition of two northern transects and the lengthening of the first five original transects.

As the airplane flies along the predefined transect, each observer counts observations viewed through the window. Observations are made by the unaided eye during the quantitative portion of the survey. However, binoculars are available for qualitative observations of human and avian activity in or near the study area. Observations are recorded using digital voice recorders with noise-canceling microphones. All waterfowl and seabirds observed along each transect are

[5] Guidelines and protocols reviewed in the preparation of the protocol include those by ESS and MassAudubon for the Cape Wind Energy Project, the New Jersey Department of Environmental Protection, those developed in the United Kingdom by the Collaborative Offshore Wind Research Into The Environment (COWRIE), and survey methods used by the University of Rhode Island for the preparation of the Ocean Special Area Management Plan (Camphuysen et al. 2004; ESS Group 2007; Paton et al. 2010; Perkins et al. 2004a; Perkins et al. 2004b; Sadoti et al. 2005a; Sadoti et al. 2005b; USACE 2004) and proposed requirements under the Virginia Permit by Rule.

counted and identified to species level when possible and the time of each observation was noted (to the nearest second). A general description of behavior (feeding, flying, resting on water, etc.) is also recorded. Weather conditions (ambient temperature, wind direction, wind speed, percent cloud cover and visibility) and sea state during the aerial survey are derived from the nearest operating weather station for each survey event.

At the completion of the survey, data are downloaded from the voice recorders and GPS unit for further analyses. Each observation recorded in the voice recorder was linked to its GPS position using the time stamp on the voice recording with the time stamp downloaded from the GPS unit.

Summary of Findings To Date

Five aerial surveys of bird activity in the study area were conducted, including two late spring and three fall surveys. The total number of birds observed during the surveys was 1208. The most abundant species surveyed was Long-tailed Duck, which accounted for 34.7% of all observations, (Table 3.1-2). This species was observed on the water in large congregations of somewhat dispersed small groups (typically fewer than ten birds each). Herring Gull was the second most abundant species observed during the 2011 surveys, comprising 32% of total observations. Although usually occurring singly or in small groups, a congregation of over 100 Herring Gulls was observed following a fishing boat on one occasion. Scoters (including Surf Scoter and Scoter sp. observations) were the third most frequently observed bird, making up 10.4% of observations and were usually observed sitting on the water. Northern Gannet and Common Eider were also observed in relative abundance during the aerial surveys, accounting for 5.9% and 4.3% of observations, respectively. Northern Gannet was usually seen flying singly or in small groups while Common Eider was typically observed sitting on the water in small groups.

Herring Gull and Great Black-backed Gull were the only species observed during all five surveys. Cormorants (including Double-crested Cormorant and Cormorant sp. observations) were also regularly observed, appearing during four of the five aerial surveys. Northern Gannet and tern sp. were the only other species observed during three or more surveys. Although Long-tailed Duck and Scoters were among the most abundant species observed during the aerial surveys, these species were only observed during the two surveys conducted in December.

Table 3.1-2 Bird Species Observed during the 2011 Aerial Surveys

Species	Number Observed	Percent of Total	Number of Surveys where Species Was Observed
Long-tailed Duck	419	34.7	2
Herring Gull	386	32.0	5
Surf Scoter	75	6.2	2
Northern Gannet	71	5.9	3
Common Eider	52	4.3	1
Scoter sp.	51	4.2	2
Duck sp.	41	3.4	2
Great Black-backed Gull	30	2.5	5
Cormorant sp.	19	1.6	3
Small duck sp.	19	1.6	1
Laughing Gull	15	1.2	2

Species	Number Observed	Percent of Total	Number of Surveys where Species Was Observed
Ring-billed Gull	14	1.2	2
Tern sp.	4	0.3	3
Red-breasted Merganser	4	0.3	1
Mallard	3	0.2	1
Brown Pelican	2	0.2	1
Double-crested Cormorant	1	0.1	1
Gull sp.	1	0.1	1
Small gull sp.	1	0.1	1

Canada Goose and Osprey were also observed flying over the Project Area but after the survey period had ended. Several additional avian species were observed in habitats located outside of, but adjacent to, the survey area. Among these, Bald Eagle, Turkey Vulture, Black Vulture, and Crow sp. were observed flying over land (the Delmarva Peninsula). Bufflehead and Scaup sp. were observed flying near the mouth of a tidal creek near shore. Mallard and Canada Goose were observed sitting on the water in tidal creeks and small sandpipers (peeps) were observed foraging on an exposed sandbar near shore.

Land Based Surveys

The CCB is presently conducting ongoing visual surveys for waterbirds from the shoreline near the mouth of Plantation Creek between September 2011and May 2012 to observe the fall, winter and spring migrations. Qualified bird observers are positioned on a platform, approximately 5-meters in the air, along the shoreline facing west toward the proposed location of the G11X.

All observations begin at sunrise and continue for at least 6 hours. Two observers are stationed at the observation point, one records data and the other observer dictates birds observed through a Leica scope. Observers switch between recording and observing several times per day. A total of 4 count days are performed out of an 8 count day period. The general weather conditions are recorded every hour, including wind speed, direction, temperature, cloud cover, visibility, and precipitation. The time of day is recorded for each individual sighting.

The distance of birds from the observation point are estimated between five bins: between 0 and 500 meters, 501 and 1000 meters, 1001 and 2000 meters, 2001 meters and 3.6 kilometers, and greater than 3.6 kilometers. A line of marker floats are placed at 500 meters, 1000 meters, 2 meters, and a shipping can buoy is at 3.6 kilometers. The marker buoys are anchored with 100-pound weights to reduce movement in storms. Buoy location has been checked several times through the season, and they have not moved.

Height of birds is estimated in five zones: sitting on the water, less than 10 meters off the water, 11 to 30 meters, 30 to 220 meters (potential Rotor Swept Zone), and greater than 220 meters above the water. Birds are averaged into a height zone if moving in a flock. The actual height of a subsample of birds flying through the closest two zones is recorded by using a Leica 1500-meter range finder and also recording the angle. This subsample will be used to show observer error in estimating height off of water. Birds are recorded as flying north or south or in “no general direction” if feeding. Only birds passing through the line of buoys are recorded. All birds are recorded to the species level when possible, and to the family level when not possible (i.e., duck species, loon species, passerine species).

Although the fall observation season has recently been completed, results of the land based survey are not yet available. An avian assessment report, including the results of the aerial survey and the land based survey will be provided as a supplemental submission to the Joint Permit Application.

3.1.1.2 Bats

State and federal agency data sources where queried to determine the bat species that are most likely to occur on the land near the proposed location for the G11X. Table 3.1-3 identifies the ten bat species that result from these database queries (USFWS, 2012; VADCR, 2012; DGIF, 2012). This species list contains cave-dwelling and tree-dwelling bats. None of these bat species is listed by state or federal endangered species programs (USFWS, 2012).

Table 3.1-3 List of Bat Species Known to Occur on Land near the Project Area

Common Name	Scientific Name
Big brown bat	*Eptesicus fuscus*
Little brown bat	*Myotis lucifugus*
Northern myotis	*Myotis septentrionalis*
Eastern pipistrelle	*Perimyotis subflavus*
Silver-haired bat	*Lasionycteris noctivagans*
Eastern red bat	*Lasiurus borealis*
Hoary bat	*Lasiurus cinereus*
Seminole bat	*Lasiurus seminolus*
Evening bat	*Nycticeius humeralis*
Northern yellow bat	*Lasiurus intermedius*

Recent studies of offshore bat movements reviewed for the purposes of this application, report that remote sensing techniques (i.e. Anabat detectors) have recorded bats flying over the ocean off of Maryland, New Jersey, New York and Rhode Island (NJDEP, 2010; Sjollema, et al., 2009). However, these studies provide little or no evidence about bat occurrences over estuaries or bays such as the Chesapeake Bay. In fact, these two regional studies hypothesize that over-ocean bat movements are migratory in nature as opposed to foraging behavior (NJDEP, 2010; Sjollema, et al., 2009). These findings may suggest that over-water bat movements would more likely result from migratory bats flying over the Atlantic Ocean and not the Chesapeake Bay, as no data supports bat foraging or migrating in the vicinity of G11X at this time.

3.1.2 Environmental Effects and Mitigation

Potential impacts to avian populations found in the vicinity of the project will primarily be limited to the operation of the WTG over time. Pre-construction, construction and decommissioning activities associated with the G11X and submarine cable may temporarily displace birds and bats and will be dependent upon the season. Similarly, all phases (pre-construction, construction, operation, decommissioning) of the upland electrical interconnection system are expected to have negligible or no effect on avian and bat resources in the Project Area as disturbances from onshore construction activities are expected to be temporary and localized and within developed areas already used for commercial/industrial operations. The installation and operation of the offshore wind turbine will have no direct impacts to bird and bat nesting, staging, or roosting habitat. The primary risk of impacts to birds and bats is from direct collision with the G11X nacelle, blades or Tower. Collisions, particularly during foul weather conditions of low visibility for birds are considered to be the most likely cause of death and injury as a result of operational wind turbines. Bats may collide with turbines and spinning rotors cause pressure gradients in proximity to the rotor, which is believed to cause barotraumas (Baerwald et al., 2008, GAO, 2005, Kunz et al., 2007, NRC, 2007, and Arnett et al., 2008).

3.1.2.1 Avian Resources

A preliminary assessment of potential impacts was conducted for both migratory and breeding populations of passerines, raptors, waterfowl, shorebirds, and wading birds. The potential for displacement or collision of these types of birds during various phases of the project was considered. Literature reviews served as the primary basis for this evaluation. Also, Gamesa is conducting voluntary aerial and land-based avian surveys in the Project Area to gain a better understanding of species utilization and seasonal activities in the project area as a precautionary measure. Based on studies and surveys completed to date, it is anticipated that the G11X Prototype WTG effects on avian species are as follows.

- Depending on the time of year for installation of the WTG, construction of the project may result in some short-term, localized displacement of birds. Upland and offshore construction activities may result in some birds being scared off by the use of equipment and human activities, in general, but this already occurs due to the developed nature of Cape Charles Harbor and marine activities that occur daily in this area. The submarine cable landfall location and upland electric transmission cable route is located in a heavily industrialized area that is active year round; Gamesa construction activities will be limited to only a few weeks during the year; there are no documented nesting sites near the proposed upland electrical cable route, so no temporary or permanent impacts on breeding birds are anticipated.

- Migratory birds may have some risk of colliding with the offshore G11X WTG depending on their flight path during migration. However, the areas of the Delmarva Peninsula reported as important migratory staging areas and bottlenecks are located 2 to 6 miles or more to the east of the proposed WTG location. Exact movements of migrants within the region are not well understood. Raptors and passerines are generally thought to be associated with staging areas that provide roosting and foraging habitat. None of these habitats correspond to the immediate surroundings of the proposed location for the G11X.

- Breeding birds are at low risk of collision with the G11X since no shorebird breeding colony or prime nesting habitat is adjacent to the proposed offshore location of the G11X. The potential for impacts to birds during the breeding season arises from collisions during transit flights or foraging activity. The shoreline of the Chesapeake Bay adjacent to the proposed location for the G11X is heavily developed and predominated by industrial, commercial, and residential land uses. There are no documented nesting and staging areas along the shoreline adjacent to the proposed location for the G11X thus minimizing the chance for congregations of birds in the area.

- Minimal impacts to state or federally listed species are anticipated due to the project being a single WTG and the USFWS does not have any records of federally listed avian species occurring in the Project Area (USFWS, 2011). Similarly, the VADCR's Natural Heritage

Program also reported that it does not have any records of rare, threatened or endangered avian species near the proposed offshore WTG location (VADCR, 2011b).

- The project consists of a single turbine and therefore any impacts due to avian collisions are not anticipated to be biologically significant.

3.1.2.2 Bat Resources

Much of what is known about the negative impacts on bats due to WTG impacts comes from post-construction surveys where bat mortality at certain locations have been documented. However, bat behavior, migration patterns, and density levels are likely to be very different over water than over land and ridge tops where post construction bat surveys have occurred. The evaluation of potential Project impacts to bats used existing bat impact studies as a basis for analysis. There are several small upland wind energy projects that are located on the Atlantic Coast that offer some perspective on potential bat impacts based on post-construction monitoring studies.

Mortality studies at land based turbines have shown tree-dwelling species, including hoary bat, eastern red bat and silver-haired bat, have died from collisions with WTGs more than their cave-dwelling relatives (Johnson, 2005; Cryan and Barclay, 2009). This occurrence seems to align with another observation that bat species with the propensity for long-distance latitudinal migration have historically interacted with wind turbines more than non-migratory species (Cryan and Barclay, 2009). With respect to bat species found on upland areas in coastal environments, post-construction wildlife monitoring at the Atlantic City Utilities Authority Jersey Atlantic Wind Power Facility found some mortality for two species of bats – hoary and eastern red – from the areas around the WTGs. (NJAS, 2008).

There is no known data on bats utilizing the airspace above the Chesapeake Bay where the G11X WTG will be located. Studies of offshore bat movements along the Mid-Atlatnic suggest that bats could be present in offshore areas where WTGs might be sited but these studies say nothing about bat movements over estuaries and bays like Chesapeake Bay, for example (NJDEP, 2010; Sjollema, et al., 2009). Due to the single G11X turbine, significant impacts are not anticipated. No direct impacts to bat habitat are expected from the construction and decommission of the G11X and associated electrical export cable system. Much of the proposed facilities are located offshore and the relatively small upland electrical components will be underground and located on previously developed industrial use land.

3.1.2.3 Mitigation

No project-specific mitigation measures are being proposed at this time for avian resources due to the negligible impacts to avian resources anticipated. Similarly, no project-specific mitigation measures are being proposed at this time for bats due to the negligible impacts to bat resources anticipated.

3.2 Wetlands and Subaqueous Land

3.2.1 Existing Conditions

The digital National Wetlands Inventory mapping (USFWS, 2011a) was reviewed to determine the extent of any jurisdictional wetland resource areas in the Project Area (Figure 3.2-1). The G11X foundation system and submarine cable will be installed in the seabed of Chesapeake Bay. Chesapeake Bay is mapped as an estuarine, subtidal deepwater habitat with an unconsolidated bottom (E1UBL) according to the Cowardin classification system.

The upland portion of the electric export cable route is located within a previously developed, existing railroad ROW. The upland cable route does not cross any mapped National Wetlands Inventory wetlands (Figure 3.2-1).The closest mapped National Wetlands Inventory wetland to the Project Area is a palustrine, unconsolidated shore wetland (PUSKCh) located approximately 200 feet to the east of the substation easement as shown in Figure 3.2-1.

The proposed location for the G11X and submarine cable route are not located within any wetlands, open water, or streams that are subject to a deed restriction, conservation easement, restrictive covenant, or other land-use protective instrument.

3.2.2 Environmental Effects and Mitigation

Approximately 215 square feet of seabed will be permanently altered for the installation of the monopile foundation. Although seabed habitat will be eliminated within this footprint of the monopile foundation, given the very small size of the impacted area, impacts to seabed marine life are negligible. Approximately 16,240 square feet of seabed at the base of the monopile foundation will be permanently altered by the installation of rock armoring for scour protection. This area will be transformed from a sandy, flat benthic habitat to a raised hard bottom feature, capable of supporting a wide array of marine and estuarine life.

An area of seabed 3.2 miles long and 2 to 4 feet wide will be temporarily altered by hydraulic jetting during the installation of the submarine cable. Temporarily altered bay bottom areas are expected to fully recover, shortly after jetting is complete, and provide equally productive habitat as before the submarine cable was installed.

In the vicinity of the landfall, approximately 150 square feet of the harbor immediately seaward of the existing bulkhead will be filled so as to allow the installation of a new steel bulkhead. There will be no impacts to wetlands along the upland portion of the transmission cable, therefore, no wetland mitigation is required.

3.3 Geologic Conditions

3.3.1 Existing Conditions

3.3.1.1 Regional Geology

Cape Charles is located along the western shore of the Delmarva Peninsula, within the southeastern portion of the Virginia Coastal Plain. The entire series of coastal plain deposits in this region are considered part of the Chesapeake Group, which occupies the same general stratigraphic horizons from Delaware to Florida. Underlying any thin veneer of recent marine deposits (Holocene sands) in this portion of the Bay (absent in many places) is the Pleistocene age Nassawadox Formation, predominantly composed of poorly sorted fine to coarse sand (yellow to tan color) and pebbles with some organics and shell fragments (Gohn et al., 2007). Grain size commonly increases with depth to very coarse sand and pebbles at the base of the section. Nassawadox deposits are considered part of the southward prograding barrier spit complex of sands that formed the southern extension of the Delmarva Peninsula. This formation is underlain by dense, dark greenish-grey sands of the upper Yorktown Formation (Chowan River) which contains high concentrations of shell material locally, derived from fossil bivalves, gastropods, echinoids, and other species throughout the formation (Ward, 1988). Some of the shell-rich beds become very compact and even cemented over time. Deposits of the Yorktown Formation are believed to represent multiple marine transgressive phases during a more tropical paleoclimatic period of the mid-late Pliocene (Dowsett and Wiggs, 1992). The Miocene age Eastover Formation underlies the Yorktown deposits and is typically comprised of well sorted very fine to fine sand with variable amounts of silt and shells (Gohn et al., 2007). Eastover deposits are also considered to represent sediments that accumulated in a former marine environment.

Modern day coastal processes continue to redistribute materials on the Bay floor. Net transport of material is believed to be west-northwesterly into the Bay, developing a Holocene sand sheet that is prograding bayward and filling the estuary.

The southern half of the Delmarva Peninsula (including Cape Charles), the southern portion of Chesapeake Bay and the adjacent mainland immediately to the west of the Bay lie within the inner rim of the much larger Chesapeake Bay Impact Crater, formed approximately 35 million years ago when a comet/meteorite hit the area (Poag, 1997).

At the time of impact, the lower part of the crater filled immediately with breccia comprised of broken granitic basement and rocks metamorphosed by forces from the impact. Over the subsequent 35 million years, the crater was slowly filled and then buried by coastal plain sediments eroding off the continent from the Appalachian Mountains to the west.

Although the impact crater is now buried by over 1,000 feet of soft sediments, differential subsidence of the breccia and overlying unconsolidated sands, silts, clays, and shell hash is believed to have caused the compaction faults identified in Chesapeake Bay by the USGS (Gohn et al., 2007). Some of these faults are interpreted as extending to within 10 meters of the bay bottom (Poag, 1997). The USGS is currently conducting more detailed studies of the location, orientation and displacement of these compaction faults.

Chesapeake Bay, and particularly in the Project area, contains buried or naturally deep remnants of ancient riverbeds and channels, called paleochannels, incised into former land surfaces that were exposed during sea level low stands, with some filled with sediments during repeated marine transgressions. The Delmarva Peninsula itself prograded to the south, as riverine and estuarine sediments were deposited on the Bay side and nearshore marine sediments transported south by longshore currents were deposited on the Atlantic Ocean side (Hobbs, 2004).

In general, the seabed and subsurface sediments found at the Chesapeake Bay side of the lower Delmarva Peninsula, and at the proposed location of the G11X offshore WTG, are comprised predominantly of unconsolidated compacted sands and silts that have been deposited in this area of the Bay during its recent geologic history (last 10,000 years). The geologic formations at and surrounding the selected site location were found to be optimal for monopile installation and supporting the structural loads of the G11X prototype WTG. These subsurface sediment types are also optimal for hydraulic jetting of the submarine cable system, to be installed 6 feet BPB.

3.3.1.2 Marine G&G Field Investigations

A multi-phase marine remote sensing geophysical investigation and shallow and deep sediment geotechnical investigations were conducted for the Project during 2011. The purposes of these field studies were to 1) characterize the bottom conditions and subsurface geology within the offshore construction footprint of the Project; 2) select a suitable location for the G11X and the associated submarine cable transmission line to shore based on these conditions; 3) provide geotechnical information to design engineers for structural loading analysis; and 4) use in characterizing the environmental quality and aquatic resource habitat conditions in the Project Area to support the project's regulatory permitting reviews. These studies are summarized below.

Marine Remote Sensing Geophysical Investigations

The in-water construction area around the proposed location for the G11X and its submarine cable route (see Figure 3.3-1) were surveyed using remote sensing geophysical equipment in 2011, to provide detailed information about water depths, and seafloor and subsurface geologic conditions. Parallel geophysical survey tracklines spaced at approximately 50 feet were run within a 2-nautical mile by 0.4-nautical mile rectangular area oriented northwest-southeast and centered on the proposed location for the G11X. Along the proposed submarine cable route, nine survey tracklines, also spaced at approximately 50 feet apart, were run along and parallel to the centerline, resulting in a complete survey of a 400-foot wide cable-area corridor. Intermittent tie-lines were run perpendicular to the parallel survey lines, to provide control.

Remote sensing survey equipment used during the investigation included:

- A multi-beam hydrographic digital depth sounder to determine existing site area bathymetry;
- A high resolution side-scan sonar to assess seabed surface conditions, seabed morphology and to detect the presence of natural or man-made obstructions at proposed work areas;
- A “chirp” (high frequency) subbottom profiler to evaluate shallow subsurface geology, stratigraphy and potential for submerged obstructions;
- A “boomer” (low frequency) subbottom profiler to evaluate deeper subsurface geology, stratigraphy and potential for submerged obstructions (only for the WTG siting areas); and
- And a marine magnetometer to identify the presence or lack of presence of surface or submerged ferrous materials or objects that may either create an obstruction to the advancement of installation or that may have cultural/historical significance.

Hydrographic, side-scan sonar, and magnetometer data were acquired concurrently along all survey tracklines. The high frequency “chirp” subbottom profiler and the low frequency “boomer” subbottom profiler were run simultaneously on every other trackline, spaced at 100 feet. The survey vessels were equipped with highly accurate vessel positioning equipment that provided sub-meter accuracy for survey efforts and special software that provided real-time survey trackline control digital data recording, and position interfaces for all equipment systems. The information was post-processed in the lab and interpreted by experienced marine geologists familiar with local geologic conditions in the survey area. The geophysical data was also provided to the Project’s marine archeologist consultant to determine the presence or absence of submerged structures found in the survey areas that may have cultural/historical significance.

Marine Shallow Subsurface Geotechnical Investigations

Following review of the geophysical data, shallow subsurface marine geotechnical investigations were conducted to collect *in situ* sediment samples via vibracoring for various types of sediment and thermal analyses (see Figure 3.3-2). These vibracores were also used to ground truth remote sensing interpretations of shallow subsurface geology (minus 10 feet BPB) along the submarine electric export cable route. Benthic surface grab samples were also collected at each vibracore location to characterize the seabed’s biological attributes and conditions in the Project Area (see Section 3.8). Sediment cores (a.k.a. vibracores) were advanced to target depths of 10 feet below the bay bottom at 19 locations spaced at approximately 0.25-mile intervals along the proposed submarine cable route. One vibracore was advanced at the proposed location of the G11X WTG site for interconnection purposes. Jet probes (hydraulic hand-held pipe probes) were also advanced along the submarine cable route at 24 selected locations to assess the presence for potential subsurface obstructions identified along the proposed route.

Sediments samples retrieved from the split and logged vibracores were then analyzed to assess the bulk physical and chemical characteristics of shallow sediments along the cable route. The vibracores were split onshore and the sediments were photographed and field-logged using the Unified Soils Classification system, with particular attention noted to stratigraphic and grain size changes downcore.

Marine Deep Geotechnical Investigation

Three deep test borings were advanced at and around the proposed location for the G11X WTG, to total depths of between 162 and 175 feet BPB (see Figure 3.3-3). The purpose of these deep borings is to confirm seismic interpretations of deeper sediments as well as provide required geotechnical soils information to validate structural loading capacities of the subsurface soils to accommodate the monopile foundation and its WTG components for structural stability. These borings confirmed acceptable load bearing capacity for the G11X WTG construction and operation.

In addition to traditional downcore split spoon samples, *in situ* cone penetrometer probes were advanced to similar subsurface depths to compare *in situ* versus ex situ soil characteristics at the WTG site (see Figure 3.3-3). This data correlated quite well with the split spoon sample analysis, and results indicate suitable structural capacity for the monopile foundation at the proposed offshore location.

3.3.1.3 Site-Specific Marine Geology

WTG Site Area

The proposed WTG site area is located north and west of the Cherrystone Inlet channel leading into Cape Charles Harbor. The water depth at the proposed WTG location is 50 feet below the North American Vertical Datum of 1988 (NAVD88), see Figure 3.3-1. In this portion of Chesapeake Bay, the NAVD88 vertical reference datum is 1.71 feet above the MLLW datum based on tidal staging data provided by NOAA, which means that 50 feet below NAVD88 is equal to 48.29 feet below MLLW.

This site area is best characterized as a gently sloping shoal (depositional platform) flanked to the west by a deeper incised natural channel formed at lower stands of sea level as part of the ancient Susquehanna River (paleochannel) ultimately draining into the Atlantic Ocean. Field studies show that the bay bottom at and surrounding the WTG site location is generally flat, sandy and featureless in terms of seabed conditions; all ideal for siting the WTG foundation and associated offshore structures.

Areas of mobile bed conditions (sand waves) were observed in the field investigations both north and south of the proposed WTG site, indicating more active sediment transport conditions compared to the area where the WTG will be sited. Surveys showed that the bedforms in this surrounding area exhibit wavelengths of 100 to 200 feet, with vertical relief (peak to trough) of 2 to 4 feet. These sandwaves were found to occur on the seabed primarily at water depths from about 20 to 45 feet. Some broader sand waves were observed at water depths of about 50 feet, The WTG was deliberately sited in areas with no sand waves, to minimize the risk of mobile sediment conditions in order to minimize the potential for scour at the base of the monopile foundation.

The subsurface geology within the upper 200 feet of seabed in the vicinity of the proposed location for the G11X, was first investigated during the shipboard remote sensing geophysical survey using shallow- (chirp) and medium-penetration (boomer) subbottom profilers. The medium penetration subbottom profiling data indicate that the subsurface geology in the WTG siting area consist of five distinct stratigraphic units (see Figure 3.3-4). The orientation of the surficial layer appears to mimic the natural slope of the present bay bottom, while the other 4 stratigraphic layers appear to be more horizontal, indicative of more compacted older sand deposits from natural processes. The deep geotechnical borings found fine to coarse sand, with occasional interbedded shell hash layers (shallow marine deposits) all the way to the target penetration depth of 165 feet BPB.

Submarine Cable Route

Water depths along the submarine cable route range from 50 feet below NAVD88 at the proposed location for the G11X to a minimum of approximately 3 to 5 feet in certain shoal areas along the route outside of Cape Charles Harbor. The Cape Charles Harbor Basin is a man-made harbor that was extensively dredged out of upland coastal plain sediments in the late 1800's to support commercial barge traffic and ferry service between Cape Charles/Virginia Eastern Shore and other ports of call within Chesapeake Bay, primarily Hampton Roads, prior to the existence of the Chesapeake Bay Bridge Tunnel. As a result of this dredging, water depths along the proposed submarine cable route within Cape Charles Harbor range from 16 to 19 feet below NAVD88.

The seabed surficial geology of the submarine cable route from the WTG to just outside Cape Charles Harbor can best be characterized as a thin veneer of less consolidated Holocene sands overlying more compacted and much older Pleistocene sands (see Figure 3.3-5). Surface sediments approaching the Cape Charles Harbor breakwater are classified almost entirely as unconsolidated sands with lesser amounts of gravel, typical of fastland erosion and offshore deposition with localized reworking by tides and currents. Sediments located in shallow areas (shoals) are also more compact in waters less than 10 feet deep as a result of constant wave and tidal action. These sediments are also characterized as predominantly sand-sized sediments with discontinuous interbedded layers of shells, shell hash and coral fragments indicative of ancient and more modern marine sedimentary deposits, very typical of the lower Chesapeake Bay environments.

Surficial sediments and sediments on the harbor bottom within the Cape Charles Harbor submarine cable route were found to be generally finer grained silts and clays with some sand depending on location in the basin (see Figure 3.3-5). This is attributed to the likelihood that because the harbor basin is deeper than the surrounding outer harbor area shoals it serves as a sediment sink for finer grained sediments in the water column settling out into deeper waters. This depositional environment is also related to the reduced wave and current energies found outside the harbor due to the presence of the existing breakwater and a more narrow inlet to the harbor basin.

Upland Cable Route

Once the submarine cable makes landfall in Cape Charles Harbor, it will transition to an underground upland cable system that will be a direct burial duct bank arrangement in soils within Gamesa's ROW on private property until it interconnects with the existing public overhead transmission lines. Historic land development within the harbor and within the ROW have altered native soil conditions due to anthropogenic activities that have occurred in this location since the late 1800's. Although the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) Soils classifies the soils along the proposed upland cable route as Bojac fine sandy loams. The upland cable route is sited adjacent and along an existing historic railroad ROW with an existing active railbed and therefore it is highly likely that excavation activities to install the underground electric cable will encounter historic man-made fill material, rather than native soils along the proposed upland cable route.

3.3.1.4 Sedimentation/Sediment Transport

Sedimentation rates and sediment transport depend on a number of factors, including current velocity, the size of suspended particles, and water depth. Sedimentation rates in the offshore Project Area have been estimated at approximately 4.4 millimters per year (CBP, 2000).

It is estimated that 8.5 million metric tons of sediment enter Chesapeake Bay on an annual basis. Of these 8.5 million metric tons, the vast majority (61%) comes from watershed sources. The remainder of the sediment load has been linked to tidal erosion (26%) and oceanic input (13%) (CBP, 2006; USGS, 2003).

Once the sediment enters the bay, there is a net southward flow extending to the Atlantic Ocean. Estuarine Turbidity Maxima (ETM) Zones or regions where fine grained sediments are trapped, deposited and potentially re-suspended are located within most of the major tributaries of the Bay. Within these zones, higher rates of turbidity and sediment deposition can be expected. The Bay's main ETM zone is located north of Baltimore, where sediment inputs from the Susquehanna River are largely contained (CBP, 2000). The spatial extent of these ETM zones appears to be regulated by the limits of saltwater intrusions within the Bay and its tributaries (USGS, 2003). The proposed Project Area is not located within one of the ETM zones.

The WTG site has been sited in a fairly stable offshore environment that is subject to wave and tidal action. This wave and tidal action may rework surface sediment supplied by oceanic inputs and recent and continued erosion of adjacent fastland which is deposited offshore until it reaches deeper waters where tides and currents have little effect on transport.

3.3.2 Environmental Effects and Mitigation

Potential Project impacts related to geology, sediments and soils will be related primarily to temporary disturbance of predominantly sand-sized marine sediments and upland soils during construction. Water Quality and Turbidity modeling conducted for the proposed project indicates that the impacts include minimum suspension and redistribution of marine sediments during embedment of the submarine cable, driving of the WTG monopile, and placement of riprap scour protection at the base of the monopile.

A sediment suspension, transport and deposition model (SSFATE) approved by the U.S. Environmental Protection Agency was used to predict relative localized turbidity, residence time (suspended sediment), and resultant transport and thickness of re-deposition associated with installation of the submarine cable system from the WTG location to the proposed landfall in Cape Charles Harbor. The SSFATE model predicts the deposition of suspended sediment resulting from cable installation by hydraulic jetting. The SSFATE model has been utilized to predict sediment fate and transport effects for several similar project characterizations for submarine cable installation and has been found to generally over-predict anticipated effects based on subsequent water quality monitoring of total suspended solids (TSS) and other parameters during cable installation activities. It is a well proven predictive model and its results have been accepted by many state and federal permitting agencies for similar projects along the East Coast.

Results of the sediment dispersion analysis predict that sediment suspension and deposition related to hydraulic jetting activities for the submarine cable along the proposed route will be temporary and localized. Figure 3.3-6 depicts the cumulative sediment deposition thickness predicted by the SSFATE model.

Results of the sediment dispersion analysis predict that indirect impacts from installation of the Submarine Transmission Cable will consist of a temporary and localized increase in suspended sediment concentrations in the water column in the areas immediately adjacent to the jetted area along the proposed route.

Instantaneous suspended sediment concentrations predicted by SSFATE from an operating jetting device at two representative locations (inside/outside harbor) along the proposed cable route are provided in Figures 3.3-7 and 3.3-8 to illustrate predicted lateral extent of suspended sediment concentrations resulting from installation of the submarine cable using hydraulic jetting. Within the Cape Charles Harbor Basin, the suspended sediment transport plume with a concentration greater than 40 milligrams per liter (mg/L) is predicted to cover an area of 1.1 acres, and extend laterally approximately 65 meters (213 feet) away from the jetting device (Figure 3.3-7). A typical location along the cable route, outside the harbor basin is predicted to have a suspended sediment transport plume with a concentration greater than 40 mg/L covering an area of 0.3 acres of seabed and extend approximately 75 meters (264 feet) laterally from the operating jetting device (Figure 3.3-8).

The model also predicted the maximum TSS water column concentrations expected to occur during jetting of the cable trench at any time during the jetting process over the entire cable route. The suspended sediment plume with a concentration greater than 100 mg/L predicted to extend a maximum lateral distance from the cable route of 50 meters (164 feet). The SSFATE model also predicts that the greater than 100 mg/L suspended sediment concentration level will extend through the water column to the surface at a handful of locations along the eastern half of the route where water is shallow and/or current speeds are low, particularly within Cape Charles Harbor. Along the west half of the proposed route, the highest suspended sediment concentrations (greater than 100 mg/L) remain in the bottom 5 to 6 feet of the water column under all tide conditions and concentrations are predicted to decrease rapidly to approximately 10 mg/L or less approximately 10 to 14 feet above the bottom under all tide conditions.

Hydraulic jetting-induced suspended sediment concentrations from installation activities are predicted to decrease rapidly with both lateral and vertical distance from the operating jetting device. Within 100 meters (328 feet) of the jetting device (laterally) the suspended sediment concentration is predicted to be less than 200 mg/L above ambient and the mean concentration is predicted to be below 200 mg/L at a distance of approximately 30 meters (98 feet) from the jetting device.

The model also predicts that suspended sediment concentrations decrease rapidly with time as the jetting device passes a fixed point. Concentrations greater than 100 mg/L above ambient are predicted to last approximately one hour. After four hours, the suspended sediment concentration level above ambient is predicted to be below 50 mg/L and the concentration drops to less than 20 mg/L above ambient after six hours.

The results of the sediment dispersion modeling indicate that increased suspended sediment concentrations induced by jetting of the cable trench will be short in duration and concentrated toward the near-bottom portion of the water column, and that suspended sediment concentrations will return to ambient conditions within approximately 6 hours after jetting has occurred. This is primarily a result of the coarser grained subsurface sediments (sandy silts) expected to be encountered along the route.

Overall the modeling analysis predicts that resultant deposition of suspended sediment from the jetting device will occur as a continuous cover with a cumulative thickness in the range of 0.1 to 2.0 millimters located in a corridor averaging 170 meters (560 feet) in width centered on the route. An area of 54 acres (22 hectares) of bay bottom is covered by deposition greater than 2 millimters. Discontinuous patches of sediment deposition greater than 3 millimters thick occur along the jetted trench. At the end of the simulation period (4 days), all of the sand size particles are predicted to be deposited on the bottom. Figure 3.3-6 shows the area of the bay bottom that will be covered by the deposit of sediment suspended by the embedment of the cable.

A scour protection system has been designed to mitigate the potential for scour at the base of the G11X foundation (see Section 1.3.2).

During upland construction, potential erosion of soils and siltation may affect nearby water bodies. Best Management Practices will be utilized in accordance with the Virginia Erosion and Sediment Control Handbook, 3rd Edition (1992) during construction to avoid or reduce these impacts. These measures will be fully detailed in an Erosion and Sedimentation Control and Stormwater Management Plan, which will be prepared once final design has been completed. Project design and construction will be conducted in accordance with applicable engineering and building standards, Best Management Practices and regulatory requirements. Compliance will be overseen by an environmental inspector.

3.4 Physical Oceanography

3.4.1 Existing Conditions

3.4.1.1 Wind

According to wind resource maps depicting the nearshore waters of Virginia's Eastern Shore, wind speeds at a height of 50 meters aloft range between 7.0 and 7.5 m/s (15.7 and 16.8 mph) (NREL, 2003) and at 90 meters range between 7.5 and 8.0 m/s or 16.8 and 17.9 mph (NREL, 2010). Between November and April, strong coastal storms can generate winds ranging from 30-50 knots out of the Northeast throughout Chesapeake Bay. Similarly, strong cold fronts from the west can generate gusts of 13 to 23 m/s (29 to 51 mph) during this same timeframe (NOAA, 2011). Early spring cold fronts can result in storms producing winds of 5 to 15 m/s (11 to 34), with gale force gusts. More severe thunder storms in later spring and summer months typically develop over the western portions of the Bay and move to the northeast at speeds of 13 to 18 m/s (29 to 40) (NOAA, 2011). Hurricanes are most likely to occur in this region during August and September.

3.4.1.2 Waves

Wave and rough water conditions within the confines of Chesapeake Bay are usually generated by strong coastal storms and cold fronts between November and April of each year. Within Chesapeake Bay, seas of 8 feet or more are present approximately 2 to 4 % of this timeframe. Generally higher wave heights are seen in the open stretches of the Bay, and smaller wave heights of 5 to 7 feet are seen in the southern portions (NOAA, 2011).

3.4.1.3 Currents/Tides

Tidal conditions within Chesapeake Bay are defined as semi-diurnal, meaning that there are two high and two low tides of unequal heights every 24 hours. In the vicinity of Cape Charles, these tides have a mean range of approximately 2.4 feet (NOAA, 2011). NOAA Tidal Station Kiptopeke, located approximate 6.8 miles south of the Project Area have a recorded mean tidal range of approximately 2.6 feet (NOAA, 2011).

Average currents at the mouth of Chesapeake Bay are known to be approximately 1.0 knots on a flood tide and 1.5 knots on an ebb tide, indicating a slightly ebb dominated tidal cycle. Average current velocities approximately 0.5 miles south of the Cape Charles City Entrance Light 1 are approximately 1.3 knots (NOAA, 2011). No NOAA Current Stations are currently located in the vicinity of the Project Area. In the upper portions of Chesapeake Bay, freshwater inputs such as the Susquehanna River are known to have a significant role in current regimes. However, within the lower portions of Chesapeake Bay where the Project Area is located, tidal currents are the prevailing factor controlling estuarine hydrodynamics (ASA, 2011).

In order to ascertain more detailed site-specific measurements of waves and currents in the vicinity of the Project Area, an Acoustic Wave and Current profiling device was deployed on September 24, 2011 and will remain on station until at least March of 2012. This system allows for site-specific monitoring of hydrodynamic conditions within the Project Area, and will allow for more detailed project design and impact assessment. The data has been used by Project engineers to validate assumptions made regarding hydrodynamic conditions during design of the G11X foundation system.

3.4.2 Environmental Effects and Mitigation

The installation and operation of the Project will not result in any impact to physical oceanographic conditions of the area. Similarly, the currents throughout the area will not be impacted by the Project's single monopile foundation.

Installation and operation of the Project is not expected to affect the large-scale physical oceanographic conditions in Chesapeake Bay. The hydrodynamic regime found in the Project Area is primarily driven by tides, with fresh water inputs considered to be only a minor contributing force (ASA, 2011). Small scale variations in the hydrodynamic regime in the immediate vicinity of the G11X may occur due to the presence of the foundation structure (e.g., localized eddies around the monopile), as water moves past the turbine structure, however, no far-field effects on currents are anticipated. As a result, there is a potential that scour may occur at the base of the foundation. A scour protection system has been designed (see Section 1.3.2) to minimize the potential for scour.

3.5 Air Quality

3.5.1 Existing Conditions

In accordance with the requirements of the Clean Air Act and Amendments, the U.S. Environmental Protection Agency has established National Ambient Air Quality Standards for criteria pollutants to protect public health and the environment. Currently, Virginia air quality, including the area of Eastern Virginia and Northampton County within which the Project is proposed, is in attainment for all of the criteria pollutants.

The Project is located within the PJM Interconnection electricity dispatch control region. PJM Interconnection is a federally regulated regional transmission organization that manages the high-voltage electric transmission grid, its energy distribution, and the wholesale electricity market, including the dispatch of electric generating facilities, to meet the regional and local electric load demand. The air emissions associated with the electricity produced to meet this demand is based on the electric generating resources in the region that are called upon to operate, their location, generating capacity, and fuel mix and type of generating facility Table 3.5-1 provides the average 2010 emission rates on a MW hour (MWhr) basis for three criteria pollutants, nitrogen oxides, sulfur dioxide and carbon dioxide based on the power generating facilities throughout the PJM Region that operated in the year to meet the electric supply needs and provides a baseline against which the operation of the G11X can be compared. Notwithstanding the fact that the G11X Project is a demonstration project for new, more efficient wind energy generator, it will also produce energy that will be sent to the local grid to help meet the electricity use requirements, it will result in a net reduction of total emissions to local ambient air quality environment since it uses wind as its fuel with zero emissions per MWhr of power produced.

Table 3.5-1 2010 PJM Regional Emissions

Emission Type	Pounds per MWhr
Nitrogen Oxides	1.3
Sulfur Dioxide	5.2
Carbon Dioxide	1167.4

Taken from PJM Environmental Information System, 2011

3.5.2 Environmental Effects and Mitigation

The G11X will, when operating, offset an equivalent amount of existing system electric generation operating to meet the regional electric demand. Given the R&D nature of this Project, the estimated annual generation from the G11X is estimated to be 13,000 MWhr per year, based on a net capacity factor of 33% for the G11X and an assumption that the turbine will have an availability factor of 80% due to R&D nature of the operations. While the actual generating mix at any given point in time for the system will vary, the expected emission reductions resulting from the Project can be based on the average emission rates developed by PJM. Therefore, assuming the average emission rate reported by Table 3.5-1, the annual and 20 year operation emission offsets for the Project are provided in Table 3.5-2.

Table 3.5-2 Estimated Emission Offsets for the G11X WTG

Emission Type	Tons per Year	Tons over Project Lifetime (20 years)
Nitrogen Oxides	8	169
Sulfur Dioxide	34	676
Carbon Dioxide	7,588	151,762

Electricity generated by the G11X would also offset other pollutants such as particulate matter and carbon monoxide in the same way. However, PJM does not quantify the average emission rate for these pollutants. The activities associated with construction and decommissioning of the G11X will result in some level of air emissions over the Chesapeake Bay due to the use of fossil fuel (diesel and gasoline) fired mobile sources (e.g., ships, cranes and other powered construction equipment). Other construction and maintenance activities, such as welding, cleaning and degreasing, painting, temporary generators etc. may also result in minor air emissions. These mobile sources do not require federal air permits and it is recognized that these emissions will be localized, short term, temporary in nature, and unlikely to result in any appreciable air quality impacts. The temporary addition of these mobile source emissions would represent a negligible addition to the emissions from fuel powered craft that already navigate the shipping channels and elsewhere through the Chesapeake Bay.

Overall, the Project will have insignificant temporary emissions associated with the installation and long term operation of the wind turbine which are similar to current marine activities in the area and the operation of the wind turbine will produce clean renewable electric power that will offset emission of current and future fossil fuel sources thereby providing a positive and beneficial effect on local and regional air quality. Therefore no mitigation measures associated with emissions from the Project are required.

3.6 Water Quality

The offshore Project Area is located within waters classified as Estuarine Waters Class II by the Virginia State Water Control Board pursuant to regulation 9 VAC 25-260 with amendments dated January 6, 2011 (VSWCB, 2011). Estuarine Waters Class II are known to support recreational uses, estuarine and marine aquatic life, shellfish harvesting, seasonal migratory fish spawning and nursery, seasonal shallow-water SAV, open-water fish and shellfish, seasonal deep-water fish and shellfish, and seasonal deep-channel refuge.

The Chesapeake Bay watershed and open water areas are broken down by the U.S. Environmental Protection Agency's Chesapeake Bay Program into segments for water quality monitoring and modeling purposes (Figure 3.6-1). The proposed Project Area is found in segment CB7PH. Sampling station CB7.3E is located approximately 3 miles southwest of Cape Charles.

3.6.1 Existing Conditions

3.6.1.1 Salinity

Within Chesapeake Bay, salinity follows a gradient of more saline to less saline from south to north due to the salt water intrusion from the Atlantic Ocean and the freshwater inputs found within the northern bay. Salinities are polyhaline (8 to 30 parts per thousand) throughout the Project Area. Water quality monitoring data acquired from the Chesapeake Bay Program Water Quality Database shows that the Project Area experienced an average salinity of 24.7 parts per thousand during the 2010 calendar year (CBP, 2011). Salinity was highest at the bottom of the water column (26.1 parts per thousand), and lowest at the surface (21.9 parts per thousand). During 2010, at station CB7.3E the lowest recorded salinity was a surface reading on February 9 of 17.98 parts per thousand and the maximum recorded salinity was a bottom reading on November 16 of 29.89 parts per thousand.

3.6.1.2 Dissolved Oxygen

While portions of Chesapeake Bay are known to experience periods of hypoxia, especially within the deeper sections of the mainstem, dissolved oxygen levels within the Project Area were reported by the Chesapeake Bay Program Water Quality Database to average 8.14 mg/L during 2010. Dissolved oxygen levels were lowest at the bottom (7.99 mg/L) and mid depth (8.08 mg/L), while the surface was highest at 9.05 mg/L. In 2010, the lowest dissolved oxygen level recorded (4.39 mg/L) was on June 2, and highest (12.91 mg/L) was recorded on February 9 (CBP, 2011). Further analysis of the Chesapeake Bay Program Water Quality Database data collected at three sampling locations off Cape Charles from 2006 to 2010 indicates that the year-round average dissolved oxygen levels in the area are between 7.00 and 9.00 mg/L. During the summer, dissolved oxygen levels generally decrease to between 4.00 and 7.00 mg/L. Dissolved oxygen levels were never found to be less than 3.00 mg/L at any point in the water column at these locations during this time period. These data suggest that the general area around the proposed Gamesa turbine location is at a low risk for anoxic events when compared to the mainstem of Chesapeake Bay.

3.6.1.3 Water Clarity and Total Suspended Solids

Water clarity in Chesapeake Bay at Station CB7.3E did not follow a seasonal trend in 2010. Secchi disk readings showed values of water clarity were lowest in January (0.8 meter) and highest values in March (2.7 meters) (CBP, 2011).

According to Chesapeake Bay Program Water Quality Database data, in 2010, TSS concentrations at Station CB7.3E ranged between 2.4 and 20.36 mg/L. TSS levels in the bottom of the water column averaged 11.6 mg/L and surface readings averaged 6.75 mg/L. The lowest

TSS value recorded during 2010 was a surface sample collected on November 16 (2.4 mg/L) (CBP, 2011).

3.6.2 Environmental Effects and Mitigation

Hydraulic jetting during submarine cable installation is generally considered to be the most technologically effective and least environmentally damaging technique for installing submarine cable systems when compared to traditional mechanical dredging and trenching. The demonstrated environmental benefit of the hydraulic jetting method as compared to other installation alternatives is that it attempts to minimize the area of direct disturbance and the amount of the suspended sediments and possible contaminants that may be introduced into the water column as a result of the installation. This is due to its time-efficient installation of cable system burial, minimum disturbance of the bay bottom, and short-term and negligible impacts to water quality.

As described in Section 3.3.2, in addition to modeling potential sedimentation impacts that may result from the Project, the sediment dispersion modeling also predicted the concentration of sediment introduced into the water column during hydraulic jetting along the proposed submarine cable route .

The results of this modeling predict that suspended sediment concentrations decrease rapidly with time as the hydraulic jetting device passes a fixed point. Concentrations greater than 100 mg/L above ambient are predicted to last approximately one hour. After four hours, the suspended sediment concentration level above ambient is predicted to be below 50 mg/L and the concentration drops to less than 20 mg/L above ambient after six hours (ASA, 2011).

The use of hydraulic jetting technology will greatly limit the amount of sediment introduced into the water column. The predicted suspended sediment concentrations will be minimal when compared with other ongoing man-made activities and natural occurrences in Chesapeake Bay. Modeling shows that hydraulic jetting induced suspended sediment concentrations are predicted to decrease rapidly and be comparable to ambient conditions approximately 6 hours after the passage of the installation device (ASA, 2011).

Overall, on the basis of these findings, the suspension of sediments induced by the operation of the hydraulic jetting device for the Project is concluded to result in localized and short-duration impacts to TSS concentrations in the Project Area, which pose a temporary and minimal risk to environmental receptors when compared with the ongoing risks posed to water quality conditions by the continuous interaction of human and natural influences on existing sediment quality conditions in the Chesapeake Bay. No impacts to salinity or dissolved oxygen within the Project Area are anticipated.

3.7 Finfish

3.7.1 Existing Conditions

3.7.1.1 Common Fish Species

The Chesapeake Bay is home to approximately 350 species of fish. Some of these fish are resident species, living in the Bay year-round, and others are migratory or seasonal species that utilize the Bay during certain times of the year to feed, reproduce or find shelter (CBP, 2009). Common fish species that can be found in the lower portion of Chesapeake Bay include: Amercian eel, American halfbeak, American shad, Atlantic croaker, Atlantic menhaden, Atlantic needlefish, Atlantic sturgeon, bay anchovy, black drum, black sea bass, blennies, bluefish, cobia, cownose ray, gobies, hickory shad, hogchoker, lined seahorse, lookdown, mackerels, northern puffer, northern stargazer, oyster toadfish, pipefish, red drum, sandbar shark, searobin, shortnose sturgeon, skilletfish, spot, spotted seatrout, sticklebacks, striped bass, summer flounder, tautog, and weakfish (CBP, 2009). A brief description of the habitat preferences and time of year that these fish species may be present in the Project Area is provided in Attachment A.

Of the species listed above, the following are resident species that are found in the Bay year-round: bay anchovy, blennies, gobies, hogchoker, lined seahorse, oyster toadfish, pipefish, skilletfish, sticklebacks, striped bass, summer flounder, and tautog. The remainder of the fish species are seasonal or migratory species that spend part of their lives in the Chesapeake Bay. Most of these species spawn in the Bay or in tributaries of the Bay in the spring and summer months.

3.7.1.2 Essential Fish Habitat

Habitat within the Project Area has been designated as Essential Fish Habitat (EFH) for 16 federally managed fish species according to the Magnuson-Stevens Fishery Conservation and Management Act. EFH is defined by the Act as “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity” (16 U.S.C. 1802 § 3). The Act requires an assessment of potential impacts to the 16 federally managed fish species with designated EFH in the Project Area. A summary table of designated EFH species within the Project Area and the specific life stage EFH designations for these species is provided below in Table 3.7-1.

Table 3.7-1 Summary of EFH Designations for the Project Area

Species	Eggs	Larvae	Juveniles	Adults
Red hake *(Urophycis chuss)*			X	X
Windowpane flounder *(Scopthalmus aquosus)*			X	X
Atlantic sea herring *(Clupea harengus)*				X
Bluefish *(Pomatomus saltatrix)*			X	X
Atlantic butterfish *(Peprilus triacanthus)*	X	X	X	X
Summer flounder *(Paralicthys dentatus)*		X	X	X
Scup *(Stenotomus chrysops)*			X	X
Black sea bass *(Centropristus striata)*			X	X
King mackerel *(Scomberomorus cavalla)*	X	X	X	X
Spanish mackerel *(Scomberomorus maculatus)*	X	X	X	X
Cobia *(Rachycentron canadum)*	X	X	X	X
Red drum (*Sciaenops occelatus*)	X	X	X	X
Sand tiger shark *(Odontaspis taurus)*		X		
Atlantic sharpnose shark (*Rhizopriondon terraenovae*)				X
Dusky shark *(Charcharinus obscurus)*		X	X	
Sandbar shark *(Charcharinus plumbeus)*		X	X	X

3.7.2 Environmental Effects and Mitigation

3.7.2.1 Potential Construction Impacts

Potential impacts to finfish and finfish habitat from installation of the submarine cable and G11X foundation will be localized and temporary, resulting from direct and indirect sediment disturbance. Impacts to benthic habitat that support certain finfish are discussed in Section 3.8.

Direct Impacts to Finfish

Egg and larval stages of demersal fish species that lie within the direct footprint of the submarine cable or G11X foundation and scour protection are expected to experience mortality since they lack mobility. Only ten out of the 36 species identified as commonly occurring in lower Chesapeake Bay have the potential for demersal eggs and/or larvae to be present in the Project Area during the in-water construction period (Attachment A). These species include: Atlantic croaker, black sea bass, hogchoker, northern puffer, northern stargazer, oyster toadfish, red drum, spotted seatrout, tautog, and weakfish. None of the early life stages with designated EFH has demersally oriented eggs or larvae.

Fish species with pelagic eggs and larvae will be less affected by temporary benthic disturbance since they are not as closely associated with the bottom; however, those in the immediate area of construction could experience some injury or mortality. Fifteen out of the 36 species identified as commonly occurring in lower Chesapeake Bay have the potential for pelagic eggs and/or larvae to be present in the Project Area during the in-water construction period (Attachment A). As stated previously, pelagic eggs should be less affected by temporary benthic habitat disturbance since they may occur in the water column above the direct influence of the installation activities.

Due to the localized and short-term nature of the construction activities, no long-term impacts to finfish populations as a whole are expected. Therefore, hydraulic jetting and installation of the single G11X will in no way hinder the successful recruitment of younger fish. No substantial impacts to finfish or the benthic habitat that supports these species are expected.

Juvenile and adult finfish species common to the Project Area (see Attachment A and Table 3.7-1) are not likely to become buried given the limited nature of the sediment disturbance. Even the demersally oriented juvenile and adult life stages of these fish species are highly mobile and should have the ability to avoid the temporary area of disturbance during construction; however, juvenile and adults in the direct path of bottom disturbing construction activities may experience some direct mortality or injury.

The temporary dispersal of benthic prey that may occur during hydraulic jetting-related activities or installation of the G11X may temporarily disrupt feeding for some benthic-oriented juveniles or adults; however given the limited area of disturbance, sufficient food base is expected to be available to foraging fish species. Direct mortality or disruption of juvenile and adult fish species from Project construction activities is expected to be minimal. Indirect impacts that could occur to these species and life stages are described in the sections below.

Indirect Impacts – Temporary Increase in Total Suspended Solids

Sections 3.3.2 and 3.6.2 provide details on the anticipated impacts to sedimentation rates and water quality, which include increases in TSS. Those life stages most affected by low-level increases in suspended sediment are larval fish. Demersal larvae that are present during in-water construction activities could be affected by temporary elevated levels of suspended sediment generated during hydraulic jetting activities. However, modeling results indicate that the suspended sediment concentrations from the hydraulic jetting operation are expected to decrease rapidly with distance from the operating jetting device and suspended sediment concentrations are predicted to return to ambient conditions within 6 hours after jetting. Therefore, impacts to these demersal larvae would be very localized and temporary.

Other larval fish species described in Attachment A and Table 3.7-1 that are pelagic in nature and could be present during the planned summer construction period should be less affected by temporary benthic habitat disturbance since they may occur in the water column above the direct influence of the installation activities.

In addition, along the west half of the proposed submarine cable route, the highest suspended sediment concentrations (greater than 100 mg/L) are predicted to remain in the bottom 5 to 6 feet of the water column under all tide conditions, according to modeling results. Concentrations are predicted to decrease rapidly to approximately 10 mg/L or less approximately 10 to 14 feet above the bottom under all tide conditions. Therefore, pelagic larvae in the deeper waters along the west half of the route may occur in the water column above the indirect influence of the elevated suspended sediment concentrations. Any larvae that are affected may be temporarily displaced in the water column as a result of the limited disturbance associated with hydraulic jetting. However, the overall area of habitat disturbed is insignificant in comparison to surrounding areas of larval habitat in the Project Area.

No significant impacts to juvenile or adult life stages common to the Project Area are expected from installation of the G11X or submarine electric export cable, since these life stages are highly mobile and should have the ability to avoid the temporary area of disturbance during construction. The temporary elevated TSS levels could indirectly affect these species by making it more difficult to navigate, forage, and find shelter. However, the narrow area of sediment disturbance assures that fish will not have to relocate very far. These fish species are also expected to rapidly return once the installation activities at a given location have been completed. Therefore, indirect disturbance from temporary elevated suspended sediment concentrations to these older life stages will be minimal.

Indirect Impacts – Sediment Deposition

Section 3.3.2 provides details on the predicted sedimentation that may result from the installation of the submarine cable. Sedimentation can potentially bury any demersal eggs or larvae that are within the Project Area. Any larvae in the immediate vicinity of the equipment needed for hydraulic jetting and installation of the G11X would experience mortality and others may experience localized increases in physical abrasion, burial or mortality. However, the area affected by hydraulic jetting and installation of the G11X is small relative to the surrounding habitat of lower Chesapeake Bay; therefore, the Project will not result in population-level effects. Burial of older life stages of demersal fish is not expected because the amount of sediment displaced is kept to a minimum by the use of hydraulic jetting and also because construction activity will facilitate disturbance avoidance in fish before sediments are settled.

Indirect Impacts – Effect of Sediment Contaminants

The results of the laboratory data obtained during the site characterization studies indicate that none of the sediment cores had chemical constituent concentrations that exceeded ER-M values. The ER-L values were exceeded for several compounds in the Cape Charles Harbor Basin, although the compounds that exceeded ER-L values for individual samples were not consistent throughout the harbor basin. Therefore, these concentration levels suggest that the ambient sediment environment is mostly free of contamination with some areas that have chemical concentrations that could result in occasional adverse effects to biota.

The use of hydraulic jetting technology will greatly limit the amount of sediment and contaminants introduced into the water column. It is anticipated that only localized and temporary impacts to sediment quality would occur from in-water construction which would pose a temporary and minimal risk to fish and fish habitat within the Project area when compared with the risks posed by their continuous interaction with existing sediments in lower Chesapeake Bay.

Indirect Impacts – Acoustical Impacts

Section 3.16 provides information on the anticipated acoustical impacts of construction and operation of the Project. The maximum underwater sound generated during in-water construction will occur during installation of the single monopile foundation for the G11X. If finfish are in the Project construction area while the monopile is being driven, they are likely to temporarily avoid the area around the monopile. Any impacts to finfish and other marine organisms would be minimized by using a “soft start” of the pile driving equipment to allow fish to move away from the area in response to construction sound. Pile driving of the single monopile is expected to be short in duration (approximately one day).

Hydraulic jetting of the submarine cable produces no sound beyond that produced by typical vessel traffic. The cable installation vessel used for submarine cable installation will produce sounds typical of vessel traffic already occurring in the Chesapeake Bay. Fish usually show a variety of avoidance behaviors when near noise-emitting vessels. Pelagic species reportedly may dive deeper in the water column, while demersal species may make lateral movements. Most fish species would be expected to increase their swimming speed in the presence of vessel sounds and may exhibit avoidance behavior. Avoidance behaviors are expected to be short-term and would likely be similar to behaviors exhibited when fish encounter recreational and commercial vessels in the lower Chesapeake Bay.

3.7.2.2 Potential Operational Impacts

Submarine Cable

The solid dielectric cable does not contain any dielectric fluid and therefore there is no risk of a leak. As the submarine cable will be buried, it will not create a physical barrier that could interfere with fish migration or use of existing habitats or nursery areas. The burial depth of the submarine cable also minimizes potential thermal impacts from cable operation. The submarine cable will generate a limited amount of heat that would be absorbed by, and dissipated into, the sediment surrounding the submarine cable. The Bay bottom temperature at cable depth is expected to increase slightly due to the cable operation. This minimal temperature increase at the cable depth of 6 feet below the bottom is not expected to adversely affect finfish species or their habitat as the temperature increase at the sediment surface is anticipated to be negligible and within the normal range of temperature experienced in the area generally.

Potential impacts to finfish from electromagnetic fields during the operation of the submarine cable are expected to be negligible as a result of the approximate 6-foot burial depth and steel armor layer covering the cable. Although high sensitivity has been demonstrated by certain species (especially sharks) for weak electric fields, this sensitivity is limited to steady (Direct Current [DC]) and slowly varying (near-DC) fields. The proposed submarine electric export cable will be designed to produce 60-Hz time-varying fields and no steady or slowly varying fields. Likewise, evidence exists for marine organisms utilizing the geomagnetic field for orientation, but again, these responses are limited to steady (DC) and slowly varying (near-DC) fields. 60-Hz alternating power-line EMF fields such as those generated by the submarine cable associated with this Project have not been reported to disrupt marine organism behavior, orientation, or migration.

Therefore, there are no anticipated adverse impacts expected from operation of the submarine cable on the behavior, orientation, or navigation of marine organisms, including fish species. There also are no anticipated adverse impacts from the submarine cable on prey items of fish species (i.e., invertebrates, and plankton).

Wind Turbine Generator

The G11X foundation is expected to be colonized by an invertebrate fouling community similar to that found on piers, revetments and other hard structures. The placement of scour protection around the G11X foundation is not expected to interfere with fish migration or use of existing habitats or nursery areas. However, the rock armoring or other scour protection instruments to be placed around the monopile may serve as habitat for fish species that are attracted to structure. Some of the fish species considered common in the Project Area that may be attracted to this structure include: black drum, black sea bass, king mackerel, oyster toadfish, red hake, scup, spot, and tautog. The rock armoring may serve as a single small patch reef habitat that could enhance species diversity locally, but would not be expected to alter the fish community or ecology of the lower Chesapeake Bay.

Research conducted at offshore windfarms in Europe which have multiple WTGs suggest that the very low vibration from wind turbines do not impact fishes in the region (AMEC, 2002). Therefore, underwater sound emissions from the single operating G11X for this Project are not anticipated to cause physical harm or behavioral changes to finfish in the Project Area. There are no anticipated adverse impacts expected from operation of the single G11X on fish species, their habitat, or their prey species (i.e., invertebrates, and plankton).

3.7.2.3 Summary of Potential Impacts to Finfish

As described above, potential impacts to finfish and finfish habitat from installation of the submarine cable and single G11X will be localized and temporary, and will primarily result from direct or indirect sediment disturbance. There will be little to no adverse impact to finfish resulting from operation of the G11X or submarine cable. Table 3.7-2 summarizes the potential impact from the Project to finfish depending on their life stage and habitat preference in the water column.

Table 3.7-2 Summary of Potential Impacts to Finfish

Level of Potential Impact*				
Potential Impact	**Near-Bottom Eggs/Larvae**	**Pelagic Egg/Larvae**	**Near-bottom Juveniles/ Adults**	**Pelagic Juveniles/ Adults**
Permanent finfish/benthic habitat loss from single G11X monopile and scour control installation.	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
Temporary finfish/benthic habitat loss (jack-up barge for G11X installation; hydraulic jetting of submarine cable, and vessel positioning/anchoring activities)	MINOR	NEGLIGIBLE	MINOR	NEGLIGIBLE
Mortality/Injury/Displacement	MINOR	MINOR	MINOR	NEGLIGIBLE
Elevated TSS levels (installation of monopile foundation, scour control, hydraulic jetting of submarine cable and limited excavation at the landfall).	MINOR	MINOR	NEGLIGIBLE	NEGLIGIBLE
Water Quality Impacts from suspension of contaminants	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE

Potential Impact	Level of Potential Impact*			
	Near-Bottom Eggs/Larvae	Pelagic Egg/Larvae	Near-bottom Juveniles/ Adults	Pelagic Juveniles/ Adults
Acoustic injury or damage (monopile driving, vessels, submarine cable installation, G11X operation)	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
Hardened structures/reef effect from single WTG monopile	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
EMF/Thermal	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE

*Level of Impact Definitions based on definitions typically used in NEPA-level environmental impact statements
Negligible – No measurable impacts.
Minor – Most impacts to the affected resource could be avoided with proper mitigation; if impacts occur, the affected resource will recover completely without any mitigation once the impacting agent is eliminated.
Moderate – Impacts to the affected resource are unavoidable; the viability of the affected resource is not threatened although some impacts may be irreversible, OR; the affected resource would recover completely if proper mitigation is applied during the life of the project or proper remedial action is taken once the impacting agent is eliminated.

3.8 Benthos

3.8.1. Existing Conditions

The Commonwealth of Virginia, in cooperation with the State of Maryland and Old Dominion University, utilizes a metric analysis called the Benthic Index of Biotic Integrity to assess the health of bay bottom habitats by comparing samples against reference values from non-impacted or degraded conditions. These measurements are taken on an annual basis at 250 locations throughout the Chesapeake Bay. The Benthic Index of Biotic Integrity system then scores each sample on a scale of 1 to 5, and any site scoring a 3 or higher is considered to meet the Chesapeake Bay Program's restoration goals. The 2008 Benthic Index of Biotic Integrity survey shows that no samples were taken within the immediate vicinity of the Project Area; however the six stations closest to Cape Charles all met the restoration goals set by the Chesapeake Bay Program. While this system does not provide specific quantifiable data for the Project Area, it does allow for a qualitative assessment of the benthic resources in the area.

3.8.1.1 Benthos

A site-specific benthic macroinvertebrate community assessment of the proposed submarine cable route was conducted in late October and early November of 2011. As part of the field program associated with this assessment, seventeen sample locations were selected to ensure that the range of environmental variables along the route would be adequately sampled.

Field collections were made from a survey vessel using a 0.10 m^2 Young-modified Van Veen grab sampler (see Figure 3.3-2). Material collected in the sampler was gently sieved in the field to remove extraneous debris and fine particles while retaining the target benthic organisms. Preserved samples were returned to the laboratory for sorting and identification of organisms under a microscope.

Substrate type and water depth varied at the sampling locations along the proposed submarine cable route, ranging from silt to coarse sand and fine gravel, occasionally with macroalgal growth. The varied habitats along the proposed submarine cable route were found to support at least 105 macroinvertebrate taxa, including various mollusks, crustaceans, annelid (segmented) worms, non-segmented worms, echinoderms, and cephalochordates. Taxa richness is varied from 10 to 32 taxa per station and estimated macroinvertebrate densities ranged from 600/m^2 to 6,340/m^2. The taxa richness and abundance levels found by site-specific sampling along the proposed submarine cable route are similar to, but somewhat lower than, those documented at a Chesapeake Bay Long-term Benthic Monitoring Program station proximal to the proposed submarine cable route (station CB7.3E). At this station, recently observed taxa richness was as high as 36 taxa per sample and estimated macroinvertebrate density was as high as 13,316/m^2 (Versar, Inc., 2011).

The most widespread taxa collected during the site-specific benthic macroinvertebrate assessment included the gastropod *Acteocina canaliculata*, the polychaete *Spiophanes bombyx*, the amphipod *Rhepoxynius epistomus*, and the bivalve *Tellina agilis*. The gastropod *Anachis obesa*, the polychaete *Pectinaria gouldi*, and the primitive worm *Phoronis sp.* were also abundant along the submarine cable route, but appeared to be more local in distribution with the first two species restricted to areas east of the Cherrystone Inlet Navigation Channel and the latter species restricted to areas west of the channel. Shellfish were not specifically targeted in this sampling program and no commercially harvested shellfish were collected as part of the site-specific benthic macroinvertebrate community assessment.

3.8.1.2 Shellfish

Common shellfish found within Chesapeake Bay include blue crabs (*Callinectes sapidus*), oysters (*Crassostria virginica*), and bay scallops (*Argopecten irradians)*. These shellfish form the basis for an important commercial and recreational fishery along much of the Mid-Atlantic Region.

The proposed location for the G11X foundation is approximately 555 feet within Area 1 of the Virginia Blue Crab Sanctuary (the majority of the associated submarine cable is located outside of the sanctuary). According to Chapter 4 VAC 20-752-10 ET SEQ, the harvest or possession of blue crabs for commercial and recreational purposes within Area 1 is prohibited between May 16 and September 15.

Section 3.13 further discusses commercial and recreational fisheries within the Project Area and discusses potential impacts. Additionally, Section 3.7 provides an assessment of EFH for the Project.

While some of the nearshore waters off of Cape Charles have been identified as optimal for clam and oyster aquaculture by the State of Virginia, no clam or oyster beds have been identified within the vicinity of the Project Area. Coordination with VMRC has also confirmed that there are no shellfish or fish trap leases within the Project Area (Mr. Hank Badger of the VMRC, pers. comm., 2011).

Cape Charles Harbor and the waters immediately north and south of the harbor mouth have been declared condemned shellfish areas and therefore harvesting is precluded. This condemnation became effective December 2, 2005 and is due to a waste water treatment outfall located within the Harbor (Virginia Department of Health, 2005; Badger, pers. comm., 2011).

3.8.1.3 Submerged Aquatic Vegetation

According to the Chesapeake Bay Program, sixteen species of aquatic grasses can be found within the waters of Chesapeake Bay and its tributaries (CBP, 2009b). Due to physical limitations, primarily salinity tolerance, only two of these species, eelgrass and widgeon grass are known to grow in the southern portions of the Bay.

A review of the 2010 Distribution of SAV in Chesapeake Bay and Coastal Bays (VIMS, 2010) showed limited SAV resources in the Project Area. SAV (40 to 70% cover) was mapped on the inside of the jetty and harbor bulkhead on the north side of Cape Charles Harbor (Figure 3.8-1); however this SAV bed appears to be limited to the shallow nearshore waters and is not in the vicinity of the submarine electric export cable. During the geophysical survey of the proposed submarine cable route in October 2011, SAV was not observed within the 400-foot wide corridor, centered on the proposed route.

The depth requirement identified for the offshore turbine of 50 feet of water would preclude the potential for the presence of SAV at the proposed location for the G11X. During the geophysical survey in June 2011, SAV was not observed within the Project Area.

3.8.2 Environmental Effects and Mitigation

3.8.2.1 Benthos

Potential direct impacts to the benthic resources may be associated with the installation of the G11X foundation and submarine electric export cable through abrasion, impingement, increased overburden stress, and direct burial of benthic macroinvertebrates. It is anticipated that these impacts will be limited to the trench and narrow paths where the jetting device travels over the bottom as well as the area occupied by the G11X foundation.

Potential indirect impacts from hydraulic jetting could also result from a temporary and localized increase in suspended sediment concentrations as well as associated sediment deposition. Sediment deposition is predicted to occur mostly adjacent to the trench and, on average, decrease to minimal levels (less than 0.1 millimeter) within 85 meters (280 feet) laterally from either side of the trench line.

A large proportion of the proposed submarine cable route, mainly from the Cherrystone Inlet Navigation Channel west, crosses sandy areas that are frequently exposed to natural wave action and/or strong currents. The macroinvertebrate community in these areas consists mainly of species that are highly motile or otherwise adapted to shifting sands (e.g., nephtyid worms, cephalochordate lancelets, haustoriid amphipods, and mellitid sand dollars). Some of these individuals may be able to avoid direct impacts of hydraulic jetting by moving away from the jetting device during installation. Indirect impacts from temporary increases in suspended sediment concentration followed by deposition are unlikely to cause more than a temporary and localized impact to most of the macroinvertebrate organisms in these areas.

The benthic macroinvertebrate community from the Cherrystone Inlet Navigation Channel east into the Cape Charles Harbor Basin includes some highly motile species but a number of less motile species (e.g., gastropods, bivalves, caprellid amphipods, and tube-dwelling polychaetes) are also common. Sedentary or less-motile species are unlikely to be able to avoid direct injury or mortality from operation of the jetting device or installation of the G11X foundation. Additionally, these species may be more sensitive to indirect impacts including temporary increases in suspended sediment concentration and partial or total burial from subsequent sediment deposition.

Although the time necessary for recovery of macrofaunal communities in disturbed sediments varies by habitat and the nature and specific type of disturbance (abrasion, impingement, direct displacement, burial, etc.), recovery time to temporary physical disturbance in temperate estuarine muds and sands is relatively short, typically ranging between six months and one-and-a-half years (e.g., Schaffner, 2010; Newell, et al., 1998). Therefore, the overall direct and indirect impacts of the proposed submarine cable installation to the benthic macrofaunal community are anticipated to be temporary and localized.

3.8.2.2 Shellfish

While some impacts to habitat utilized by blue crabs are expected due to the proposed construction activities, impacts would be minimal due to the small footprint of the construction area and the short time duration. Population level impacts to Chesapeake Bay's blue crab populations are not expected. Blue crabs enter a period of dormancy during late fall and winter months when water temperature within Chesapeake Bay drops. During this time, the crabs will migrate to deeper waters and bury themselves within the bottom substrate; during the remainder of the year, this species is extremely mobile. The planned construction period is scheduled to be outside of this dormancy period, and therefore the mobile crabs will likely avoid disturbances by displaying avoidance behaviors. Limited mortality of blue crabs can be anticipated due to impacts associated with a small number of individuals not avoiding the jetting device, which may crush or otherwise kill crabs which do not flee far enough from the area of cable embedment or monopile installation.

Due to the lack of shellfish beds within the Project Area, no negative impacts to shellfish resources are anticipated due to the proposed construction activities. Placement of the monopile foundation and any associated scour protection will provide hard substrate which may be utilized for settlement and colonization by organisms such as oysters, and crabs.

3.8.2.3 Submerged Aquatic Vegetation

Minor impacts to SAV resources are anticipated due to the construction of the Project. The footprint of the Project Area is devoid of SAV, eliminating the potential for direct disturbance. However, the numerically modeled suspended sediment plume is predicted to deposit between 0.1 and 2 millimters of sediment along the southeastern most portion of a small SAV bed located along the northeastern bulkhead of Cape Charles Harbor. It is predicted that 2 millimters of sediment will be deposited over approximately 0.17 acres of SAV, and that between 0.1 and 1.9 millimeters will be deposited over approximately 0.46 acres of SAV. This minor amount of deposited sediment is not anticipated to have any lasting impacts on the SAV resources, and it is expected that natural currents and water movement will remove any deposited sediment from the photosynthetic surfaces of the SAV.

3.9 Protected Species

3.9.1 Existing Conditions – Offshore

NMFS Northeast Regional Office, Protected Resources Division indicated in a letter dated November 7, 2011 (NMFS, 2011) that four species of federally threatened or endangered sea turtles, several species of marine mammals, including seals and dolphins protected under the MMPA, and the proposed endangered Atlantic sturgeon (*Acipenser brevirostrum*) have the potential to utilize the Project Area during certain times of year. The VADCR's Natural Heritage Program also indicated that loggerhead and Kemp's Ridely sea turtles are known to utilize the waters of the Project Area (VADCR, 2011). Many of these species would only occur occasionally on a transient basis or would be extremely unlikely to occur in the Project Area. A more detailed description of the marine turtles, marine mammals, and fish species identified in the NMFS and VADCR agency letters and their potential to be present in the Project Area is provided below.

3.9.1.1 Sea Turtles

Four species of federally and state-listed threatened or endangered sea turtles may be found seasonally in the vicinity of the Project Area: the federally threatened loggerhead (*Caretta caretta*), federally endangered Kemp's ridley (*Lepidochlelys kempi*), federally endangered green sea turtle (*Chelonia mydas*), and the federally endangered leatherback (*Dermochelys coriacea*).

Sea turtles generally have the potential to migrate into waters in the vicinity of the Project Area in late spring when water temperatures warm and return south in the mid-fall when water temperatures drop in response to the changing season, but have the potential to occur from the beginning of April to the end of November (CBP, 2009a). Any sea turtles found in the vicinity of the Project Area are typically small juveniles, the most abundant being the loggerhead followed by the Kemp's ridley (VIMS, 2010). The leatherback and green sea turtles are less common in Chesapeake Bay, and therefore less likely to be present within the Project Area (VIMS, 2010).

3.9.1.2 Sturgeon

Atlantic sturgeon are a demersal, anadromous species that migrate to freshwater for spawning during the late winter to early summer time period. They are known to spawn in the tributaries of the Chesapeake Bay during April and May, and then leave Chesapeake Bay in the fall for the near shore marine waters of Virginia (Atlantic Sturgeon Status Review Team, 2007; CBP, 2011a). Therefore, adult sturgeon could be migrating through the Chesapeake Bay Project area and past the Cape Charles offshore sites in the late winter/early spring on their way to freshwater spawning sites, and then again in the fall when they migrate to near shore marine waters.

For the first summer after hatching, juvenile sturgeon remain in fresh water and then migrate to estuaries in winter. Juveniles remain in estuaries for 3 to 5 years before migrating to the near-shore marine environment as adults (NMFS, 2006); therefore, juvenile sturgeons have the potential to occur in Chesapeake Bay and near the Cape Charles offshore sites year-round.

3.9.1.3 Marine Mammals

All marine mammals are protected by the MMPA and some are additionally listed as endangered or threatened under the Endangered Species Act of 1973. Initial consultation with the NMFS confirmed that the Project Area is not a high use area for whales, and that the presence of any whale listed under the ESA would be rare in the Project Area (NMFS, 2011).

Atlantic Bottlenose Dolphins (protected by the MMPA, but not listed as endangered or threatened) have reportedly been found in the lower Chesapeake Bay in the summer. Small pods of these dolphins have often been observed near Cape Charles and the James and Elizabeth rivers (CBP, 2011c); therefore, they are likely to be present seasonally in the Project Area. Harbor seals (*Phoca vitulina*) are also found in the Chesapeake Bay, typically in the winter months. Harbor seals have been observed hauled out on riprap near the Chesapeake Bay Bridge tunnel and are protected under the MMPA.

3.9.2 Existing Conditions – On Shore

According to correspondence from the USFWS dated November 30, 2011, the northeastern beach tiger beetle (*Cicindela dorsalis dorsalis)* is the only federally listed species known to occur near the terrestrial boundary of the Project Area. This species is listed by the USFWS and the VADCR as threatened. Northeastern beach tiger beetle habitat includes long, wide beaches with little human and vehicular activity. Threats to this species include shoreline development, beach stabilization, and high levels of recreational use. The species has been extirpated from almost all of its range north of the Chesapeake Bay and the greatest numbers of populated sites are now located along the Chesapeake Bay shoreline in Virginia (USFWS, 2011b). The existing site conditions are not considered suitable habitat for the northeastern beach tiger beetle, and activities related to the Project will not affect any local beaches in the vicinity of the Project which may support this species.

3.9.3 Environmental Effects and Mitigation

3.9.3.1 Sea Turtles

Construction and installation of the Project is expected to have minimal adverse impacts to the federally and/or state-listed threatened or endangered marine turtle species known to occur within the Project Area. As described above, NMFS (2011) reports that sea turtles are present within Chesapeake Bay on a seasonal basis (April through November), including the planned construction period of July and August. Given that sea turtles are known to utilize Chesapeake Bay during this time frame, it is anticipated that individuals may be present during construction activities. However, sea turtles are highly mobile animals and are likely to avoid the limited area of construction due to the presence of and noise generated by the construction vessels and activities. In addition, since none of the sea turtle species known to frequent Chesapeake Bay nests or resides there year-round, no direct or indirect impacts to sea turtle nesting or breeding sites will occur. Due to the transient and sporadic nature of any sea turtles potentially in the Project Area, construction, operation, and maintenance of the Project will have negligible impact, if any, on these protected species.

3.9.3.2 Sturgeon

Construction and installation of the Project is not anticipated to have adverse impacts to shortnose or Atlantic sturgeon. In the unlikely event that random or transient shortnose or Atlantic sturgeon adults are present during construction activities, they are highly mobile and can avoid the temporary area of disturbance during construction. Due to the limited potential for interaction between Atlantic sturgeon and Project activities, it is anticipated that construction, installation and maintenance of the Project will have negligible impact, if any, on these protected fish species.

3.9.3.3 Marine Mammals

Construction and installation of the Project is not expected to have adverse impacts to any of the federally or state-listed threatened or endangered marine mammal species or any marine mammal protected under the MMPA. As described above, NMFS (2011) reports that only rare, transient marine mammal individuals would be expected to occur within the Project Area. If transient marine mammals are present during construction, they are extremely mobile animals which can avoid the limited area of construction. Due to the limited potential for interaction between marine mammals and Project activities, it is anticipated that construction, operation, and maintenance of the Project will have negligible impact, if any, on these protected species.

3.9.3.4 Anticipated Monitoring Activities.

While the likelihood of protected species occurring in the Project Area during construction is considered low, the Applicant anticipates the NMFS will require standard monitoring practices for marine mammals and sea turtles. To the extent it is required, a monitoring plan will be developed, prior to initiation of offshore construction activities, that specifies the expectations of any observers contracted for the Project.

3.10 Visual and Aesthetic Environment

The G11X will be located approximately 3 miles southwest of Cape Charles, Virginia. The G11X will consist of a tubular steel tower with a maximum estimated height of 269 feet (82 meters) above mean sea level and a base diameter of 19 feet (5.9 meters) and a top diameter of 13 feet (3.9 meters). The tower will be connected to a monopile foundation using a tubular transition structure near the water surface. The generator and other ancillary equipment will be housed within the nacelle mounted at the top of the tower. The G11X rotor assembly (blades and hub) measuring 420 feet (128 meters) in diameter will be attached to the components within the nacelle. The maximum estimated height of the entire unit is 479 feet above

MSL (146 meters) when the blade is in the upright position. The G11X will be painted an off white color for aerial visibility and to minimize reflective glare.

This section will address potential visibility of the G11X within a 5-mile radius of the Project (the visual study area) using industry accepted methodology. This methodology addresses the following:

- Character of the existing landscape
- Visually sensitive resources within the visual study area
- Potential Project visibility within the visual study area
- Visual simulations and assessment

3.10.1 Existing Conditions

The 5-mile visual study area (shown on Figure 3.10-1) includes approximately 14 square miles of upland on the Delmarva Peninsula (or about 18% of the total visual study area). This land mass includes the Town and surrounding areas. The remaining portion of the visual study area includes open water of the Chesapeake Bay.

3.10.1.1 Character of Existing Landscape

Cape Charles is a small harbor town with residential streets and tightly spaced homes interspersed with mature vegetation. The topography is flat with the exception of sand dunes along the Chesapeake Bay coast to the west. Vegetation within the town consists of street trees and mature deciduous trees in yards and open spaces. Mason Avenue and Randolph Avenue (Route 184) make up the commercial mixed use district; structures consist of turn-of-the-century two- and three-story closely situated or attached buildings constructed of stone, brick and some later wood frame structures. Mason Avenue is a wide main street that accommodates street side parking and two-way traffic with curbs delineating wide sidewalks lined with street trees and pedestrian-scale street lighting. The town's character led to the establishment of the Cape Charles Historic District (see Section 3.12).

North of the historic commercial district are residential areas, which consist of linear subdivided blocks, large Victorian homes set back from the streets and lined with sidewalks and landscaped lawns. A residential area is also located to the west bordering on Bay Avenue and the town's public beaches. Cape Charles Harbor, south of Mason Avenue, serves as both a recreational and commercial port of call along the eastern shore of Chesapeake Bay. The Harbor receives approximately 14,600 port visits from commercial vessels annually (see Section 3.11.1.1). The port consists of a large industrial area (approximately 60 acres) to the south bordered by commercial vessel dockage areas. To the east, there are small vessel slips, a boat launch, and USCG facility along with associated parking areas. A Coastal Habitat Natural Area Preserve is south of the harbor, which is bordered to the east by the Sustainable Technology Industrial Park.

To the south of Cape Charles, development density drops, giving way to rural residential and agricultural lands interspersed with the suburban residential developments. Included in these developments is the Bay Creek Resort and Club which consists of residential units and recreation open space. The resort's marina is located to the north and the country club is to the east of the large residential development to the south of Cape Charles.

Vegetation within the study area generally consists of forest lots and hedgerows scattered along developed zones and waterways. Large bays and estuaries also occur throughout the study area and are typically lined with forest vegetation. These areas are a mix of secondary growth, deciduous and evergreen trees as well as low scrub shrub emergent vegetation. Due to the relatively flat topography and dense development in the town, views of open water toward the proposed location of the G11X are typically limited to the waterfront. However, second and third story views may be available from a number of periphery structures within developed areas. Water views from more inland areas tend to be blocked by intervening structures and vegetation.

3.10.1.2 Visually Sensitive Resources

As it is not possible to analyze a project's potential visibility from every location within a visual study area, visually sensitive resources are compiled to establish priority areas for analysis. Visually sensitive resources included in this analysis meet one of the following criteria:

- National Parks
- National Forests (designated scenic areas)
- National or state designated scenic roads and rivers
- State parks and recreation lands (including trails)
- State natural areas and preserves
- National or state designated or eligible historic structures and districts (aboveground resources) (Virginia Department of Historic Resources, Virginia Landmarks Register, National Register of Historic Places [NRHP])
- State designated recreation lands

No National Parks, National Forests, State Parks, National or State Scenic Areas are found within the visual study area. The Kiptopeke State Park is located approximately 6.5 miles away from the proposed location of the WTG and is therefore outside the visual study area. As shown on Table 3.10-1, two state-designated natural areas, one eligible scenic river, one state-designated trail and 21 listed or eligible aboveground historic resources (including the Cape Charles Historic District) were identified within the 5-mile visual study area. Table 3.10-1 lists these resources, county, city (where applicable) and preliminary potential visibility of the G11X based on the mapped vegetated viewshed analysis results. For additional descriptions of eligible and historic resources, refer to Section 3.12.

Resources considered visually sensitive at the local level including public beaches and shoreline recreational areas in the visual study area were also considered (see Section 3.10.1.6).

Table 3.10-1 Visually Sensitive Resources within 5-Mile Visual Study Area

ID	Resource Name	County and City	Distance to G11X (miles)	Mapped Viewshed*
Previously Recorded Aboveground Historic Properties				
182-0002	Cape Charles Historic District	Northampton-Cape Charles	2.7	Yes
065-0024	Stratton Manor	Northampton	4.4	Yes
065-0027	Town Fields	Northampton	4.2	Yes
065-0057	Magothy Bay Church	Northampton	4.4	No
065-0066	Custis Tombs	Northampton	3.4	Yes
065-0070	Old Plantation Flats Lighthouse	Northampton (demolished)	1.4	Yes

ID	Resource Name	County and City	Distance to G11X (miles)	Mapped Viewshed*
065-0079	Tenant House 1, Rt. 642	Northampton	3.0	Yes
065-0090	Belle Vue	Northampton	4.7	No
065-0092	Boggs Place (Marriott's Plantation)	Northampton	4.1	No
065-0093	Hollywood (Scott House)	Northampton	3.7	No
065-0094	House, Rt. 642	Northampton	3.0	Yes
065-0096	Hermitage	Northampton	4.0	Yes
065-0099	Tower Hill	Northampton	4.6	Yes
065-0103	Piney Forest (Jarvis House)	Northampton	4.4	No
065-0110	Tenant House 2, Rt. 642	Northampton	3.0	No
065-0119	House, Rt. 642	Northampton	2.5	Yes
065-0138	Bayview	Northampton	3.9	Yes
065-0333	Lower Northampton Baptist Church	Northampton	5.0	No
065-0373	Powell House	Northampton	5.0	No
182-0001	Bethel School, Philadelphia Church of Christ	Northampton-Cape Charles	3.3	Yes
182-0003	Cape Charles Colored School (Rosenwald), Geo. Robberecht Seafood Company	Northampton-Cape Charles	3.2	Yes
Recreational Resources				
ANPD001	State Route 184 (Stone Road) Eastern Shore Loop Trail	Northampton	2.7	Yes
ANPD002	Kings Creek (Scenic River Recommendation)	Northamption	3.9	Yes
DCR001	Cape Charles Coastal Habitat Natural Area Preserve	Northamption	2.6	Yes
DCR002	Wm. B. Trower Bayshore State Natural Area Preserve	Northamption	4.4	Yes

* Visibility based on Vegetated Viewshed Analysis

3.10.1.3 Viewshed Mapping

A vegetated viewshed map (Figure 3.10-1) was prepared to indicate geographic areas within the study area that may offer eye level visibility of the highest point of the G11X (blade tip in upright position, or 479 feet [146 Meters] above MSL). This viewshed map incorporated 30-meter resolution digital elevation model data derived from a Triangular Irregular Network from the Center for Geospatial Information Technology at Virginia Tech and 30-meter resolution multi-spectral land cover information (to determine vegetation cover) from the National Land Cover Dataset 2006. To determine Project visibility, inputs were given for observer height (5 feet) and Project maximum estimated height (479 feet) of the built G11X. The computer then scans every cell within the 5-mile visual study area to determine whether interceding landforms or vegetation block views toward the Project. Vegetated areas are assumed to be screened from views of Project and are therefore manually classified as not visible. GIS mapped vegetation height is conservatively assumed to be 30 feet high. Existing structures are not considered in the viewshed mapping and therefore visibility results (as shown in Figure 3.10-1) are over-estimated, particularly in downtown areas such as Cape Charles. Due to the resolution of the National Land Cover Dataset 2006, certain small vegetative stands, hedgerows, and landscape vegetation are also not considered in this analysis. It is likely that actual visibility will be reduced by these factors.

The vegetated viewshed analysis (Figure 3.10-1) results suggest that 91% of the visual study area has potential visibility of at least the highest point of the G11X. However, of the total 5-mile visual study area, 82% is open water. To determine potential land based visibility of the G11X, the vegetated viewshed analysis was refined by clipping the results to exclude the open water area. These results suggest that approximately 47% of the total land area within the visual study area may have views of the G11X.

The vegetated viewshed analysis depicts areas of potential visibility along the Eastern Shore Loop Trail (State Route 184), and Kings Creek which were both recommended as candidates for state scenic resources by the Accomack-Northampton Planning District (2007 Virginia Outdoors Plan). Two state open space resources, including the Cape Charles Coastal Habitat Natural Area and WMB Trower Bayshore State Natural Area Preserve also fall within vegetated viewshed. These four resources all include some beachfront, where visibility of the G11X will be most unobstructed. The vegetated viewshed also suggests that inland views from these resources will be less frequent.

3.10.1.4 Field Confirmation of Visibility

To further assess potential Project visibility, trained field observers visited the visual study area on March 25, 2011, October 30, 2011, and November 3, 2011. To document the extent of potential visibility of the G11X, photographs were taken from representative viewpoints and selected visually sensitive resources toward the proposed location for the G11X. Photograph bearings were determined by using a GPS bearing and/or an aerial photo with predetermined positions and bearings to the proposed location for the G11X. Photos were generally taken from visually sensitive resources at the most open unobstructed ground level view available within the public ROW. The digital single lens reflex camera was set to match approximately 50 millimeters to obtain the most distortion-free images and provide the best perspective representation. The camera was also placed on a leveled tripod to ensure maximum stability and direction control. If views of the G11X are likely to be screened, a photograph was taken to document the lack of visibility and the reason for it.

Generally, the results of the field reconnaissance found that the vegetated viewshed map overestimated land based visibility of the G11X within the visual study area. For example, the vegetated viewshed maps indicated potential visibility of the G11X from within the Town, but field confirmation showed that views toward the proposed location for the G11X were significantly reduced by structures and vegetation. This was also true in areas where localized landscape or hedgerow vegetation blocked views, such as the Cape Charles Colored School (Resource ID# 182-0003, Figure 3.10-5 – Photo 5).

3.10.1.5 Visual Simulations

Visual simulations were created to represent how the G11X would look when introduced into the landscape from selected viewpoints. Simulations take into account the precise locations of the viewer, the proposed location of the G11X, and the contextual elements within a view. The G11X was digitally incorporated into a selected photograph to create a representation of how the G11X would appear within that view.

To create simulations, photographs selected to represent views of the Project are matched with a virtual camera created using the three-dimensional (3D) modeling software, Autodesk® 3ds Max® 2010. This virtual camera matches the location, elevation and focal length of the original photograph. Additionally, the output dimensions are set to precisely match those of the photograph. These settings allow duplication of the original photograph's size, perspective and zoom level.

The G11X is modeled in Autodesk® 3ds Max® 2010 with the necessary degree of detail. In order to ensure the correct position and scale of the modeled objects, all data is georeferenced in an appropriate coordinate system, unit and datum. A terrain model, typically derived from USGS 7.5 digital elevation data, is converted to a mesh for use in Autodesk® 3ds Max® 2010. With the G11X and surrounding contextual information in the model, a "through camera" view is generated. The camera is then aligned and adjusted to match the original photograph. To align the camera, the view direction and elevation are adjusted at each simulated viewpoint until the contextual information in the model matches the corresponding elements in the base photograph. The visible horizon and water is also aligned within the view to ensure an accurate representation of the G11X height.

Once the 3D camera has been aligned, a virtual sunlight system is placed in the model. This system computes the exact lighting parameters based on the project location, time of year and time of day the photograph was taken and atmospheric conditions observed in the field. The 3D model is then rendered for final production and post processing. Haze is estimated by observing objects in the photographs. Specific elements have actual color and a perceived color based on the amount of haze in the atmosphere. This effect increases with distance. To determine how much haze should be applied, distant objects are compared to close objects and a haze quantity is applied to the foreground object until it matches the distant object. Based on several foreground/background tests, a haze factor was determined for the Project's visual simulations. Autodesk® 3ds Max® 2010 also has the ability to estimate haze based on weather data and this was used to test the results.

<u>3.10.1.6 Description of Viewpoint Locations</u>

Three viewpoints were chosen for simulation production, based upon the availability of open views of the proposed location for the G11X. These viewpoints represent how the proposed WTG would look from various locations.

Viewpoint 1 – Bay Creek Resort and Club, Existing View (Figure 3.10-2A)

This viewpoint is approximately 3.7 miles northeast of the proposed location for the G11X at a bay front medium density residential and resort area. This portion of Bay Creek Resort and Club is located north of and adjacent to Cape Charles. While not a visually sensitivity resource as defined in Section 3.10.1.2, this location offers open views to the southwest from beachfront areas that have a relatively high number of viewers. Large single family residential units are situated along the shorefront and continue east to the Kings Creek estuary. North of the residential area is a large parking lot bordered by the Bay Creek Marina and shops and restaurants at Kings Creek. Views to the water are generally unobstructed on the western shore of the complex, but decrease within the development due to intervening structures.

Viewpoint 1 – Bay Creek Resort and Club, Proposed View (Figure 3.10-2B)

Viewpoint 1 looks southwest from the beach's edge and shows several large homes in the foreground and middle ground. Vegetation is restricted to landscaped shrubs, dune grasses, and sparse mature trees. In the simulated view, the G11X appears in the background and introduces a distinct vertical element into the seascape. However, the existing foreground development makes the G11X less prominent.

Viewpoint 2 – Cape Charles Historic District, Existing Beach View (Figure 3.10-3A)

Viewpoint 2 was taken approximately 2.8 miles northeast of the proposed location for the G11X at the edge of the Cape Charles Historic District; the Cape Charles public beach also extends to this location. The existing view includes the Cape Charles Pier, along with channel markers, buoys, and breakwaters which are partially submerged due to high tide at the time the photograph was taken, and often are more visible in the foreground. While not seen in the photograph, both commercial ships and seasonal recreational vessels frequent the harbor and shipping channel. Refer to Section 3.12 for a description of the Cape Charles Historic District.

Viewpoint 2 – Cape Charles Historic District, Proposed Beach View (Figure 3.10-3B)

Photosimulation 2B shows a view of the G11X from within the limits of the Cape Charles Historic District at a town public beach, at a distance of 2.8 miles from the proposed location for the G11X. In this simulation the G11X appears comparable in scale to the much nearer, and much smaller, offshore structures. It appears to be even less visible because of its color which significantly reduces its contrast against the background sky. The lesser contrast between the G11X and the background sky, compared to the contrast of foreground structures and objects and the background sky, further illustrates the *de minimis* visual effect of the G11X from within the Cape Charles Historic District (JMA, 2011). The Project's architectural historian found that although the G11X will be visible from portions of the Cape Charles Historic District, the visual effect will be significantly moderated by distance and the presence of existing visual and auditory intrusions (see Section 3.12).

At Viewpoint 2, the proposed location for the G11X will be taller than any other elements within the view, but its white color will generally make it less apparent against the sky. This is likely to be an even greater mitigating factor during periods of heavy visitor use at this public beach (i.e., hot summer days when haze can be heavier). However, during late afternoon and sunset hours the G11X will appear more prominent on the horizon. This is mitigated somewhat by the visual clutter of built features associated with the harbor entrance in the foreground.

Viewpoint 3 – Cape Charles Pier, Existing View (Figure 3.10-4A)

Viewpoint 3 is approximately 2.6 miles northeast of the proposed location for the G11X from the Cape Charles Pier. The Pier extends approximately 500 feet into the water from the Cape Charles harbor entrance and is accessed by Bay Avenue. Viewpoint 3 offers the most unobstructed existing view of the Chesapeake Bay found in the Town. Breakwaters and buoys are the only visible built elements in the view at the time this photograph was taken. Commercial vessels are frequently visible in the bay and seasonal recreational boats are commonly seen in both the bay and the harbor entrance. The working harbor provides a sense of industry in this view.

Viewpoint 3 – Cape Charles Pier, Proposed View (Figure 3.10-4B)

The G11X is clearly visible from this view and it presents a distinct new vertical element that is significantly taller than any other built element. Foreground buoy markers and breakwaters tend to detract minimally from views of the turbine. Atmospheric haze diminishes the details of the G11X at this distance, but the major components are distinguishable.

3.10.2 Environmental Effects and Mitigation

Field reconnaissance confirmed visibility from most shoreline locations, but many inland locations were heavily screened from view by forest vegetation and structures. Photo 1 (Figure 3.10-5) from Cape Charles Park shows a view surrounded by closely situated buildings with no views of the G11X. In other areas, such as The Cape Charles Colored School (Resource 182-003, Figure 3.10-5 Photo 5) vegetation blocks views toward the proposed location for the G11X. The field confirmation found that visibility of the G11X will be considerably less than suggested by the viewshed analysis.

Three locations within the visual study area were simulated to show how the G11X would look when introduced to the existing view. In all views the G11X will be a substantial vertical element on or near the horizon. The G11X will be larger than any other existing element in the view and will be easily recognizable when operational. As demonstrated by the visual simulations, perceived scale and visibility of the G11X diminishes over distance. The turbine appears as a modern and simple form that in certain contexts may complement existing land uses, such as the industrial section of the harbor. Public perception will likely vary by user type and sensitivity. Those that see the beachfront and bay as pristine landscape may have a higher sensitivity than those that focus activities and sensitivities on a local landscape level. Tourist activities within Cape Charles are focused on streets, shops, historic attractions and the beach. While the turbine may be occasionally visible in these settings, it is unlikely to diminish enjoyment of these resources. In fact, it may become a feature of interest.

Given the presence of commercial vessel traffic and the industrial nature of Cape Charles Harbor, the G11X is likely to have minimal visual impact. Of the 21 previously recorded above-ground historic properties identified within the visual study area, 13 were noted as having potential visibility of the G11X based upon the vegetated viewshed map (see Section 3.12) (JMA, 2011). However, research by the Project's architectural historian found that only eight of the 13 previously recorded historic aboveground properties mapped as having potential visibility were significant historic properties (i.e., listed on the NRHP), previously determined eligible for the NRHP, or in the opinion of the architectural historian meet NRHP eligibility criteria). Field confirmation found that even fewer will have G11X visibility due to intervening structures and vegetation. Six of the eight significant historic properties were found to have settings (including views of the ocean) that contribute in an important way to their historic and/or architectural significance. Of the six, the introduction of views of the G11X would not have a significant effect on the Cape Charles Historic District, Custis Tombs and the Hermitage and would have no effect on Stratton Manor, Belle Vue, and Tower Hill, in the opinion of the architectural historian (see Section 3.12) (JMA, 2011).

Views from the two state open space resources (Charles Coastal Habitat Natural Area Preserve and the Wm. B. Trower Bayshore State Natural Area Preserve) will be limited to shoreline areas. Trails within these areas are typically focused on woodland resources and the G11X will not negatively impact the enjoyment of these resources.

Inland resources that potentially have views toward the Project will receive minimal to low visual impact while shoreline resources might expect low to moderate visual impacts when the G11X is clearly visible. Homeowners within the beachfront area with views of the proposed location for the G11X may also experience moderate visual impacts, depending on the sensitivity of the individual viewers. Under hazy or adverse weather conditions this impact will be further reduced.

The required FAA light on the G11X will be similar to the existing channel marker and buoy lights already visible from most areas with views of the bay. Based on the presence of these existing lights and the potential for additional light pollution from commercial vessels, the light contributions from the FAA signal is not expected to cause adverse visual impacts.

3.11 Air and Marine Navigation / Transportation

3.11.1 Existing Conditions

3.11.1.1 Marine Navigation

The proposed location for the G11X is approximately 1 mile northwest of the Cherrystone Inlet Channel at its closest approach and 3.6 miles east of the York Spit Channel (see Figure 3.11-1). The Cherrystone Inlet Channel serves as the main approach to Cape Charles Harbor. The York Spit Channel serves as the primary route for northbound marine traffic to the port of Baltimore, the Potomac River, and the Chesapeake and Delaware Canal. At the northern entrance to the channel an anchorage area designated as Quarantine Anchorage Area Q – Quarantine Anchorages (33 CFR §110.168) exists for those vessels requiring an examination by public health, customs, or immigration authorities. All Project work will be conducted outside of the marked and maintained navigational channels within Cape Charles Harbor and the Cherrystone Inlet Channel. Additional information pertinent to specific marine navigation interests in the vicinity of the Project Area are discussed below.

Cape Charles Harbor

Cape Charles Harbor is located approximately 9 miles north of Wise Point. The Harbor consists of three distinct basins, the main harbor basin, the northern Harbor of Refuge, and the southern Mud Creek Basin. Entrance to the Cape Charles Harbor is via the federally maintained Cherrystone Inlet Channel.

Cape Charles Harbor serves as both a recreational and commercial port of Call along the eastern shore of Chesapeake Bay. Commercial traffic that enters Cape Charles Harbor is generally associated with the Bay Coast Railroad or the Bayshore Concrete Products Facility. Historically, the railroad operated a floating operation connecting Cape Charles to Little Creek, although this service has not operated for the last two years (Cape Charles Town Planner, pers. comm., 2011). The Bayshore Concrete Products Facility receives raw materials and transports finished products offsite, by way of barge service on an as needed basis, approximately two to three times per week (Cape Charles Town Planner, pers. comm., 2011). The USCG operates Station Cape Charles out of the south basin of the harbor.

3.11.1.2 Aeronautical Navigation

The U.S. Flight Information Publication IFR Enroute High Altitude – US map H-12 indicates that IFR route J121-174-209 is located several miles due east of the Project Area (Sky Vector, 2011).

3.11.1.3 Land Transportation

The proposed upland cable route does not cross any public roads, with the exception of the Old Cape Charles Road Bridge. The upland cable route passes under the bridge, which is known locally as the hump, as it parallels the existing railroad tracks. The Bay Coast Railroad floating service that once connected the Eastern Shore to the western side of Chesapeake Bay through Cape Charles is currently out of service. As a result, rail traffic into and out of Cape Charles is much less frequent than in the past and is limited to deliveries into and out of the Bayshore Concrete Products Facility every other day (BCRR Vice President, pers. comm., 2012). In addition to the commercial rail traffic the Bay Creek Railway offers an hour long dinner car experience out of Cape Charles on Friday, Saturday, and Sunday evenings between Memorial Day and Labor Day (Cape Charles Town Planner, pers. comm., 2011).

3.11.2 Environmental Effects and Mitigation

3.11.2.1 Marine Navigation

As a highly visible structure from the water in lower Chesapeake Bay, the G11X will be an aid to navigation and present a beneficial impact for marine navigation in the area. A lighting scheme will be developed for the G11X in consultation with the USCG as part of the application to designate the turbine as a regulated Private Aid to Navigation. Based on previous experience, Gamesa anticipates the USCG will require two LED lights on the G11X, one on each side, in order to provide 360 degrees of visibility. The intensity and color of the lights will be determined by the USCG.

The buried submarine cable will have no impact to navigation in the Chesapeake Bay or Cape Charles Harbor. The cable burial depth of 6 feet will provide sufficient sediment overburden to avoid cable damage by vessel anchors or other mechanical impacts. Additionally, there will be no measurable electro-magnetic affects from the cable given its AC current.

Once installed, the location of the G11X and submarine cable will be charted by the National Oceanic and Atmospheric Services on the next version of the Nautical Chart for the lower Chesapeake Bay. It is also expected that notifications will be published in the Coast Pilot and Notice to Mariners for this area of the Chesapeake Bay. A cable area will likely be designated in the vicinity of the cable route, although these designations do not restrict or preclude vessel traffic or general navigation within these areas.

Project activities are not anticipated to interrupt recreational or commercial shipping activities within the Project Area. While an exclusion area may be established around any operating construction/installation vessels by the USCG, these areas are not anticipated to require extensive course deviations by passing vessels.

3.11.2.2 Aeronautical Navigation

An FAA Determination of No Hazard to Air Navigation was issued for the Project on May 10, 2011 regarding a preliminary siting location for the G11X, approximately 1 mile northwest of the proposed location. A revised application has been submitted to the FAA to update the Project Area and is pending review. Given the proximity of the initial determination, it is assumed that a similar No Hazard Determination will be issued by the FAA for the Project.

Based on previous experience, Gamesa anticipates that the FAA will require a single FAA-L864 medium intensity flashing red light at the top of the nacelle. The flash rate and duration will be determined by the FAA.

3.11.2.3 Land Transportation

Installation and operation of the export cable between the Project landfall and the substation will have no negative effects on the operation of the Bay Coast Railroad or the Bay Creek Railway. By utilizing best management and construction practices, such as pipe jacking under the existing rail bed, the project will minimize its presence within the existing ROW. The Project is not anticipated to cause any delays or stoppages to safely complete the installation of the Project.

3.12 Cultural and Historic Resources

This section describes previously identified cultural resources within the Project's submerged and upland Areas of Potential Effect (APEs), as defined below, and addresses the potential for unrecorded cultural resources to be affected by the Project. This section assesses the Project's potential impacts on those cultural resources considered significant (i.e., meeting eligibility criteria for listing on the NRHP).

The following cultural resource investigations were conducted in 2011 within the Project's offshore, upland and visual APEs, to assist in Project compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations contained in 36 CFR 800:

- **Submerged Cultural Resources**: R. Christopher Goodwin & Associates, Inc. (RCG&A) of Frederick, Maryland: *Submerged Archeological Cultural Resources Assessment: Gamesa Offshore Wind Turbine Project* (RCG&A, 2011)
- **Upland Cultural Resources**: John Milner Associates, Inc. (JMA) of Arlington, Virginia: *Phase IA Archeological Reconnaissance and Historic Properties Viewshed Analysis: Gamesa Offshore Wind Energy Project* (JMA, 2011)

All aspects of these investigations were completed in accordance with the Secretary of the Interior's Standards and Guidelines for Archeological and Historic Preservation and other applicable state and federal laws and regulations as cited herein.

3.12.1 Existing Conditions

3.12.1.1 Submerged Cultural Resources

Submerged cultural resources include submerged landforms that have a high probability of containing drowned prehistoric and historic archeological sites, as well as shipwrecks and related disposal sites. The presence or absence of these in the vicinity of the Project Area was assessed by RCG&A through archival research and review of marine geophysical remote sensing data collected during site characterization studies.

The marine archeologist's review of data from the Project's remote sensing investigations was conducted within the APE to evaluate the potential for physical disturbance during construction of the offshore Project components. For the G11X, the APE was defined as an approximate 2,000- by 2,000-foot area centered on the proposed location for the G11X. The APE for the submarine cable transmission route to shore was defined as a 400-foot-wide corridor centered on the proposed submarine cable route, to allow for some minor re-routing within the corridor if necessary.

A summary of RCG&A's investigation is provided below.

Archival Research

Archeological and architectural site files for the vicinity of the Project Area were reviewed by RCG&A using the online Virginia Department of Historic Resources (VDHR) data sharing system and by visiting the VDHR archives in Richmond. Additional research was conducted at the Virginia Historical Society in Richmond and the Cape Charles Historical Society Museum in Cape Charles. No offshore or nearshore submerged archeological sites have been recorded within the area examined, including the Project Area, although a total of 20 terrestrial archeological sites have been identified within an approximately 1-mile (1.6-kilometer) radius of the Cape Charles harbor basin (RCG&A, 2011). These sites represent nearly every phase of prehistoric and historic occupation of the area, from the Paleoindian through the 20th century.

Review of the various shipwreck and disaster lists (such as the Northern Maritime Research, NOAA's Automated Wreck and Obstruction Information System database and other secondary sources indicated that the majority of vessel incidents listed for the general area around Cape Charles occurred on the outer Atlantic shoreline, east and south of the Delmarva Peninsula. In brief, no shipwrecks or other archeological resources were identified within the APE during review of shipwreck databases, nautical charts and various secondary sources (RCG&A, 2011).

However, the research indicates at least 14 named vessels of various sorts have been reported wrecked within approximately 2 miles (3.2 kilometers) of the offshore Project Area (RCG&A, 2011). These wrecks are thought to have occurred due to the lack of accurate navigational aids until the 19th century and the presence of numerous shoals and storms that affect this region. The history of Cape Charles Harbor was also researched by RCG&A, and indicated that Cape Charles was a community planned solely to provide a terminus for a proposed steam ferry service between the lower Delmarva Peninsula and the growing urban centers of Hampton Roads. The site selected for the harbor was known locally as "Mud Creek", one of several tidal ponds in the area. To accommodate a barge and ferry terminal, the creek entrance was dredged and by 1884 the lower reaches of the creek had been dredged to a depth of 11 feet. The historic and present status of dredging and related projects conducted within the harbor at Cape Charles was obtained by RCG&A through contact with USACE – Norfolk District; the information indicates that the harbor has been dredged multiple times in the 20th century.

Marine Archeological Investigation of Remote Sensing Surveys

To assess whether submerged cultural resources are located within the offshore Project Area, marine archeologists from RCG&A coordinated with the Project team during the design and implementation of the marine geophysical surveys. The geophysical survey design allowed the identification of anomalies that might represent areas that could impede construction as well as areas that could represent relict landforms or significant submerged cultural resources. Magnetometer, side scan sonar, multibeam bathymetry, and shallow and deeper subbottom profilers were run on 50- to 100-foot trackline spacing intervals, depending on equipment type. Subsurface features of interest indicated on subbottom profiler data were also penetrated by vibracores, and sediments obtained to ground-truth the geophysical data.

RCG&A utilized post-processed remote sensing data, vibracore information and the results of background research on the regional geomorphology, prehistory and history, to identify anomalies on and beneath the bay bottom with the potential to represent significant submerged cultural resources. The natural and anthropogenic forces that impact shipwrecks typically scatter wreckage in localized debris fields along the bay bottom. These objects usually can be detected with a remote sensing array that includes a marine magnetometer, side scan sonar and a sub-bottom profiler. Areas with potential to contain prehistoric archeological remains, such as submerged and buried surfaces associated with former watercourses such as relict terraces, point bars, and channel margins, can be detected with a subbottom profiler. The identification of potential cultural resources from sidescan sonar, subbottom profiler and magnetometer records involved correlation of data by a marine archeologist from the entire remote sensing array.

Review of the subbottom profiler data by RCG&A identified no paleo-channels with potential for prehistoric anthropogenic deposits in the WTG siting area (RCG&A, 2011). No subsurface paleofeatures were documented or mapped by RCG&A along the submarine cable route and in the harbor, though the types of surficial sediments in those areas prevented deep subbottom penetration. The multiple past episodes of dredging in the harbor have likely destroyed any paleo landforms with potential for prehistoric resources.

Review of remote sensing data by RCG&A resulted in the identification of seven targets that may represent potential cultural resources, and were recommended for avoidance by RCG&A by buffer zones ranging from 50 to 150 feet from the center point of each target (RCG&A, 2011). Three targets were recommended for avoidance within the WTG siting area (Targets 1-3) and four targets were recommended for avoidance along the cable route (CR Targets 3, 6, 7 and BR Target 1). This information will be provided to the Project's design engineers.

3.12.1.2 Upland Archeological Resources

A Phase 1A upland archeological reconnaissance survey was conducted in the fall of 2011 by JMA. The purpose of the survey was to identify previously recorded upland archeological sites that may be affected by Project-related construction and/or operation. The survey also evaluated the potential for there to be previously unrecorded archeological resources within the area that will potentially be affected by the undertaking. The survey was conducted in accordance with relevant sections of the VDHR's *Guidelines for Conducting Historic Resources Survey in Virginia.*

Archival Research

Archival research was conducted to collect information about previously recorded archeological sites within 1 mile of the proposed upland cable route. The research included review of VDHR's site forms using the VDHR data sharing system, review of primary and secondary materials and historic cartography related to the study area, and examination of holdings at the Virginia Room at the City of Fairfax Regional Library, the Library of Congress and the New York Public Library.

The research found that 54 previously recorded archeological sites are located within approximately 1 mile of the proposed upland cable route. None is located directly along the proposed route. Fifteen are prehistoric Native American sites or have Native American components; none is located in close proximity to the proposed route, but are mainly located along Kings Creek. Forty-nine are historic period archeological sites, or are sites with historic components, ranging from 17th to 20th century occupations. None of the 54 previously recorded archeological sites is located within the APE for Project-related ground disturbance, as discussed below, and therefore none will be affected by the Project.

Upland Field Reconnaissance

A field reconnaissance of the upland study area was conducted by JMA in November 2011, to verify the current conditions of previously recorded archeological, architectural and other historic resources and to collect information to evaluate prior ground disturbance in upland areas where Project construction is planned. Previously recorded resources and the Project's archeological APE were photographed by JMA.

Fifty-four previously recorded archeological sites are located within approximately 1 mile of the proposed upland cable route (JMA, 2011). None is located directly along the proposed route. Fifteen are prehistoric Native American sites or have Native American components; none is located in close proximity to the proposed route, but are mainly located along Kings Creek. Forty-nine are historic period archeological sites, or are sites with historic components, ranging from 17th to 20th century occupations.

For purposes of assessing the effects of the Project on upland archeological resources, the APE was defined as all areas of planned Project-related ground disturbance. The proposed upland cable route will be located within a 15-foot wide easement directly adjacent to the existing Bay Coast Railroad track's railroad ties. JMA found that at some locations, especially east of Old Cape Charles Road, ground disturbance caused by preparation of the railroad bed appears minimal and does not extend out as far as 15 feet from the existing track's railroad ties. As a result, JMA recommended Phase IB field testing of the upland cable route east of Old Cape Charles Road and at the proposed substation location, with judgmental shovel tests placed in the former rail yard west of Old Cape Charles Road to document prior disturbance. The purpose of the Phase 1B is to determine the presence or absence of potentially significant cultural resources within the APE for physical disturbance.

3.12.1.3 Aboveground Historic Resources

JMA conducted an assessment of visual impacts to aboveground historic resources in accordance with VDHR's guidance document, *Assessing Visual Effects on Historic Properties*.

As part of the assessment, previously recorded above-ground historic architectural resources were compiled from VDHR files within an APE for visual effects. The APE was defined as a visual study area within 5 miles of the proposed location for the G11X in Chesapeake Bay (see Section 3.10). The APE for potential visual effects on above-ground historic architectural resources previously recorded in VDHR files was defined as areas inside the 5-mile visual study area that would experience ground level views of the highest element of the G11X, preliminarily based upon topographic and vegetated viewshed maps (see Section 3.10).

All previously recorded above-ground historic architectural resources were identified by JMA within 5 miles of the proposed location for the G11X, regardless of whether the viewshed maps indicated visibility of the G11X. These resources include those that are listed or eligible for inclusion on the NRHP, are listed in VDHR files but have not had eligibility determinations, or have been found not eligible for the NRHP.

A total of 21 previously recorded above-ground architectural resources were found within the 5-mile visual study area, including the Cape Charles Historic District (JMA, 2011). These are listed in Table 3.10.1. Three are within the town of Cape Charles (note that the Cape Charles Historic District is included as one resource in its entirety). The remaining 18 are outside the Town in Northampton County. Three of these resources are listed on the NRHP. One is Custis Tombs, which is individually recorded in VDHR files but is also included within the listing for the Arlington Archeological Site. The other two properties are Stratton Manor and the Cape Charles Historic District.

In addition to the NRHP-listed resources, two of the 21 had previously been determined eligible for the NRHP; six had been evaluated and found not eligible, and ten were recorded by VDHR but had not had their eligibility evaluated by VDHR (JMA, 2011). During the field reconnaissance, JMA's architectural historian attempted to collect additional information about these ten unevaluated properties. Some were not evaluated because the resources were not visible from a public ROW, or their access roads were gated or posted as private. One (the Bethel School) could not be evaluated because it could not be located at the recorded location. The Old Plantation Flats Lighthouse was not evaluated because it had been demolished. In the opinion of JMA, four of the remaining previously unevaluated properties (Belle Vue, the Hermitage, Tower Hill and the Lower Northampton Baptist Church) do satisfy the criteria for NRHP eligibility set forth at 36 CFR 60.4. The fifth previously unevaluated property (Powell House) does not, in the opinion of JMA, satisfy NRHP eligibility criteria.

Of the properties that were already listed, eligible or evaluated as eligible by JMA within the visual study area, six were identified where the maritime setting is an important component of the characteristics from which the property derives its significance (JMA, 2011). JMA found that the entire NRHP-listed Cape Charles Historic District, a unique collection of historic 19th and early 20th century residential and commercial architecture, derives much of its historic and architectural significance from its maritime setting. The other five resources are the Custis Tombs, Stratton Manor, Belle Vue, The Hermitage and Tower Hill.

The architectural historian assessed visual impacts to each of these properties by visiting each and assessing the availability of bay views from publicly accessible areas in the direction of the proposed location for the G11X. The architectural historian also reviewed visual simulations of how the G11X would look when inserted into the landscape at various representative locations where at least partial views of the G11X were available and distances. Details about the preparation of the visual simulations are presented in Section 3.10. Visual impacts are discussed below in Section 3.12.2.3.

3.12.2 Environmental Effects and Mitigation

The Project's potential effects on those cultural resources considered significant (i.e., meeting eligibility criteria for listing on the NRHP) are assessed in this section, as feasible. Mitigation measures are proposed, as needed.

3.12.2.1 Submerged Cultural Resources

Review of remote sensing data by RCG&A resulted in the identification of seven targets within the Project's offshore APE that may represent potential cultural resources. These were recommended for avoidance by RCG&A by establishing buffer zones ranging from 50 to 150 feet from the center points of the delineated targets. Three targets were recommended for avoidance within the WTG siting area (Targets 1-3) and four targets were recommended for avoidance along the cable route (CR Targets 3, 6, 7 and BR Target 1). This information will be provided to the Project's design engineers, to confirm that avoidance is feasible.

If avoidance is not feasible, additional consultation between Gamesa, USACE – Norfolk District and VDHR will be conducted, to establish procedures and protocols for any additional survey and/or evaluation of the targets.

An unanticipated discoveries plan will be developed prior to the start of construction, as recommended by RCG&A, to provide guidance to construction personnel in the event that previously unidentified submerged cultural resources are encountered during Project construction.

3.12.2.2 Upland Archeological Resources

For purposes of assessing the effects of the Project on upland archeological resources, the APE was defined as all areas of planned Project-related ground disturbance. No previously recorded archeological properties were identified within the upland portions of the construction ROW associated with the Project. Installation of the proposed cable to a minimum of 3 feet below the existing grade will include excavation of a trench approximately 12 feet wide at the top but narrows with depth. The trench will be located immediately adjacent to the existing New York, Philadelphia and Norfolk RailroadGround disturbance will also be associated with construction of a submarine/upland cable transition vault in the former rail yard near the landfall and a substation at the eastern terminus of the upland cable.

JMA recommended conducting a Phase IB archeological investigation that includes a pedestrian survey of the entire upland cable ROW, and shovel testing east of Old Cape Charles Road to test for possible significant archeological resources within the 15-foot wide easement and at the substation location. Judgmental shovel tests would also be excavated in the former rail yard west of Old Cape Charles Road to document areas of previous disturbance. The Phase 1B would determine the presence or absence of potentially significant archeological resources within the upland cable route's APE for disturbance (the construction footprint, including access roads and staging areas).

3.12.2.3 Aboveground Historic Resources

Visual alterations to the setting of a significant aboveground historic resource can affect the qualities of the resource that made it eligible for the NRHP. JMA found six aboveground historic resources with settings (including views of the Bay) that contribute in an important way to their historic and/or architectural significance.

Although the G11X will be visible from portions of the Cape Charles Historic District, JMA found that the visual effect will be significantly moderated by distance and the presence of existing visual and auditory intrusions (JMA, 2011). In the opinion of JMA, the Project will not have a significant effect on the district. Some views of the Custis Tombs will include limited views of the G11X. Visual effects will be significantly moderated by distance and intervening vegetation. The Project will not significantly affect the Hermitage because views of the property from the adjacent public ROW will not include views of the Project. In the opinion of JMA, the Project will have no effect on Stratton Manor, Belle Vue, and Tower Hill due to the moderating effects of distance, and the presence of intervening vegetation and/or structures which minimize or eliminate views of the Project.

In summary, construction and operation of the Project will have no significant effect on aboveground historic resources.

3.13 Commercial and Recreational Fisheries

3.13.1 Existing Conditions

The lower Chesapeake Bay in the vicinity of Cape Charles is used for both commercial and recreational fishing. A public boat ramp in the harbor provides easy access to Chesapeake Bay for both commercial and recreational fishers. The Project Area is located in a high angler traffic area due to its easy access from public boat ramps, proximity to a channel (VMRC, 2011a), and location on the edge of a drop-off that quickly changes from shallow to deep water (a targeted area for fishing) (VMRC, 2011). According to VMRC (2011b), black drum, flounder and croaker fisheries develop in the spring and continue to develop throughout the summer and the cobia fishery begins in June. The black drum fishery is particularly important in this area. Generally black drum start arriving in April to begin spawning, and the first black drum are typically caught in the latter part of April. During several weeks in May, there are hundreds of boats fishing for black drum, during the day and at night in the waters off of Cape Charles (VMRC, 2011a). Usually, by about June 15, the black drum disperse and this concentrated local fishery is finished for the year. The striped bass trophy season starts in May and continues into June with high levels of fishing activity occurring during the May and June timeframe. Striped bass are also fished throughout the summer, but the peak commercial and recreational striped bass season is typically in November and December. Commercial fishers utilizing this area can be seen offloading their daily catches of blue crabs, horseshoe crabs, conchs, fish clams, shark and scallops at Cape Charles Harbor (Town of Cape Charles, 2011).

Chesapeake Bay is well known for its blue crab fishery, the most valuable commercial species in the Chesapeake Bay. According to VMRC (2011b), commercial crabbing with individual crab pots takes place in the Project Area. In the areas near the main navigation channel, a few commercial fishermen may work along the channel edge, but would not tend to put their pots in the main navigational channel. All pots must be registered and marked with proper identification tags. The lawful periods for the commercial harvesting of crabs by crab pot in Virginia is from March 17 through November 30 (VMRC Regs Chapter 4 VAC 20-270-30). The allowed season for recreational crab pot harvesting (up to 5 crab pots) is from May 1 to September 15 (VMRC Regs 4 VAC 20-670-30). Currently the crab dredge fishery in this area is under a moratorium (VMRC, 2011a).

Most of the recreational fishing in this area is made up of individuals using private boats and a few head boats operating out of the nearby Cherrystone campground (VMRC, 2011a). According to the Town of Cape Charles Harbor web page (Town of Cape Charles, 2011), charter boats run daily expeditions for cobia, striped bass, flounder, drum, spadefish, trout and croaker out of Cape Charles Harbor during the appropriate seasons.

3.13.2 Environmental Effects and Mitigation

The potential effects of Project construction on commercial and recreational fishing gear and commercial and recreational fishing activities are expected to be minimal. Commercial or recreational fishing activities may be temporarily disrupted in the immediate vicinity of Project construction. Given the proposed Project construction schedule, the main fisheries that could be active during in-water construction include flounder, croaker, cobia, striped bass, and blue crab. But these fisheries occur throughout the regional area and not specifically at the exact Project area location.

Construction of the G11X will occur in a small area (immediately surrounding the single monopile), allowing use of the surrounding area. During installation of the submarine cable, construction will occur in a linear fashion. Construction vessels and associated equipment will move along the route, minimizing disruption to any single area; therefore, impacts will be temporary and localized. In addition to active construction being limited to a small area, Gamesa will work with federal and state fisheries agencies to publish the project schedule and construction locations to minimize disruption of regular commercial or recreational fishing activities. With advance notice of project construction activities, commercial fishermen could choose to fish outside of the construction area or to remove any fixed gear such as crab pots that may be in the direct line of Project construction. The USCG may establish limited temporary vessel restrictions around immediate construction sites and vessels to protect public safety. However, as noted, this will occur in a small area and only for a limited amount of time during actual construction of the monopile (approximately one day) and installation of the submarine cable (approximately two weeks).

Operation of the proposed Project should not adversely affect commercial or recreational fishing in the Project Area. During Project operation, Gamesa will not be placing any restrictions on commercial or recreational fishing activities nor creating any fishing exclusion zones surrounding the single G11X or submarine cable.

Once installed, the submarine cable will have no impact to commercial or recreational fishing in the Chesapeake Bay or Cape Charles Harbor. The submarine cable will be jetted (buried) into the harbor sediments to a target depth of 6 feet BPB. This cable burial depth is expected to provide sufficient sediment overburden to avoid cable damage by vessel anchors or other mechanical impacts. In addition, as described in Section 3.11.2, there will be no measurable compass deflection effects for commercial or recreational vessels transiting over the cables and no electrical interference with radio, GPS, or radio-beacon navigational equipment. The presence of the G11X may serve as a source of structure and may attract fish species thereby enhancing habitat diversity and density in the area and also enhancing recreational or commercial fishing for certain species such as black drum, black seabass, flounder, and tautog. Post-construction commercial and recreational fishing is expected to be unchanged from pre-construction, except that the single G11X may serve as an attraction for certain fish species and therefore an attraction for recreational and possibly commercial anglers.

3.14 Socioeconomics

This section describes the socioeconomics and demographics of the Town, and compares population trends between 2000 and 2010 using available U.S. Census data for the Town, Northampton County and Virginia. This section also evaluates the potential socioeconomic effects of the Project, and addresses potential environmental justice issues.

3.14.1 Existing Conditions

The Town is the largest of the five incorporated towns in Northampton County, both in land mass and population. Founded in the 1880s when the railroad was extended south from Maryland to a newly dredged port on the western side of the Delmarva Peninsula to provide a rail-sea link to Norfolk across the Chesapeake, the first economies of the Victoria-era Town centered on farming, fishing, food processing, and transportation of these goods to markets along the Eastern Seaboard. As new transportation patterns emerged in the mid-20th century and food processing plants relocated and centralized, the Town began a slow economic decline (The Virginian-Pilot, 2008).

Lack of redevelopment has helped to protect Victorian-era buildings from demolition, and today Cape Charles has one of the best preserved historic districts on the Eastern Shore. This characteristic, together with its maritime location, rural setting and mild climate, increasingly draws tourists, part-time summer residents, and retirees to the area.

The historic downtown, laid out in a grid around Central Park, is centered along Mason Avenue between Peach Street and Harbor Avenue on the north side of the Harbor, and contains mixed use residences and small shops serving residents and visitors. The Town is governed by a Mayor and Town Council. The 2008-2009 municipal budget was approximately two million dollars, which supported Town services including public water and wastewater treatment for some areas (Town of Cape Charles, 2011).

3.14.1.1 Employment Opportunities

Town leaders have recognized that the Town needs to diversify employment opportunities to lessen the relatively high unemployment rates in the Town and Northampton County compared with the State of Virginia. According to the 2009 Cape Charles Comprehensive Plan, commercial and mixed use investment is encouraged in the Town and along the Harbor, both to revitalize the Town and discourage development along outlying rural Route 13 and agricultural lands.

In an effort to encourage new commercial investments in the 1990s, Town leaders established the Port of Cape Charles Sustainable Technologies Industrial Park on a 570-acre parcel southeast of the Harbor. The park was chosen as a national prototype for sustainable development by then-President Clinton, but progress slowed due to the national economic downturn. Portions are now being subdivided for other types of development, including mixed use complexes and yacht servicing.

A large planned residential complex called Bay Creek Resort and Club is also currently under development on land southeast of the historic district that was annexed by the Town in 1992 from Northampton County. Two golf courses designed by Arnold Palmer and Jack Nicklaus, a marina and some residences have been completed.

3.14.1.2 Population and Demographics

After the 1964 opening of the Chesapeake Bay Bridge-Tunnel, ferry service from Cape Charles across the Chesapeake and supporting railroad traffic on the Eastern Shore steeply declined. The population of the Town subsequently dropped from 4,500 to 1,200, with the toll on the bridge-tunnel preventing the Town from evolving into a bedroom community for commuters to Norfolk (The Virginian-Pilot, 2008).

At the time of this writing, the U.S. Census has released only 2010 population and race data at the town level, although complete 2010 data is available for Northampton County and the State of Virginia. As shown on Table 3.14-1, the 2010 population of the Town was 1,009, a decrease of 11% from 2000. This decline is twice that of the county, which experienced a decline of 5.4%. On the other hand, the state significantly increased its population (by 13%) over the same decade.

According to the Cape Charles Town Planner, the part time population of Cape Charles actually increased in 2010, although this information is not reflected in the census (pers. comm., 2012).

The median value of owner-occupied housing units in Northampton was $211,700 between 2005 and 2009, almost 15% lower than the median price in the state as a whole. Median reported 2009 household income in Northampton County was only 58% of median income in the state. And the percent of the population under the poverty level was twice as high in Northampton County as in the state.

Table 3.14-1 U.S. Census Demographics, 2000 and 2010

Parameter	Town of Cape Charles	Northampton County	Virginia
Population 2010	1009	12,389	8,001,024
Population 2000	1,134	13,093	7,078,515
Population % change, 2000 to 2010	-11%	-5.4%	13.0%
Median value of owner-occupied housing units, 2005-2009	NR	$211,700	$247,100
Median household income, 2009	NR	$34,501	$59,372
Populations below poverty level, 2009	NR	20.6%	10.6%

Note:
NR: Not reported in dataset

Cape Charles Planning Commission Population Study

A population study conducted in 2005 by the Cape Charles Planning Commission concluded that the Town's population of full time residents declined slightly between 2000 and 2005, while the retired population increased in size. Many of the new full-time residents were older retirees with high levels of educational attainment. Between 2000 and 2005, the number of housing units increased, with most new units constructed at Bay Creek. However, the study noted that many of the units at that development appeared vacant or were occupied by part-time residents, with a large number of vacant units for sale or rent (Cape Charles Planning Commission, revision date June 25, 2007).

Racial Distribution

According to the Cape Charles 2007 Population Study, as of 2005 approximately two-thirds of the year round population and 95% of the part-time population were white. Between 2000 and 2005, the Town study found a decrease of 42% in the population of blacks, and attributed this to potential declining job opportunities (Cape Charles Planning Commission, revision date June 25, 2007). The population of whites and all other races remained approximately the same over the period.

U.S Census data for 2010 reported approximately 65% of the Town's population was white, 31% was black and 4% were of other or mixed races.

3.14.2 Environmental Effects and Mitigation

The Project is expected to result in positive economic and social effects to Cape Charles, due primarily to increased tourism, as wind turbines have proven to be attractions in areas such as Europe. Local fishermen have also indicated that the rip rapped base of the G11X may increase fish habitat and populations, which could result in increased catches.

The potential effects of the Project were assessed with respect to Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" of 1994. Local agencies have been informed about the Project. The Project will not create air, water or other forms of environmental pollution during operations, will not generate significant noise, and will not result in adverse visual impacts. Construction impacts will be short-lived and localized. Because the Project will not result in significant and adverse environmental effects on any population, no mitigation for environmental justice is required.

3.15 Land Use

3.15.1 Existing Conditions

3.15.1.1 Study Area

A study area extending 5 miles out from the proposed turbine location was used to assess the potential land use/land cover impacts of the project. A GIS analysis was performed using the National Land Cover Dataset (2006) from the Multi-Resolution Land Characteristics Consortium. The dataset uses a 16-class land cover classification scheme that has been applied consistently across the conterminous United States at a spatial resolution of 30 meters.

As shown in Figure 3.15-1 and Table 3.15-1, 84% of the study area is covered by open water due to the proposed turbine being located in Chesapeake Bay over 2 miles from the nearest point of land. Developed areas comprise roughly 2% of the total study area. The town of Cape Charles, encompassing less than 1 square mile, is the largest developed portion in the study area. The majority of habitable land in the study area is related to agricultural use. Cultivated crops comprise 4.5% and pasture and hay comprise 2.9% of the study area.

Table 3.15-1 Land Cover Percentages within 5 Miles of the Proposed Turbine Location

Land Cover	Percent
Open Water	84.0
Cultivated Crops	4.5
Pasture/Hay	2.9
Woody Wetlands	1.6
Barren Land (Rock/Sand/Clay)	1.5
Evergreen Forest	1.4
Developed, Open Space	1.1
Mixed Forest	0.7
Developed, Low Intensity	0.6
Emergent Herbaceous Wetlands	0.6
Shrub/Scrub	0.4
Deciduous Forest	0.3
Developed, Medium Intensity	0.2
Developed, High Intensity	0.1
Grassland/Herbaceous	0.0

3.15.1.2 Proposed Upland Cable Route

The proposed upland cable route is located on two separate parcels owned by the Bay Coast Railroad. The land is currently industrial in nature and being used for rail transportation and related activities. The Town zoning classification for the proposed upland cable route crosses both the Harbor and Sustainable Technologies Industrial Park Districts (see Figure 3.15-2). Both zoning classifications allow for utility installations and facilities.

3.15.2 Environmental Effects and Mitigation

The proposed cable will be buried underground within 15 feet of the existing railroad tracks and a small substation will be built at the end of the upland route in the immediate proximity of an existing overhead transmission line. Given the industrial/commercial nature of the area along the upland cable route and the minimal impact associated with construction and operation activities, impact to land use is considered to be negligible.

3.16 Noise Assessment

3.16.1 Existing Conditions

3.16.1.1 In-Air Sound

The Town is located on the eastern shore of Virginia on a small peninsula, bordered by the Chesapeake Bay to the west, King's Creek to the north and Old Plantation Creek to the southeast. The town occupies approximately 2,817 acres and has a population of approximately 1,000 residents. Most commercial land uses are concentrated in the historic downtown area along four blocks of Mason Avenue between Peach Street and Harbor Avenue, and along the first blocks of Strawberry Street and Peach Street where they intersect Mason Avenue. Commercial activity consists of retail and service establishments and specialty shops catering to local and regional customers as well as tourists and visitors. The sound environment of downtown Cape Charles is considered typical for a small suburban town, with localized commercial areas. The area surrounding downtown Cape Charles is considered rural.

The large industrial Bayshore Concrete Products Facility is located south of the historic downtown area of Cape Charles, directly across from the harbor front. The facility manufactures and supplies various pre-cast and pre-stressed concrete structural materials for use in the United States and internationally. Fabrication activities at the facility include operation of heavy equipment (cranes, trucks, power tools, etc.) and movement of raw materials via a large hopper-conveyor system. During routine operations at the facility, industrial noises are clearly audible throughout downtown Cape Charles.

A sound assessment was performed for the Project including a background ambient sound level survey to evaluate the existing conditions of the local community closest to the proposed location for the G11X in order to evaluate the anticipated sound levels that may be perceived by local residents at the shoreline and in the vicinity of the Project.

The results of the ambient sound measurements are provided in Tables 3.16-1 (Daytime) and 3.16-2 (nighttime). A locus map showing the location of each measurement station is provided in Figure 3.16-1 This information serves as the basis for assessing the potential noise impacts of the Project at representative locations in the community.

Table 3.16-1 Summary of Short-term Ambient Sound Measurements at Community Locations: Daytime

Site	Address or Description	Date	Observed Wind Speed (mph)	Time Start[1]	Duration[2]	Measured Daytime Ambient Sound Levels		Sources of Ambient Sound
						Sound Level Metric	dBA	
ST1	Old Cape Charles Road	3/25/11 (Weekday)	3.77	16:05	22:38	Leq	53	Traffic on Old Cape Charles Road, industrial sound coming from Bayshore Concrete Products Facility , birds/insects, wind in the trees, an HVAC system within Bay Creek, and aircraft traveling at high altitudes overhead
						L10	57	
						L50	43	
						L90	**39**	
		3/26/11 (Weekend)	9.28	12:47	23:00	Leq	55	
						L10	55	
						L50	42	
						L90	**36**	
ST2	Mason Ave and Plum Street	3/25/11 (Weekday)	4.71	15:00	22:27	Leq	55	HVAC system at the nearby municipal building, traffic traveling along Mason Avenue and Plum Street, and wind in the trees
						L10	60	
						L50	45	
						L90	**37**	
		3/26/11 (Weekend)	6.11	14:27	22:30	Leq	53	
						L10	56	
						L50	41	
						L90	**36**	
ST3	Along T-1111 between Plum Street and T-1109	3/25/11 (Weekday)	3.77	15:29	22:19	Leq	55	Traffic along Plum Street and Randolph Avenue, birds, nearby HVAC systems, and sounds from the church on Randolph Avenue
						L10	59	
						L50	49	
						L90	**37**	
		3/26/11 (Weekend)	6.16	14:56	22:03	Leq	55	
						L10	56	
						L50	41	
						L90	**34**	

[1] Time is provided in hours and minutes (i.e., hh:mm) and based on a 24-hour clock with 12:00 a.m. equal to 00:00 and 11:00 p.m. equal to 23:00.
[2] Duration is provided in minutes and seconds (i.e., mm:ss).

Table 3.16-2 Summary of Short-term Ambient Sound Measurements at Community Locations: Nighttime

Site	Address Or Description	Date	Observed Wind Speed (mph)	Time Start[1]	Duration[2]	Measured Nighttime Ambient Sound Levels		Sources of Ambient Sound
						Sound Level Metric	dBA	
ST1	Old Cape Charles Road	3/25/11 (Weekday)	14.56	00:57	24:27	Leq	42	Wind in the trees, traffic on Old Cape Charles Road, and distant marine vessel traveling offshore
						L10	44	
						L50	42	
						L90	**38**	
		3/26/11 (Weekend)	1.40	23:39	14:44	Leq	40	
						L10	41	
						L50	34	
						L90	**30**	
ST2	Mason Ave and Plum Street	3/25/11 (Weekday)	14.19	01:28	27:43	Leq	42	Traffic along Mason Avenue, wind in the trees, and aircraft overhead
						L10	42	
						L50	39	
						L90	**37**	
		3/26/11 (Weekend)	1.60	23:03	22:03	Leq	46	
						L10	46	
						L50	35	
						L90	**31**	
ST3	Along T-1111 between Plum Street and T-1109	3/25/11 (Weekday)	Nighttime measurement data are not available at this location; however, ambient L_{90}s are expected to be approximately 2 dB less than the measured L_{90}s at Sites ST-1 and ST-2.					
		3/26/11 (Weekend)	Nighttime measurement data are not available at this location; however, ambient L_{90}s are expected to be approximately 2 dB less than the measured L_{90}s at Sites ST-1 and ST-2.					

[1] Time is provided in hours and minutes (i.e., hh:mm) and based on a 24-hour clock with 12:00 a.m. equal to 00:00 and 11:00 p.m. equal to 23:00.
[2] Duration is provided in minutes and seconds (i.e., mm:ss).

3.16.1.2 Underwater Sound

The ambient sound levels within the ocean are the result of a number of natural and man made sources. Underwater sound is generated by a variety of natural sources, such as breaking waves, rain, and marine life. It is also generated by a variety of man-made sources, such as pleasure and fishing vessels, large commercial and military ships and military sonars. Ambient underwater noise was not evaluated for this Project, although the Project Area is characterized as a typically nearshore marine sound environment that is likely dominated by marine traffic travelling in and out of Cape Charles Harbor as well as up and down Chesapeake Bay (see Section 3.11 for a discussion of local marine traffic).

3.16.2 Environmental Effects and Mitigation

3.16.2.1 In-Air Sound

The primary source of air-borne sound during construction will be related to the installation of the steel monopile foundation using pile driving techniques. The acoustic emission level for pile driving activity associated with the construction of the proposed Project was based upon published data for vibratory pile driving, which indicates a maximum A-weighted sound pressure level of 95 dBA at a distance of 50 feet (USDOT FHA, 2006). The basic model assumes hemi-spherical wave divergence from a point source located at the site of the WTG installation, but excludes excess attenuation due to atmospheric absorption over the propagation path. This basic model for air-borne sound propagation also excludes the shielding effects due to intervening structures, buildings, and/or terrain, along the propagation path from the construction site to noise-sensitive locations along the shore-line.

Operational sound levels from the G11X have been evaluated at the closest noise-sensitive locations along the shoreline, where Cape Charles residents were most likely to detect the maximum sound levels generated by the offshore turbine. Based on the results of noise assessment, predicted sound levels from the offshore wind turbine are expected to produce a negligible increase in background sound levels in Cape Charles. Ambient sound levels are expected to increase by only 0.0 to 0.1 decibels during typical daytime hours and by 0.2 to 0.3 decibels during typical nighttime hours. These changes in the ambient sound levels are generally considered to be imperceptible.

3.16.2.2 Underwater Sound

The operation of the WTG also will produce sound underwater. Vibration and noise from the machinery in the nacelle is transmitted down the tower to the foundation and radiates into the water. Recent field measurements of offshore WTGs under normal operating conditions demonstrated that underwater sound from the turbine was only measurable above ambient sound levels at frequencies below 500 Hz. The total sound pressure level was in the range of 109 to 127 dB re 1 μPa (root-mean-square), measured at distances between 14 and 20 meters from the foundations (Tougaard et al., 2009a). These underwater sound levels would generally be considered too low to be audible to most protected marine species, like dolphins and porpoises, which have higher sensitivity to sounds at higher frequencies. Certain species with greater sensitivity at lower frequency could perceive the sound, suggesting that some degree of behavioral response, typically avoidance, could result during operation, but mortality or injury from this sound source is highly unlikely (Tougaard et al., 2008; Tougaard et al., 2009b).

The primary source of underwater sound during construction will be related to the installation of the steel monopile foundation by pile driving hammer technology. Pile driving by this method typically generates low-frequency, impulsive sounds in excess of 200 dB re 1 μPa at the source. The percussive sound energy from the pile strike travels over distance and falls well within the range of perception for most marine turtles and mammals (Tougaard et al., 2008). Sound levels are known to decrease with distance so that potential impacts to marine species are dependent on proximity to the pile driving location. For instance, underwater sound measurements during the installation of steel monopiles by pile driving for the Horns Rev Offshore Wind Farm recorded a sound at the source of 235 dB re 1 μPa that dissipated to 175 dB re 1 μPa at a little more than 1 kilometer away (Tougaard et al., 2008).

Underwater sounds impact protected marine turtle and mammal species in a variety of ways that are species-specific and highly dependent on a wide range of factors related to the characteristics of the sound and the ambient acoustic environment. See Section 3.9 for a discussion of potential protected species that may be present in the Project Area during construction. Harassment of these marine species is considered a “take” under the Marine Mammal Protection Act and the Endangered Species Act. NMFS applies regulatory sound level thresholds for harassment of protected species when reviewing proposed actions with respect to the possibility for a taking from man-made sound sources.

The range of impacts on marine species resulting from anthropogenic underwater sounds is the subject of much scientific study. Sound levels from pile driving are not expected to reach levels that would result in injury or mortality of protected marine species for this Project. However, sound levels during pile driving have the potential to impact marine species close enough to perceive the sound by causing some change in behavior or activity. The possibility exists that a very small number of protected marine species may come in proximity to the installation of the monopile foundation for the proposed project. However, the localized and short-term nature of the activity makes it highly unlikely that acoustical harassment will occur during construction of the project.

4.0 SUMMARY OF PROJECT IMPACTS

The following sections describe the anticipated benefits and potential environmental impacts associated with the proposed Project.

4.1 Project Benefits

Operation of the prototype G11X and state-of-the art foundation system will be studied and monitored as part of a research and development program for future commercial application and deployment of this offshore 5-MW WTG in worldwide markets, including the east coast of the United States. Establishment of this prototype will provide a research and development platform that will add to the growing body of knowledge that will help to continue to advance the offshore wind industry. Development and proving of the next generation of larger, fully marinized WTGs designed for the harsh marine environment is expected to result in a more reliable machine that requires less routine maintenance than currently available turbines. Higher generating capacity with less routine maintenance will result in lower operating costs, which is expected to help reduce the overall cost of offshore generated wind energy. Economic benefits to the local community will include additional manufacturing, construction and operations jobs as well as indirect benefits to local businesses (restaurants, hotels, hardware stores, marinas, fuel suppliers etc.) related to project construction and testing, as well as an anticipated increase in tourism related spending.

Additionally the project will provide a clean renewable source of electricity to the mainland electric transmission grid, and will serve as an example for other Mid Atlantic communities as to how renewable offshore energy might benefit their communities.

4.2 Potential Project Impacts

Potential Project related impacts were evaluated for a wide range of resources or receptors including avian and bat communities, wetlands, geologic conditions, physical oceanography, air quality, water quality, finfish, benthos, marine protected species, visual and aesthetic environment, air and marine navigation/transportation, cultural and historic resources, commercial and recreational fisheries, socioeconomics, land use and project generated noise. The majority of will experience no negative impacts associated with the proposed project. Some may experience temporary or low level impacts and are summarized below.

Avian and Bat Communities

Potential impacts to avian populations found in the vicinity of the project will primarily be limited to the operation of the WTG over time. Pre-construction, construction and decommissioning activities associated with the G11X and submarine cable may temporarily displace birds and bats and will be dependent upon the season. Similarly, all phases (pre-construction, construction, operation, decommissioning) of the upland electrical interconnection system are expected to have negligible or no effect on avian and bat resources in the Project Area as disturbances from onshore construction activities are expected to be temporary and localized and within developed areas already used for commercial/industrial operations. Migratory birds may have some risk of colliding with the offshore G11X WTG depending on their flight path during migration. However, the areas of the Delmarva Peninsula reported as important migratory staging areas and bottlenecks are located two to six miles or more to the east of the proposed WTG location. Minimal impacts to state or federally listed species are anticipated due to project being a single WTG and the USFWS does not have any records of federally listed avian species occurring in the Project Area (USFWS, 2011). Similarly, the VADCR's Natural Heritage Program also reported that it does not have any records of rare, threatened or endangered avian species near the proposed offshore WTG location (VADCR, 2011b).

Small potential of collision risk to migrating and foraging bats near the G11X may exist once construction is completed. However, there is no known data on bats utilizing the airspace above the Chesapeake Bay where the WTG will be installed. Due the single turbine, significant impacts are not anticipated. No direct impacts to bat habitat are expected from the construction and decommission of the proposed location for the G11X and associated electrical export cable system.

Wetlands and Subaqueous Lands

Approximately 215 square feet of seabed will be permanently altered for the installation of the monopile foundation. Although seabed habitat will be eliminated within the footprint of the monopile foundation, given the very small size of the impacted area, impacts to seabed marine life are negligible. Approximately 16,240 square-feet of seabed at the base of the monopile foundation will be permanently altered by the installation of rock armoring for scour protection. This area will be transformed from a sandy, flat benthic habitat to a raised hard bottom feature, capable of supporting a wide array of marine and estuarine life. An area of bay bottom 3.2 miles long and 2 to 4 feet wide will be temporarily altered by hydraulic jetting during the installation of the submarine cable. Temporarily altered bay bottom areas are expected to fully recover, shortly after jetting is complete, and provide equally productive habitat as before the submarine cable was installed.

In the vicinity of the proposed landfall, approximately 150 square feet of the harbor immediately seaward of the existing bulkhead will be filled so as to allow the installation of a new steel bulkhead. There will be no impacts to wetlands along the upland portion of the transmission cable.

Water Quality

The results of the sediment dispersion modeling predict that suspended sediment concentrations decrease rapidly with time as the hydraulic jetting device passes a fixed point. Concentrations greater than 100 mg/L above ambient are predicted to last approximately one hour. After four hours, the suspended sediment concentration level above ambient is predicted to be below 50 mg/L and the concentration drops to less than 20 mg/L above ambient after six hours (ASA, 2011).

The use of hydraulic jetting technology will greatly limit the amount of sediment introduced into the water column. The predicted suspended sediment concentrations will be minimal when compared with other ongoing man-made activities and natural occurrences in Chesapeake Bay. Modeling shows that hydraulic jetting induced suspended sediment concentrations are predicted to decrease rapidly and be comparable to ambient conditions approximately 6 hours after the passage of the installation device (ASA, 2011).

Overall, on the basis of these findings, the suspension of sediments induced by the operation of the hydraulic jetting device for the Project is concluded to result in localized and short-duration impacts to TSS concentrations in the Project Area, which pose a temporary and minimal risk to environmental receptors when compared with the ongoing risks posed to water quality conditions by the continuous interaction of human and natural influences on existing sediment quality conditions in the Chesapeake Bay. No impacts to salinity or dissolved oxygen within the Project Area are anticipated.

Finfish

Potential impacts to finfish and finfish habitat from installation of the submarine cable and single G11X will be localized and temporary, and will primarily result from direct and indirect sediment disturbance. There will be little to no adverse impact to finfish resulting from operation of the G11X or submarine cable. Table 3.7-2 summarizes the potential impact from the Project to finfish depending on their life stage and habitat preference in the water column.

Benthos

Potential direct impacts to the benthic resources associated with the installation of the G11X foundation and submarine electric export cable are expected to be limited to the trench and narrow paths where the jetting device travels over the bottom as well as the area occupied by the G11X foundation.

Although the time necessary for recovery of macrofaunal communities in disturbed sediments varies by habitat and the nature and specific type of disturbance (abrasion, impingement, direct displacement, burial, etc.), recovery time to temporary physical disturbance in temperate estuarine muds and sands is relatively short, typically between six months and one-and-a-half years (e.g., Schaffner, 2010; Newell, et al., 1998). Therefore, the overall direct and indirect impacts of the proposed submarine cable installation to macrofaunal communities are anticipated to be temporary and localized.

Marine Protected Species

Construction and installation of the Project is expected to have minimal adverse impacts to the federally and/or state-listed threatened or endangered marine species known to occur within the Project Area. While the likelihood of protected species occurring in the Project Area during construction is considered low, the Applicant anticipates the NMFS will require standard monitoring practices for marine mammals and sea turtles. A monitoring plan will be developed, prior to initiation of offshore construction activities, that specifies the expectations of any observers contracted for the Project.

Visual and Aesthetic Environment

Given the presence of commercial vessel traffic and the industrial nature of Cape Charles Harbor, the G11X is likely to have minimal visual impact. Of the 21 previously recorded aboveground historic properties within the visual study area, 13 were noted as having potential visibility of the G11X based upon the vegetated viewshed map. However, research by the Project's architectural historian found that only eight of the 13 were considered significant historic properties. Field confirmation found that even fewer will have G11X visibility due to intervening structures and vegetation. Six of the eight significant historic properties were found to have settings (including views of the ocean) that contribute in an important way to their historic and/or architectural significance. Of the six, the introduction of views of the G11X would not have a significant effect on the Cape Charles Historic District, Custis Tombs and the Hermitage and would have no effect on Stratton Manor, Belle Vue, and Tower Hill, in the opinion of the architectural historian (JMA, 2011).

Inland resources that potentially have views toward the Project will receive minimal to low visual impact while shoreline resources might expect low to moderate visual impacts when the G11X is clearly visible. Homeowners within the beachfront area with views of the G11X may also experience moderate visual impacts, depending on the sensitivity of the individual viewers. Under hazy or adverse weather conditions this impact will be further reduced.

The required FAA light on the G11X will be similar to the existing channel marker and buoy lights already visible from most areas with views of the bay. Based on the presence of these existing lights and the potential for additional light pollution from commercial vessels, the light contributions from the FAA signal is not expected to cause adverse visual impacts.

Noise

Based on the results of the noise assessment conducted for the Project, predicted sound levels from the offshore wind turbine are expected to produce a negligible increase in background sound levels in Cape Charles. Underwater sound levels from operations are generally considered to be too low to be audible for most protected marine species. During construction, sound pressure levels from pile-driving activity have the potential to cause certain behavioral responses, such as avoidance, in marine species close enough to perceive the sound. The possibility exists that a very small number of protected marine species may come in proximity to the installation of the monopile foundation for the proposed project. However, the localized and short-term nature of the activity makes it highly unlikely that acoustical harassment will occur during construction of the project.

5.0 REFERENCES

Ahlen, I., L. Bach, H.J. Baagoe, J. Pettersson. 2007. Bats and offshore wind turbines studied in southern Scandinavia. The Swedish Environmental Protection Agency. Stockholm, Sweden. Vindval, Report 5571.

Ahlén, Ingemar. 2003. Wind Turbines and Bats – A Pilot Study, Final Report 11 December 2003. Swedish National Energy Administration, Box 310 SE-631 04 Eskilstuna, Sweden. 1-5 pp.

AMEC Project Investments Ltd.(AMEC) 2002. Lynn Offshore Wind Farm Environmental Impact Statement Non-Technical Summary. 18 pp.

American Society of Mammologists. 2001. Mammals of North Carolina. http://www.mammalsociety.org/statelists/ncmammals.html. Accessed February, 2011.

Applied Science Associates (ASA). 2011. Simulations of Sediment Dispersion from Hydraulic Jetting Cable Burial, Lower Chesapeake Bay. Prepared for Gamesa Energy USA, LLC.

Arnett, E. B., K. Brown, W. P. Erickson, J. Fiedler, T. H. Henry, G. D. Johnson, J. Kerns, R. R. Kolford, C. P. Nicholson, T. O'Connell, M. Piorkowski, and R. Tankersley, Jr. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72:

Atlantic Sturgeon Status Review Team. 2007. Status Review of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). Report to National Marine Fisheries Service, Northeast Regional Office. February 23, 2007. 174 pp.

Audubon. 2010. Audubon Important Bird Areas. Lower Delmarva Northhampton County. http://www.audubon.org/bird/iba/virginia/Documents/Lower%20Delmarva%20fact%20sheet.pdf . Accessed February, 7 2011.

Audubon. 2010a. Audubon Important Bird Areas Barrier Island Lagoon System Northhampton and Accomack Counties. http://www.audubon.org/bird/iba/virginia/Documents/Barrier%20Island_Lagoon%20System.pdf. Accessed February, 7 2011.

Baerwald, E.F., G.H. D'Amours, B.J. Klug, and R.M.R. Barclay. 2008. Barotrauma is a significant cause of bat fatalities at wind turbines. Current Biology, Volume 18, Issue 16. 26 August 2008. Pages R695-R696, ISSN 0960-9822, 10.1016/j.cub.2008.06.029. http://www.sciencedirect.com/science/article/pii/S0960982208007513.

Camphuysen, K., T. Fox, M. Leopold and I.K. Peterson. 2004. Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the U.K. Report Commissioned by COWRIE, United Kingdom.

Chesapeake Bay Program (CBP). 2011. Chesapeake Bay Program Water Quality Database (1984-Present). www.chesapeakebay.net/data_waterquality.aspx.

CBP. 2011a. Bay Field Guide: Shortnose Sturgeon. www.chesapeakebay.net/bfg_shortnosesturgeon.aspx?menuitem=14487. Accessed November 14, 2011.

CBP. 2011b. Bay Field Guide: Atlantic Sturgeon. www.chesapeakebay.net/bfg_atlantic_sturgeon.aspx?menuitem=14388. Accessed November 14, 2011.

CBP, 2011c. Bay Field Guide: Bottlenose Dolphin. http://www.chesapeakebay.net/bfg_bottlenose_dolphin.aspx?menuitem=14438. Accessed November 14, 2011.

CBP. 2009. Chesapeake Bay Program Bay Field Guide – Fish. http://www.chesapeakebay.net/bfg_fish.aspx?menuitem=14340. Accessed on November 9, 2011.

CBP. 2009a. Chesapeake Bay Program Bay Field Guide – Sea Turtles. http://www.chesapeakebay.net/bfg_seaturtle.aspx?menuitem=14464. Accessed on February 9, 2011.

CBP. 2009b. Chesapeake Bay Program Bay Field Guide – Underwater Bay Grasses (SAV). http://www.chesapeakebay.net/baygras.htm. Accessed on February 2, 2011.

CBP. 2009c. Fish. http://www.chesapeakebay.net/fish.aspx?menuitem=14624. Accessed on February 10, 2011.

CBP. 2006. Best Management Practices for Sediment Control and Water Clarity Enhancement.

CBP. 2000. The Impact of Susquehanna Sediments on the Chesapeake Bay Program: Scientific and Technical Advisory Committee Workshop Report.

Cryan, Paul M. 2011. Wind Turbines as Landscape Impediments to the Migratory Connectivity of Bats. ENVIRONMENTAL LAW [Vol. 41:355]

Cryan, P.M. 2003. Seasonal distribution of migratory tree bats (Lasiurus and Lasionycteris) in North America. Journal of Mammalogy. 84(2):579-593.

Cryan, P.M., A.C. Brown. 2007. Migration of bats past a remote island offers clues toward the problem of bat fatalities at wind turbines. Biological Conservation I39:1-11.

Cryan, P.M., M.A. Bogan, R.O. Rye, G.P. Landis, and C.L. Kester. 2004. Stable hydrogen isotope analysis of bat hair as evidence for seasonal molt and long-distance migration. Journal of Mammalogy. 85(5):995-1001.

Cryan, P.M., R.M.R. Barclay. 2009. Causes of Bat Fatalities at Wind Turbines: Hypotheses and Predictions. Journal of Mammalogy. 90(6):1330–1340.

Dowsett, H.J. and Wiggs, L.B., 1992. Planktonic Foraminiferal Assemblages of the Yorktown Formation, Virginia, USA. Micropaleontology, Volume 38, No. 1.

DONG Energy 2006. Danish Off shore Wind – Key Environmental Issues. The Danish Energy Authority and the Danish Forest and Nature Agency.

ESS Group, Inc. 2007. Cape Wind Energy Project-Final Environmental Impact Report (FEIR) EOEA #12643, Development of Regional Impact CCC#JR#20084. Volumes 1-3. Prepared for Cape Wind Associates, L.L.C., Boston, Massachusetts. Wellesley, Massachusetts.

Geo-Marine, Inc. 2010. New Jersey Department of Environmental Protection Ocean/Wind Power Ecological Baseline Studies, Final Report, Volume 1, Appendix B-Bats. Prepared by Geo-Marine, Inc. Plano, Texas. http://www.nj.gov/dep/dsr/ocean-wind/report.htm#1.

Gohn, G.S., Sanford, W.E., Powars, D.S., Horton, J.W., Jr., Edwards, L.E., Morin, R.H., Self-Trail, J.M. 2007. Site report for USGS test holes drilled at Cape Charles, Northampton County, Virginia, in 2004. United States Geological Survey, Open-File Report 2007-1094.

Government Accountability Office [GAO]. 2005. Wind power: impacts on wildlife and government responsibilities for regulating development and protecting wildlife. U.S. Government Accountability Office 05-9006, Washington, D.C., USA. ,http://www.gao.gov/new.items/d05906.

Hobbs, C.H. 2004. The Geological History of Chesapeake Bay, USA. Quaternary Science Reviews, Volume 23, p. 641-661.

John Milner Associates, Inc. (JMA). 2011. Phase 1A Archeological Reconnaissance and Historic Properties Viewshed Analysis: Gamesa Offshore Wind Energy Project. Prepared for Gamesa Energy USA, LLC.

Johnson, G.D. 2005. A review of bat mortality at wind-energy developments in the United States. Bat Research News (46)2: 45-49.

Kirkley, J. 1997. Virginia's Commercial Fishing Industry: Its Economic Performance and Contributions. Virginia Institute of Marine Science School of Marine Science College of William and Mary. 79 pp.

Knowles, A. 2008. An Introduction to the Seat Turtles of Virginia. CBNERR-VA. Presentation. http://ccrm.vims.edu/education/seminarpresentations/turtle.pdf. Accessed on February 9, 2011.

Kunz, T.H., E.B. Arnett, W.P. Erickson, A.R. Hoar, G.D. Johnson, R.P. Larkin, M.D. Strickland, R.W. Thresher, M.D. Turtle. 2007. Ecological impacts of wind energy development on bats: Questions, research needs, and hypotheses. Frontiers in Ecology and the Environment, Volume 5, Issue 6, August 2007. 315-324 pp.

Long, E.R., D.D. MacDonald, S. L. Smith, F.D. Calder. 1995. Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management. Vol. 19, No. 1, p. 81-97.

Manning, Phillip. 2004. North Carolina's Coastal Plain in Important Bird Areas of North Carolina, compiled by Walker Golder. Audubon, North Carolina. Chapel, Hill, NC.17-92 pp.

Multi-Resolution Land Characteristics Consortium. National Land Cover Database 2006. http://www.mrlc.gov/nlcd2006.php.

National Marine Fisheries Services (NMFS). November 7, 2011. Initial Threatened and Endangered Species Consultation Request Response.

NMFS. 2006. Atlantic (Acipenser oxyrhynchus) and Shortnose (*Acipenser brevirostrum*) Sturgeons. http://www.nefsc.noaa.gov/sos/spsyn/af/sturgeon/archives/42_Atlantic_ShortnoseSturgeons_2006.pdf.

NMFS. December, 1998. Final Recovery Plan for the Shortnose Sturgeon Acipenser brevirostrum. http://www.nmfs.noaa.gov/pr/pdfs/recovery/sturgeon_shortnose.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2011. United States Coast Pilot 3, 44rd edition. http://www.nauticalcharts.noaa.gov/nsd/cpdownload.htm. Accessed October 17, 2011.

National Renewable Energy Laboratory (NREL). 2010. Virginia 90 meter Offshore Wind Speed Map. http://www.windpoweringamerica.gov/windmaps/offshore_states.asp?stateab=VAhttp://www.windpoweringamerica.gov/windmaps/offshore_states.asp?stateab=VA.

NREL. 2009. United States Wind Resource Map 50 meter. http://www.nrel.gov/gis/wind.html.

NREL. 2003. Virginia 50-meter Wind Resource Map. http://www.windpoweringamerica.gov/images/windmaps/va_50m_800.jpg

National Research Council [NRC]. 2007. Environmental impacts of windenergy projects. The National

Academies Press, Washington, D.C., USA.

National Wind Coordinating Committee (NWCC). 2001. Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons of Avian Collision Mortality in the United States.

New Jersey Audubon Society (NJAS). 2008. Post-Construction Wildlife Monitoring at the Atlantic City Utilities Authority-Jersey Atlantic Wind Power Facility, Periodic Report Covering Work Conducted Between 20 July and 31 December 2007. Submitted to: New Jersey Board of Public Utilities, New Jersey Clean Energy Program, Two Gateway Center (8th Floor), Newark, NJ 07102. 6 pp.

New Jersey Department of Environmental Protection (NJDEP) Office of Science. 2010. Ocean/Wind Power Ecological Baseline Studies January 2008–December 2009. Prepared by Geo-Marine, Inc. Plano TX.

Newell, R.C., L.J. Seiderer, and D.R. Hitchcock. 1998. The Impact of Dredging Works in Coastal Waters: A Review of the Sensitivity to Disturbance and Subsequent Recovery of Biological Resources on the Sea Bed. Oceanography and Marine Biology: An Annual Review. 36:127-178.

North Carolina Birding Trail Guide (NCBT). http://www.ncbirdingtrail.org/trail_guide.asp. Accessed February 2011.

Paton, P., K. Winiarski, C. Trocki and S. McWilliams. 2010. Spatial Distribution, Abundance, and Flight Ecology of Birds in Nearshore and Offshore Waters of Rhode Island. Interim Technical Report for the Rhode Island Ocean Special Area Management Plan 2010. Department of Natural Resources, University of Rhode Island.

Perkins, S., T. Allison, A. Jones, and G. Sadoti. 2004a. A survey of tern activity within Nantucket Sound, Massachusetts, during the 2003 breeding season. Final Report for Massachusetts Technology Collaborative.

Perkins, S., T. Allision, A. Jones, and G. Sadoti. 2004b. A survey of tern activity within Nantucket Sound. Massachusetts, during the 2003 fall staging period. Final Report for Massachusetts Technology Collaborative.

Perry, Mathew C. and Alicia M. Wells-Berlin. 2012. Effect of nutrients on the physiology energetics, and behavior of captive seaducks relative to seaducks feeding ecology in Chesapeake Bay. http://seaduckjv.org/studies/pro3/pr34.pdf (accessed January 11, 2012).

PJM Environmental Information System 2011. PJM System Mix – Year: 2010. https://gats.pjm-eis.com/myModule/rpt/myrpt.asp Accessed December 2011.

Poag, C.W., 1997. The Chesapeake Bay bolide impact – a convulsive event in Atlantic Coastal Plain evolution. In: Segall, M.P., Colquhoun, D.J., Siron, D. (eds), Evolution of the Atlantic Coastal Plain – Sedimentology, Stratigraphy, and Hydrology. Sedimentary Geology, Volume 108, p. 49-50.

R. Christopher Goodwin & Associates, Inc. (RCG&A). 2011. Submerged Archeological Cultural Resources Assessment: Gamesa Offshore Wind Turbine Project. Prepared for Gamesa Energy USA, LLC.

Roble, Steven M. 2010. Commonwealth of Virginia Natural Heritage Resources of Virginia: Rare Animals. Virginia Department of Conservation and Recreation Division of Natural Heritage, Richmond, Virginia Natural Heritage Technical Report 10-12.

Ross, Paige, G and Mark W. Luckenbach. 2009. Distribution, habitat characteristics, prey abundance and diet of surf scoters (*Melanitta perspicillata*) and long-tailed ducks (*Clangula hyemalis*) in polyhaline wintering habitats in the mid-Atlantic region: a comparison of shallow coastal lagoons and Chesapeake Bay environs. http://seaduckjv.org/sdjv_pr104_final_report_Sept2009.pdf

Sadoti, G., T. Allison, S. Perkins, A. Jones. 2005a. A Survey of Tern Activity within Nantucket Sound, Massachusetts, During the 2004 Breeding Period. Final Report for the Massachusetts Technology Collaborative.

Sadoti, G., T. Allison, S. Perkins, E. Jedrey, A. Jones. 2005b. A Survey of Tern Activity within Nantucket Sound, Massachusetts, During the 2004 Fall Staging Period. Final Report to for the Massachusetts Technology Collaborative.

Schaffner, L.C. 2010. Patterns and Rates of Recovery of Macrobenthic Communities in a Polyhaline Temperate Estuary Following Sediment Disturbance: Effects of Disturbance Severity and Potential Importance of Non-local Processes. Estuaries and Coasts. 33:1300-1313.

Sjollema, A. L., and J. E. Gates. 2009. Bat activity and patterns in the vicinity of proposed wind facilities along the mid-Atlantic Coast. 66th Annual Northeast Fish and Wildlife Conference, Marriott Boston Newton, Newton, Massachusetts. 25-27 April.

Sky Vector Aeronautical Charts. 2011. The U.S. Flight Information Publication IFR Enroute High Altitude – US map H-12. http://www.skyvector.com

The Virginian-Pilot Newspaper. May 15, 2008. http://hamptonroads.com/2008/05/eastern-shore-town-cape-charles-braces-influx-new-housing. Accessed November 10, 2011.

Tougaard, J., P.T. Madsen, M. Wahlberg. 2008. Underwater Noise from Construction and Operation of Offshore Wind Farms. Bioacoustics 17:1-3 (2008): 143-146.

Tougaard, J., J. Carstensen, J. Teilmann, H. Skov, P.J. Rasmussen. 2009a. Pile driving zone of responsiveness extends beyond 20 km for harbor porpoises (Phocoena phocoena (L.)). J Acoust Soc Am. 2009 Jul;126(1):11-4.

Tougaard, J., O.D. Henriksen, and L.A. Miller. 2009b. Underwater noise from three types of offshore wind turbines: estimation of impact zones for harbor porpoises and harbor seals. Department of Arctic Environment, National Environmental Research Institute, Aarhus University, Roskilde, Denmark. (jat@dmu.dk). J Acoust Soc Am. 2009 Jun;125(6):3766-73.

Town of Cape Charles. www.capecharles.org. Accessed November 8, 2011.

Town of Cape Charles On-line Zoning Ordinance. Zoning map and District Regulations. http://capecharles.org/zoningord.htm.

Town of Cape Charles Planning Commission. Revision date June 25, 2007. The 2007 Cape Charles Population Study. Cape Charles, Virginia. http://capecharles.org/pdf/compplan/popstudy.pdf. Accessed November 8, 2011

Town of Cape Charles Planning Commission. June 11, 2009. Cape Charles Comprehensive Plan. Cape Charles, Virginia. http://www.capecharles.org/documents/20090611-CompPlan-Final-Approved.pdf. Accessed November 10, 2011.

U.S. Army Corps of Engineers (USACE). 2002. The Coastal Engineering Manual. http://chl.erdc.usace.army.mil/cem

USACE. 2004. Cape Wind Energy Project - Draft Environmental Impact Statement. USACE #NAE-2004-338-1, EOEA File #12993, Development of Regional Impact. CCC #JR#20084. Prepared for Cape Wind, Associates L.L.C., Boston, Mass. Concord, Mass November 2004.

U.S. Department of Transportation, Federal Highway Administration (USDOT FHA), 2006. FHWA Roadway Construction Noise Model User's Guide, FHWA-HEP-05-054, DOT-VNTSC-FHWA-05-01, Final Report, Table 1.

U.S. Geological Survey (USGS). 2003. A Summary Report of Sedimentation Processes in Chesapeake Bay and Watershed. Edited by Michael Langland and Thomas Cronin. Water-Resources Investigations Report 03-4123.

USGS. Professional Paper 1612. The Effects of the Chesapeake Bay Impact Crater on the Geologic Framework and the Correlation of the Hydrogeologic Units of the lower York-James Peninsula, Virginia. http://pubs.usgs.gov/pp/p1612/.

USGS. Professional Paper 1622. The Effects of the Chesapeake Bay Impact Crater on the Geologic Framework and the Correlation of the Hydrogeologic Units of Southeastern Virginia, South of the James River. http://pubs.usgs.gov/pp/p1622/.

USGS. Open-File Report 2007-1094. Site Report for USGS test holes drilled at Cape Charles, Northampton County, Virginia, in 2004. http://pubs.usgs.gov/of/2007/1094/.

USGS. Fact Sheet 49-98. The Chesapeake Bay Bolide Impact: A New View of Coastal Plain Evolution. http://marine.usgs.gov/fact-sheets/fs49-98/.

U.S. Census Bureau. Data for 2010. http://quickfacts.census.gov/qfd/states/51/51131.html. Accessed November 8, 2011.

U.S. Census Bureau. American Factfinder Data for 2010. http://factfinder2.census.gov. Accessed November 10, 2011.

U.S. Fish and Wildlife Service (USFWS), 2012. Environmental Conservation Online System. Query results generated on January 10, 2012 at http://ecos.fws.gov/tess_public/countySearch!speciesByCountyReport.action?fips=51001.

USFWS. 2011. Draft Land-Based Wind Energy Guidelines Recommendations on Measures to Avoid, Minimize, and Compensate for Effects to Fish, Wildlife, and their Habitats. http://www.fws.gov/windenergy/docs/Final_Wind_Energy_Guidelines_2_8_11_CLEAN.pdf. Accessed February 11, 2010.

USFWS. 2011a. National Wetlands Inventory. http://www.fws.gov/wetlands/. Accessed November 21, 2011.

USFWS, 2011b. Northeastern Beach Tiger Beetle USFWS Species Profile. 2011. http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=I02C. Accessed December 13, 2011.

Virginia Department of Conservation and Recreation (VADCR), 2012. Virginia Natural Heritage Resources Database Physiographic Province Search. Query results generated on January 10, 2012 at http://www.dcr.virginia.gov/natural_heritage/resources/select_prov.cfm.

VADCR. 2011. The Natural Communities of Virginia Classification of Ecological Community Groups Second Approximation (Version 2.4). Accessed June, 2011.

VADCR, Natural Heritage Program. 2011a. Definitions of Abbreviations used on Natural Heritage Resource Lists. http://www.dcr.virginia.gov/natural_heritage/help.shtml.

VADCR, Natural Heritage Program. April 10, 2011b.Initial Threatened and Endangered Species Consultation Request Response.

VADCR, Division of Soil and Water Conservation. 1992. Virginia Erosion and Sediment Control Handbook, 3rd Edition.

Virginia Department of Environmental Quality (VADEQ). 2011. Wind Permit by Rule Guidance, Section III: Coastal Avian Protection Zone Narrative. http://www.deq.virginia.gov/coastal/coastalgems.html.

Virginia Department of Game and Inland Fisheries (DGIF), 2012. Virginia Fish and Wildlife Information Service (VaFWIS) County Search. Query results generated on January 10, 2012 at http://vafwis.org/fwis/?Menu=Home.__By+Map.

Virginia DGIF, Bureau of Wildlife Resources, Statewide Resources. August 9, 2011.

Virginia DGIF. 2010. Fish and Wildlife Service Species Information. http://vafwis.org/fwis/?Title=VaFWIS+Species+Information&vUT=. Accessed February, 7 2011.

Virginia Department of Health, Division of Shellfish Sanitation. 2005. Notice and Description of Shellfish Area Condemnation Number 089-011, Cape Charles and Vicinity.

Virginia Institute of Marine Science (VIMS). 2010. Virginia's Sea Turtles. http://www.vims.edu/research/units/programs/sea_turtle/va_sea_turtles/index.php.

VIMS. 2009. 2009 Distribution of Submerged Aquatic Vegetation in Chesapeake Bay and Coastal Bays. http://web.vims.edu/bio/sav/sav09/index.html.

Virginia Marine Resources Commission (VMRC). 2010. Report of the Opportunities For Offshore Wind Energy in State Territorial Waters to the Governor and the General Assembly of Virginia, Senate Document No. 10. Commonwealth of Virginia Richmond 2010. 30 pp.

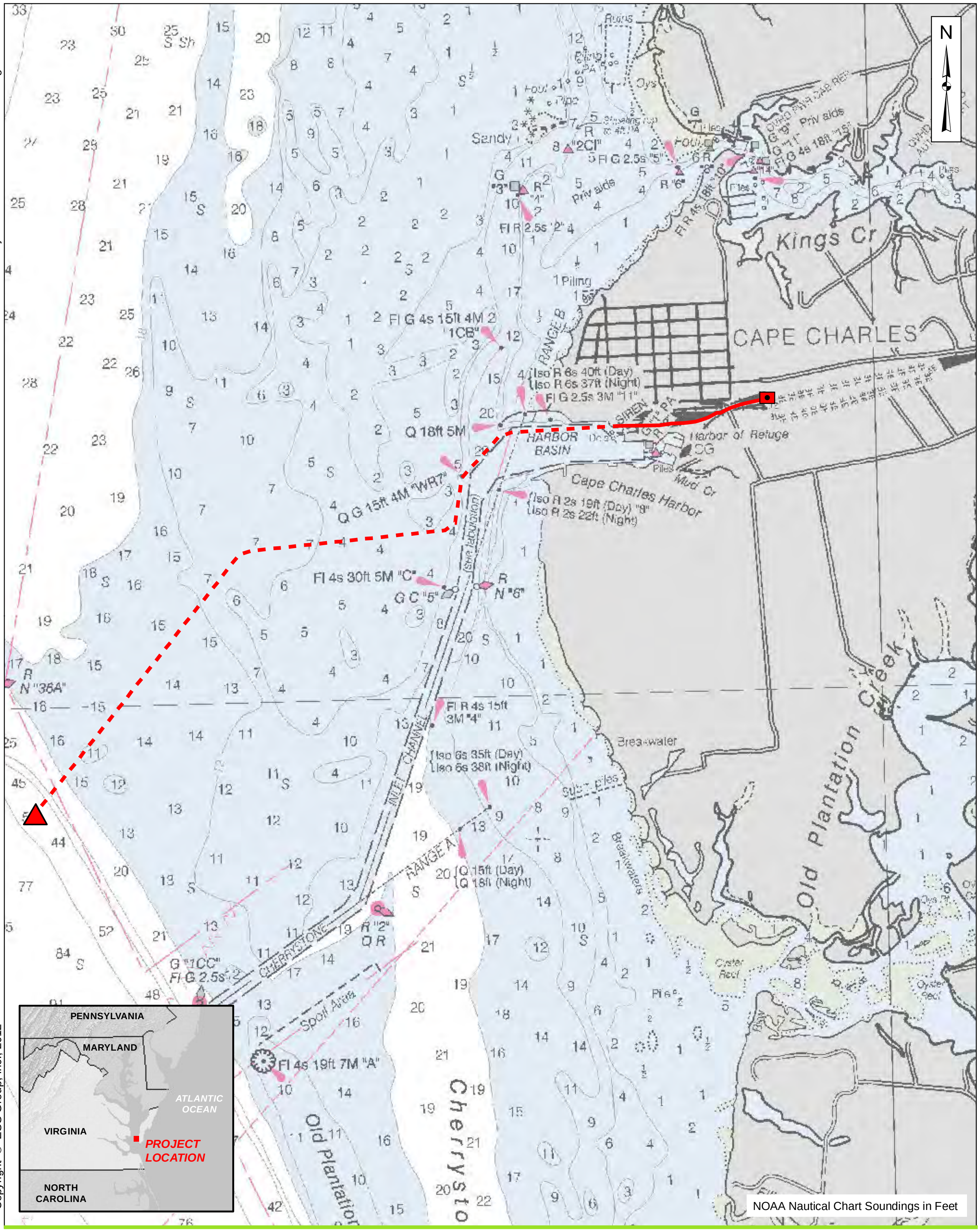
VMRC. 2011. Personal communication with Lewis Gillingham.

Virginia State Water Control Board (VSWCB). 2011. 9 VAC 25-260 Virginia Water Quality Standards. Statutory Authority: §62.1-44.153a of the Code of Virginia. With Amendments effective January 6, 2011.

Ward, L.W., 1988. Mesozoic and Cenozoic Stratigraphy of Southeastern Virginia and Southern Maryland. Field Trip Guide, U.S. Geological Survey.

Watts, B.D. 2006. Synthesizing information resources for the Virginia Important Bird Area Program: Phase I Delmarva Peninsula and tidewater. Center for Conservation Biology Technical Report Series, CCBTR-06-05. College of William and Mary Williamsburg, VA. 70 pp.

Figures



ess group
environmental consulting & engineering services

GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

Scale: 1" = 3,000'

0 3,000 Feet

Source: 1) ESS, Siting Area & Routing, 2011
2) NOAA, Nautical Chart, 2011

Legend

- Substation Easement
- Proposed G11X WTG Location
- Submarine Cable Route
- Upland Cable Route

Site Locus

Figure 1.0-1

Location: G:/GIS-Projects/Gamesa/VA/00-mxd/Landfall-Locus.mxd

ess group
environmental consulting & engineering services

GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

Scale: 1" = 800'

0 800 Feet

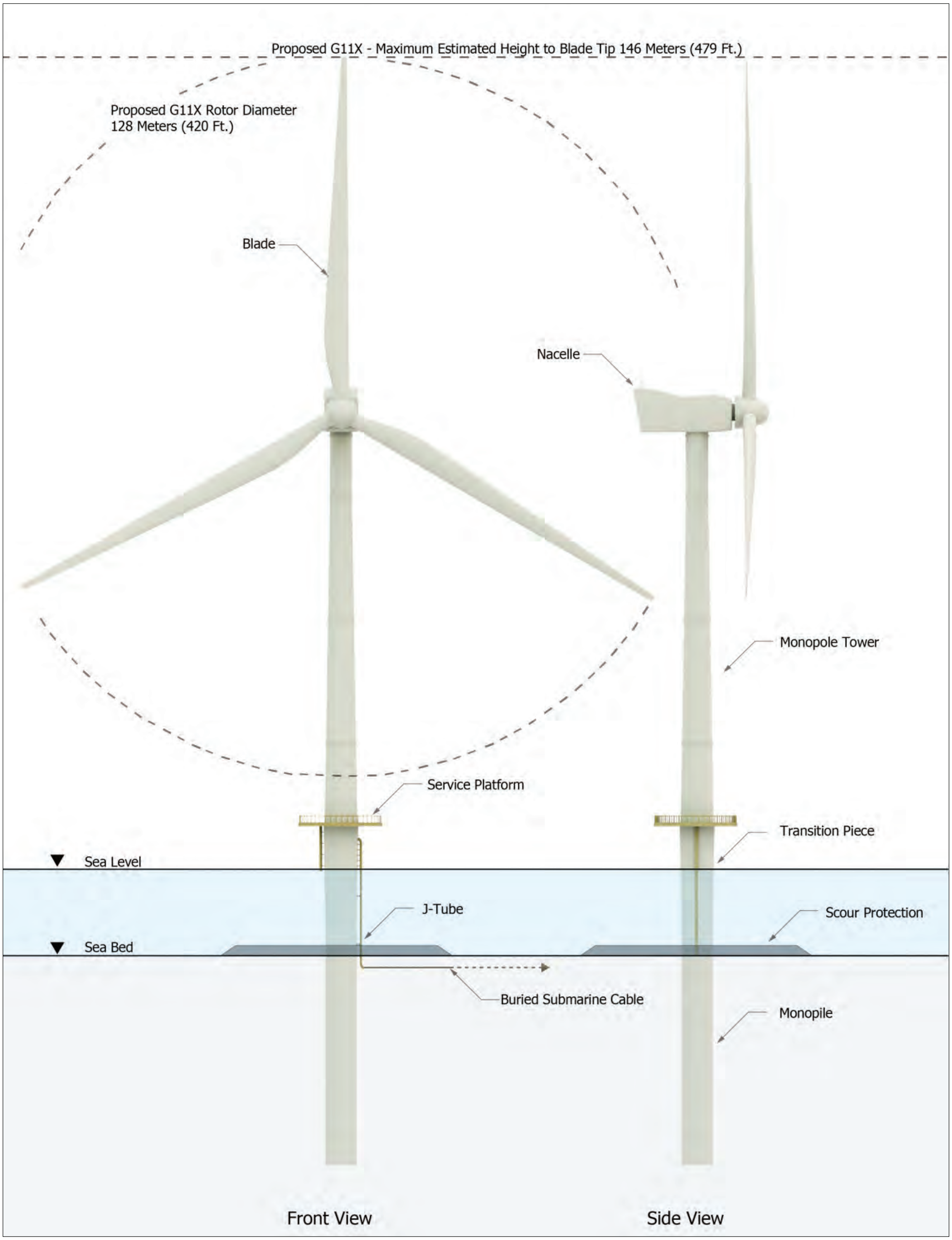
Source: 1) ESS, Siting Area & Routing, 2011
2) USDA, Ortho, 2011

Legend

- Proposed G11X WTG Location
- Submarine Cable Route
- Upland Cable Route
- Limit of Privately Held Submerged Lands
- Permitted Breakwaters (Not yet Built)
- Substation Easement

Submarine Cable Landall and Upland Cable Route

Figure 1.0-2



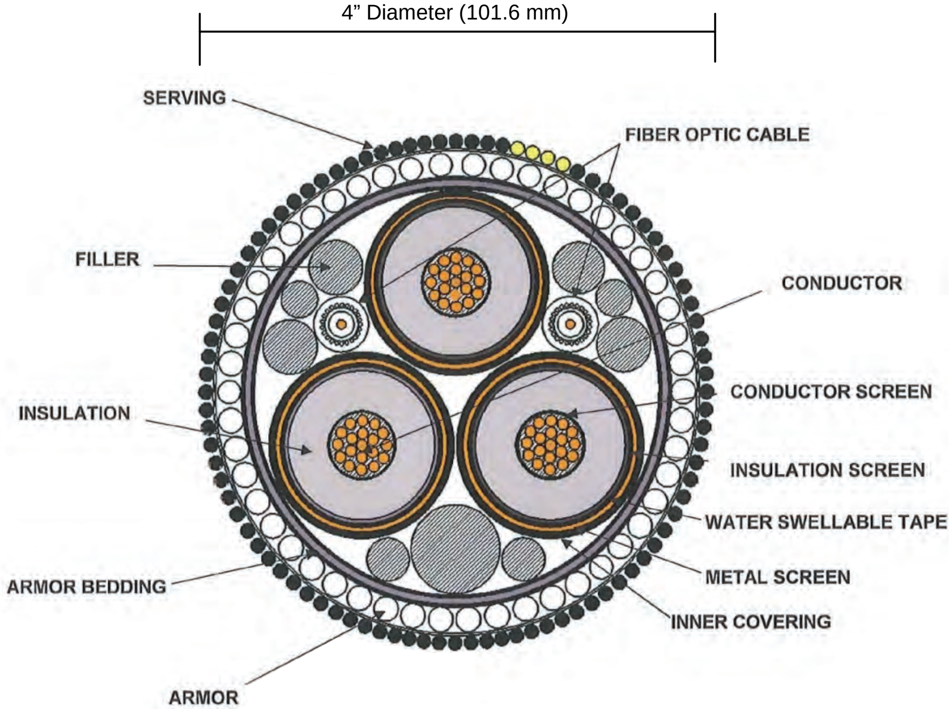
GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

Scale: Not to Scale

Typical Offshore Wind Turbine Schematic

Figure 1.2-1

Submarine Cable Cross-Section Schematic



Representative Submarine Cable Image

GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

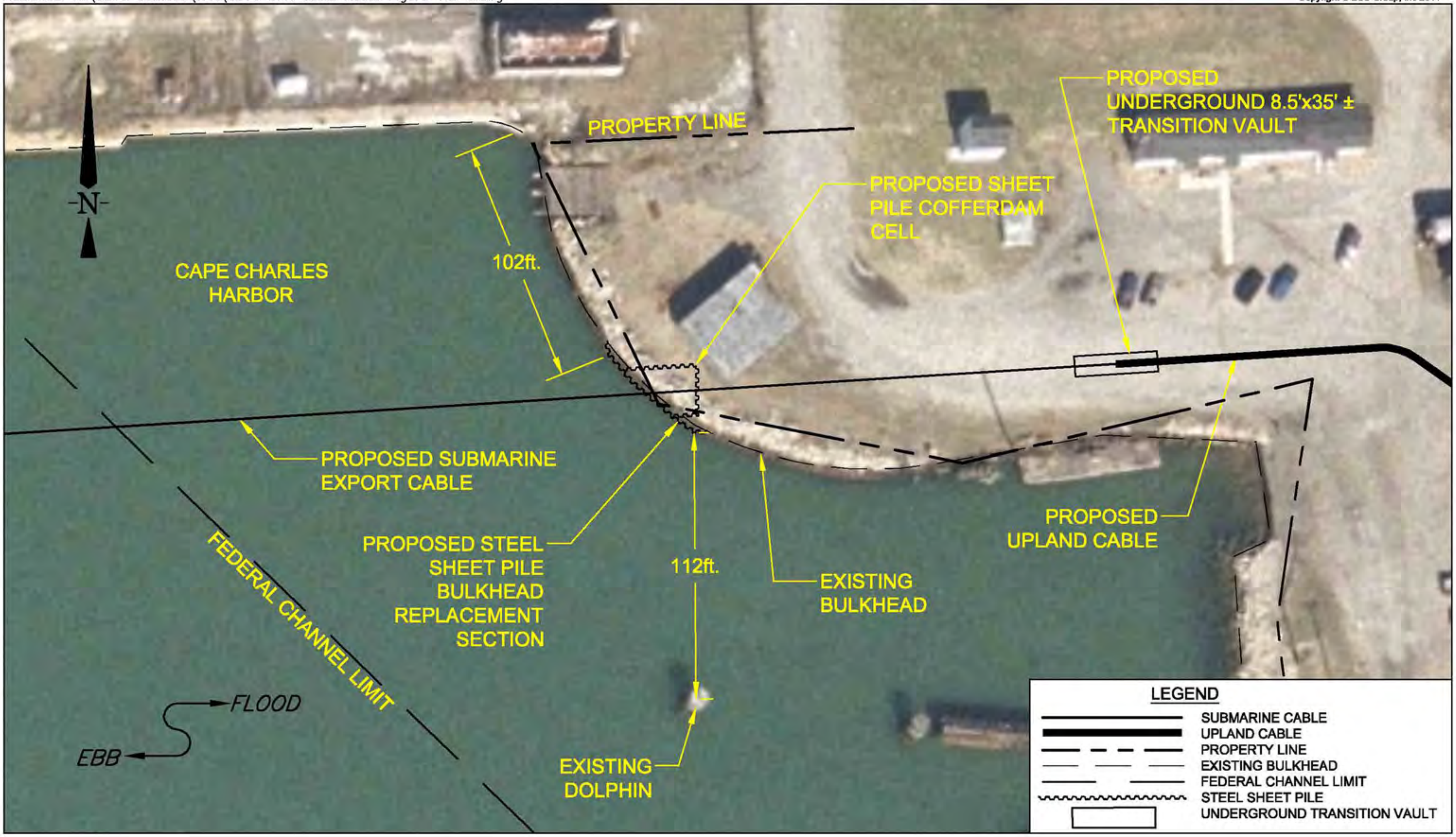
Scale: Not to Scale

Source: Submarine Cable Installation Specification DRAFT 10-13-2011

Schematic of Submarine Cable

Figure 1.2-2

DATE: Jan 16, 2012 – 11:51AM
FILENAME: H:\G216 Gamesa\JPA\G216-JPA Cable Route Figure 1.2-3.dwg



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Offshore Cape Charles, Virginia

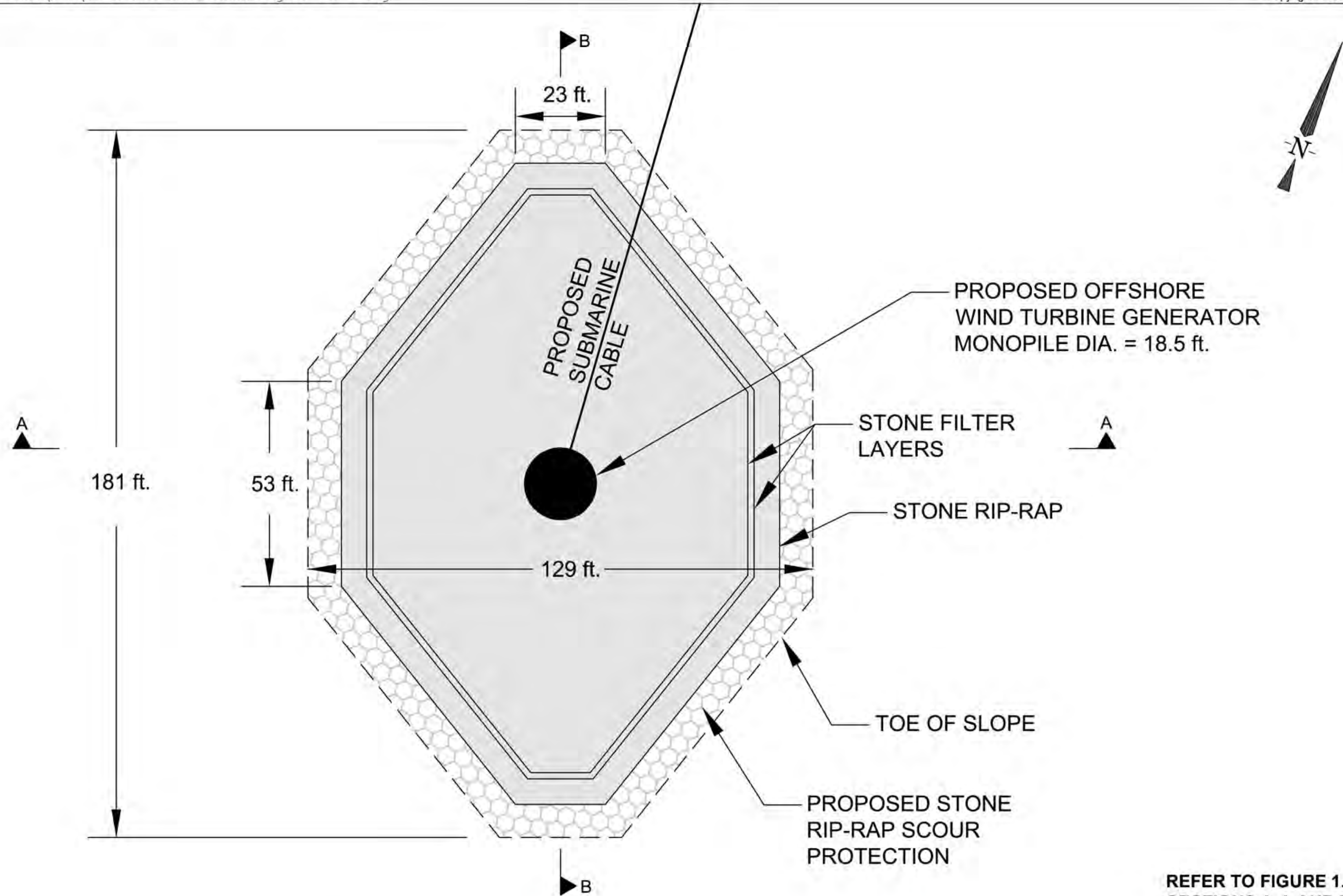
Scale: 1"=60'
0 60 FEET

Source: Aerial Imagery dated 2002 obtained from Randford University

Layout for Submarine Cable Landfall

Figure 1.2-3

DATE: Jan 16, 2012 - 12:10PM
FILENAME: H:\G216 Gamesa\JPA\G216-JPA Cable Route Figure 1.3-1.dwg



REFER TO FIGURE 1.3-1b FOR SECTIONS A-A AND B-B.

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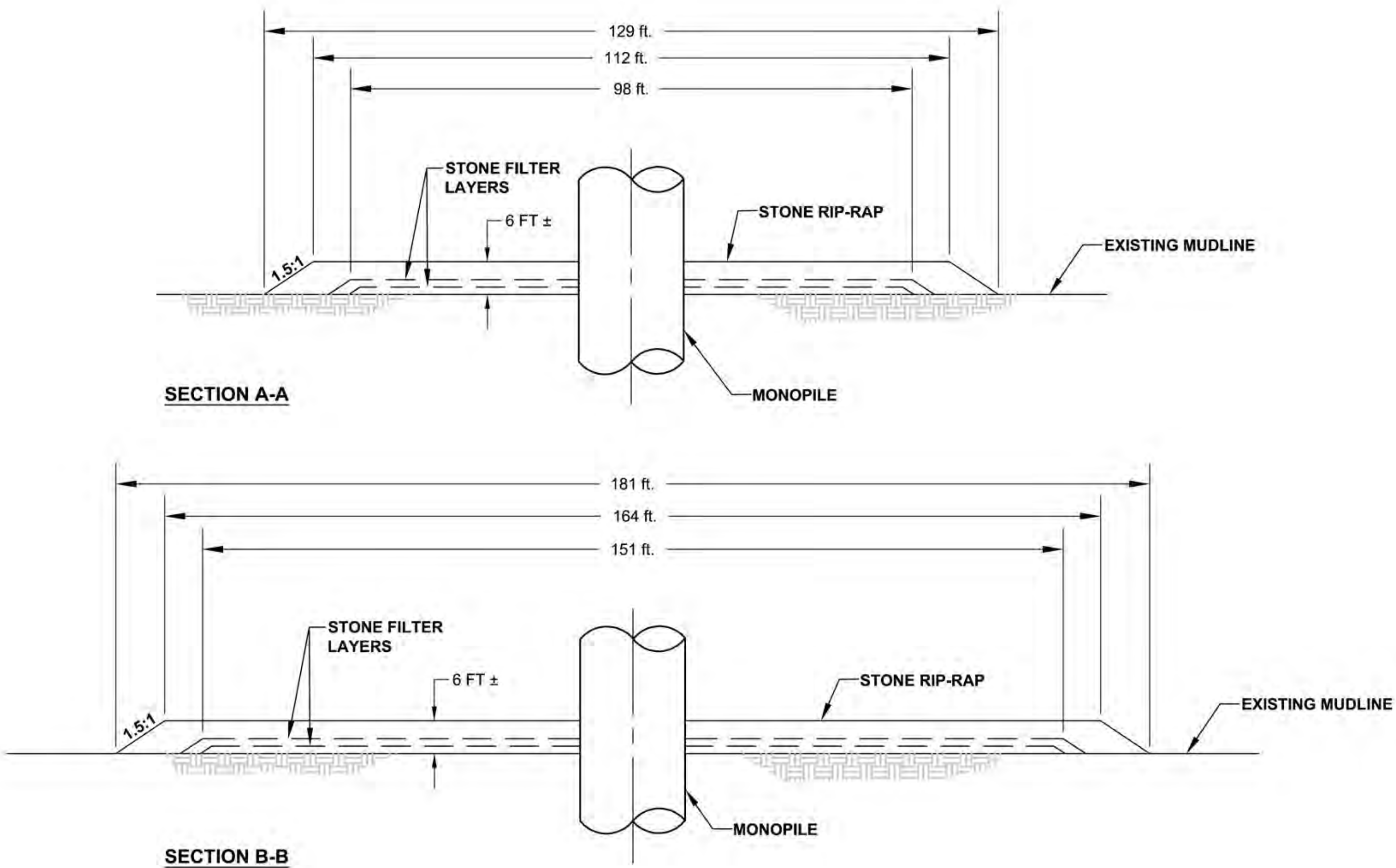
Offshore Cape Charles, Virginia

Scale: 1"=40'
0 40 FEET

Source: Scour Protection designed by PB America, Inc.

Foundation
Scour Protection Design
Plan View

Figure
1.3-1a



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Offshore Cape Charles, Virginia

Scale: N.T.S.

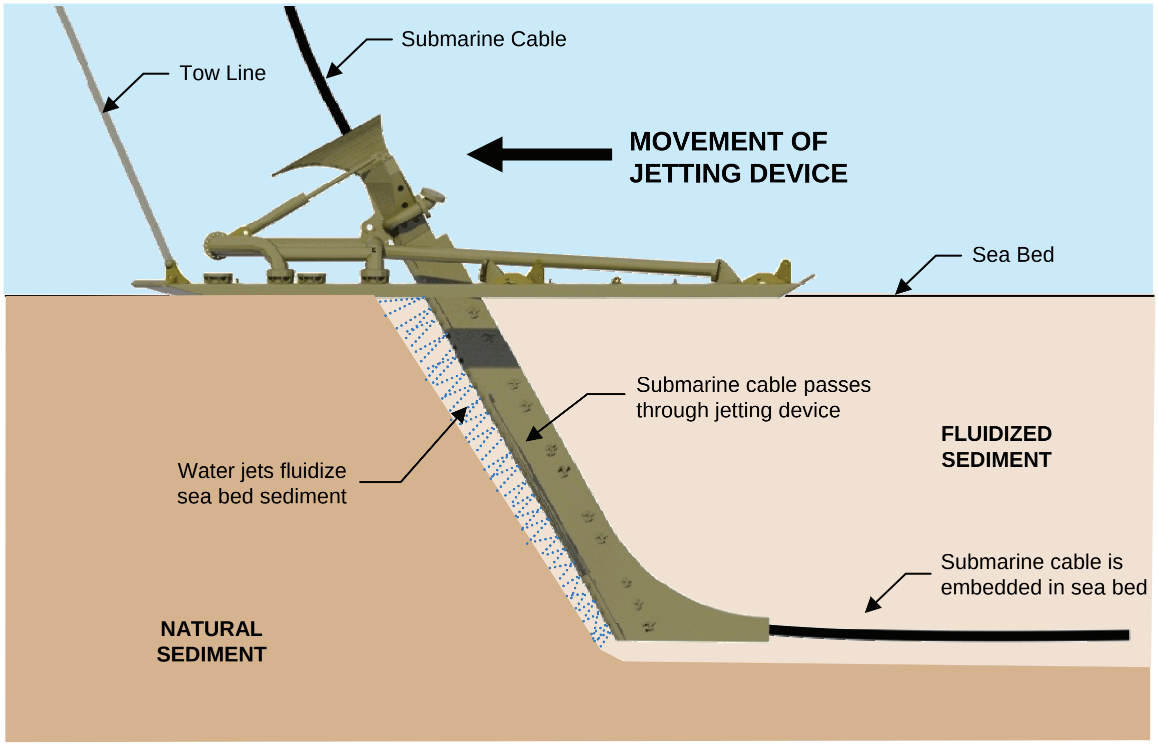
0 N.T.S.

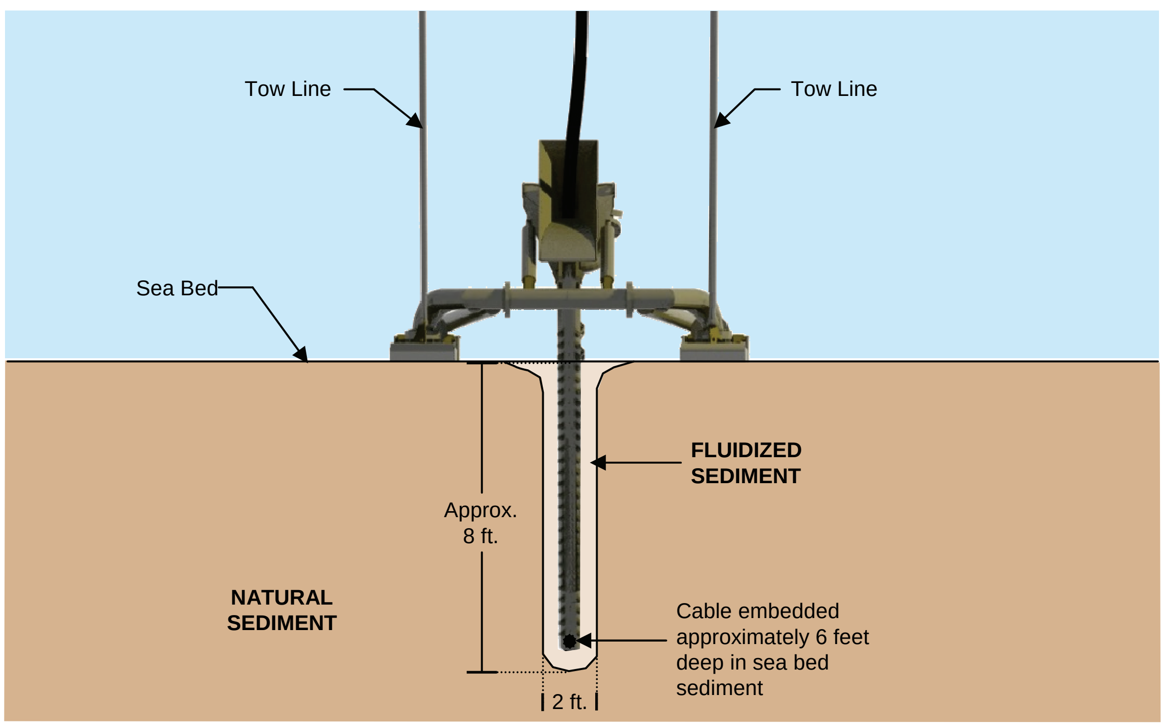
Source: Scour Protection designed by PB America, Inc.

Foundation
Scour Protection Design
Section View

Figure 1.3-1b

Location: J:\G216-000 Gamesa\Permitting\Joint Permit\Draft-Figures\PPT\Final





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Offshore Cape Charles, Virginia

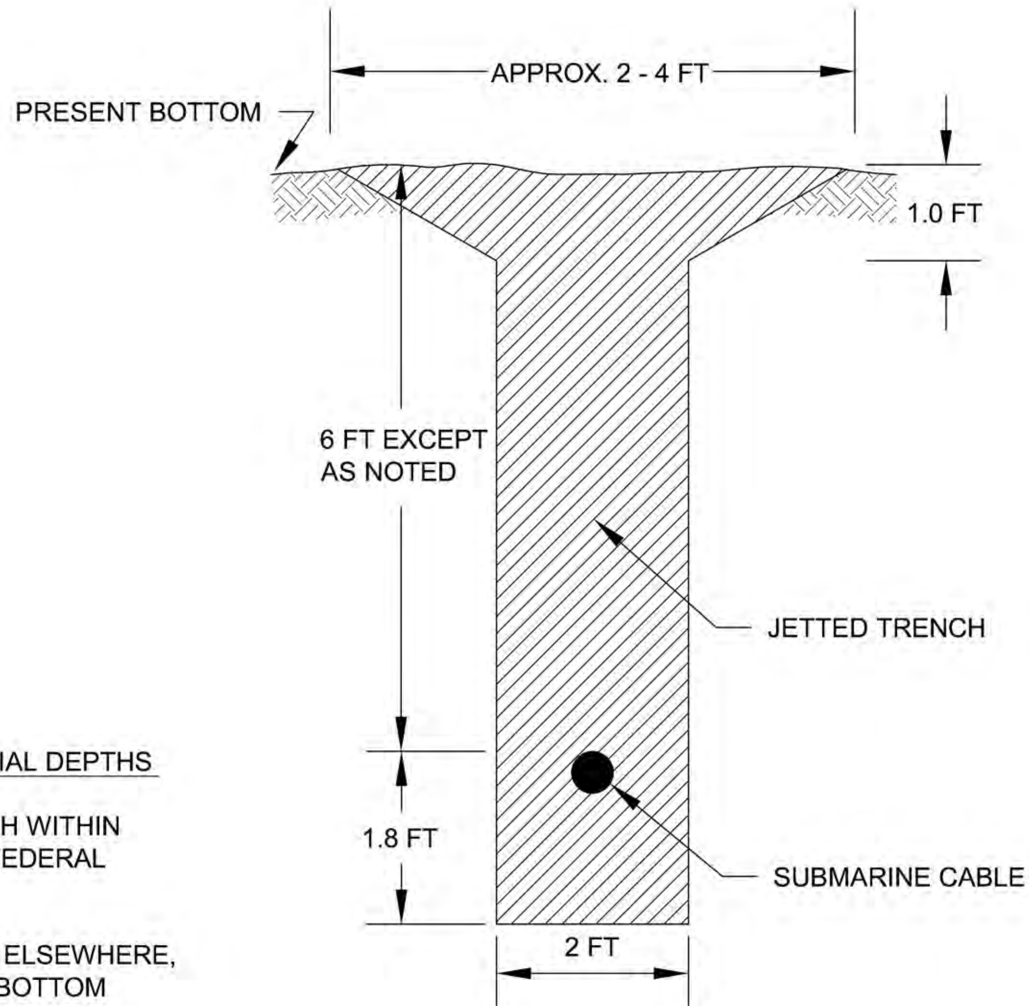
Scale: Not to Scale

Source: ESS Group, Inc.

Typical Hydraulic Jetting Device for Submarine Cable Installation

Figure 1.3-2

DATE: Jan 18, 2012 - 12:59PM
FILENAME: H:\G216 Gamesa\JPA\G216-JPA Cable Route Figs 1.3-2.dwg



PROPOSED SUBMARINE CABLE BURIAL DEPTHS

- 6 FT BELOW AUTHORIZED DEPTH WITHIN CAPE CHARLES CITY HARBOR FEDERAL CHANNEL LIMITS.
- 6 FT BELOW PRESENT BOTTOM ELSEWHERE, EXCEPT 3 FT BELOW PRESENT BOTTOM WITHIN 40 FT OF PROPOSED BULKHEAD

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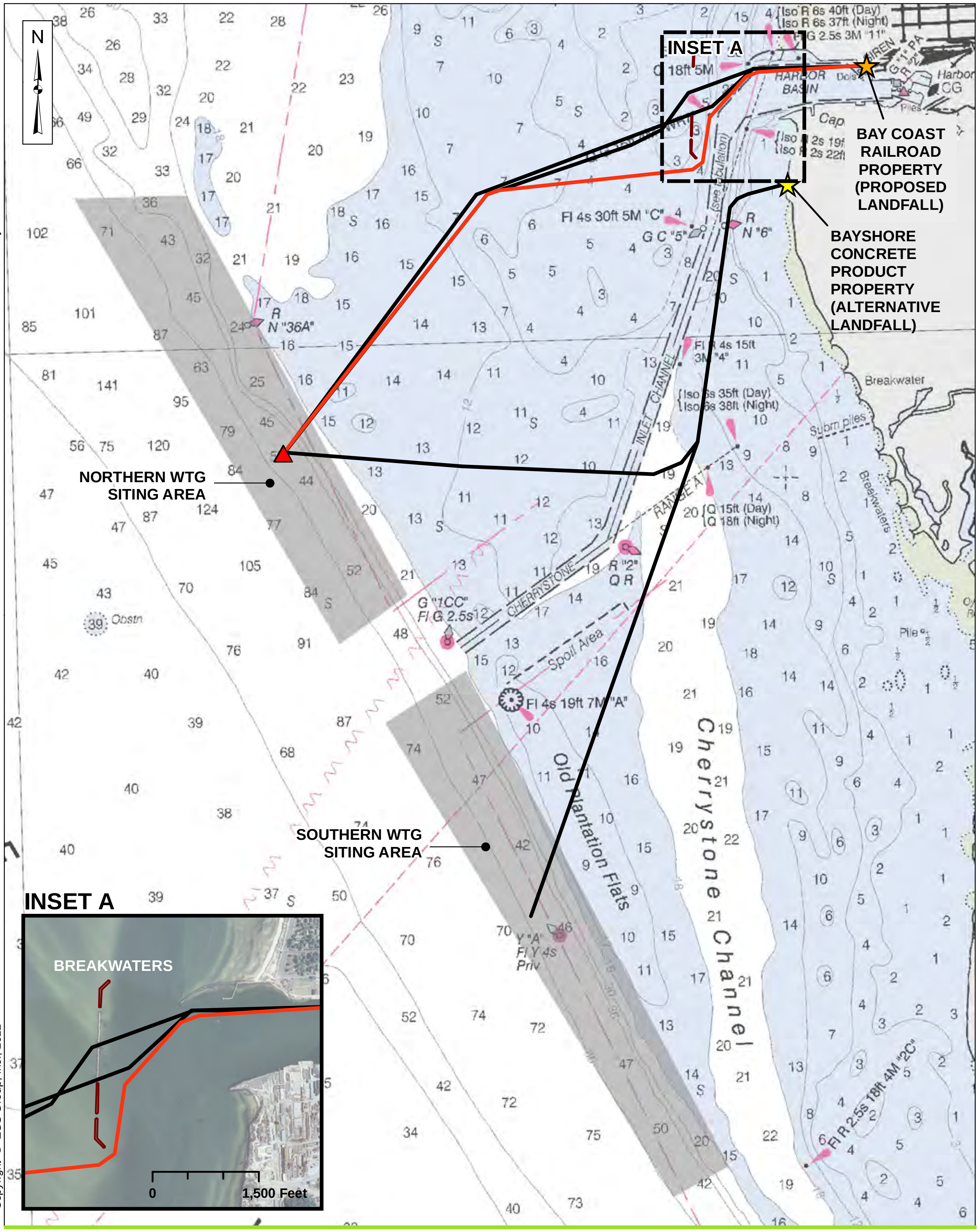
GAMESA ENERGY USA LLC
Offshore Cape Charles, Virginia

Scale: N.T.S.
0 N.T.S.

Typical Cross Section of Submarine Cable Trench

Figure 1.3-3



Location: G:/GIS-Projects/Gamesa/VA/00-mxd/VA-Alts.mxd

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GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

Scale: 1" = 3,000'

0 3,000

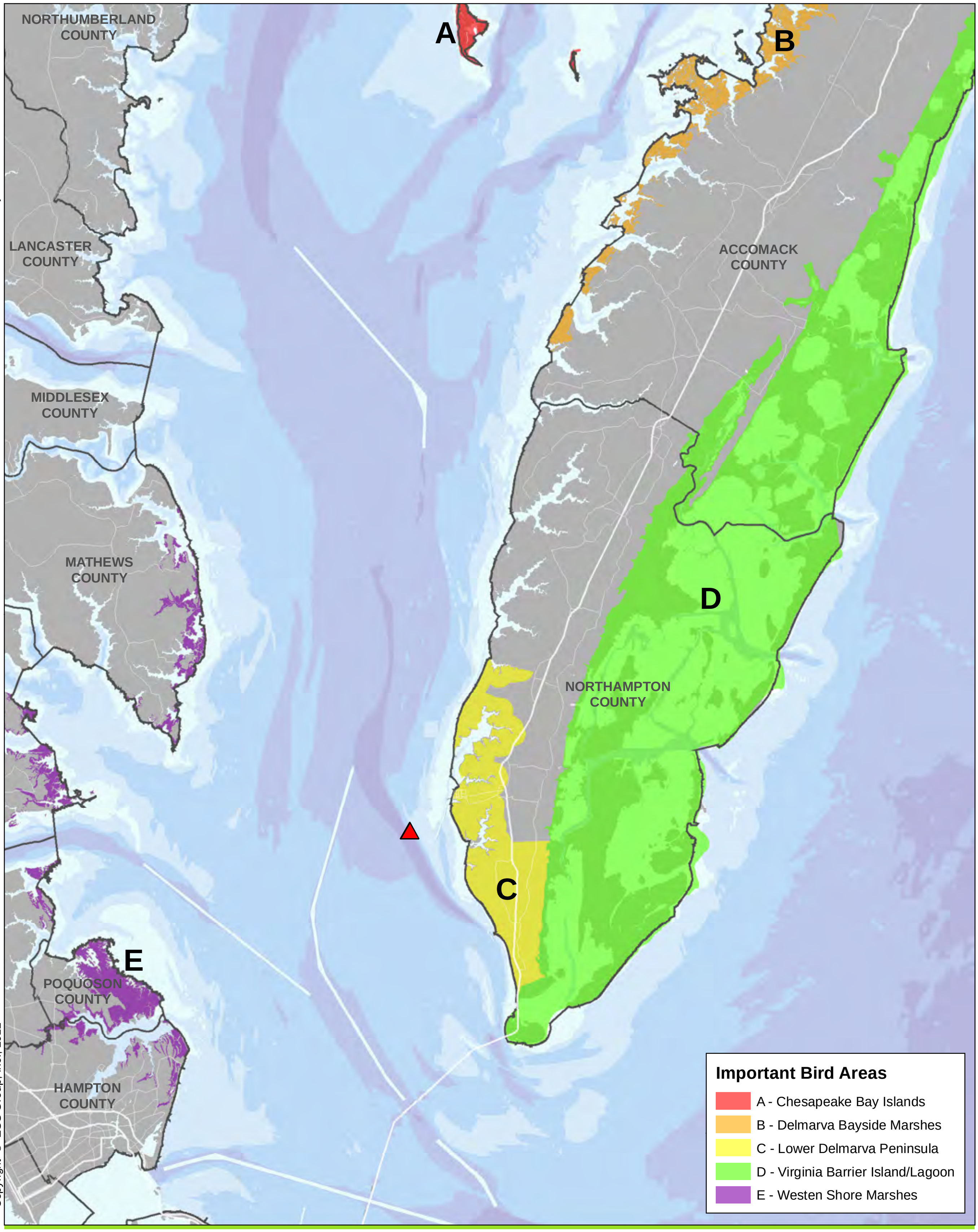
Source: 1) NOAA, Nautical Chart (12224), 2009
2) ESS, Siting Area & Routing, 2011

Legend

- Proposed G11X WTG Location
- Proposed Landfall Location
- Alternative Landfall Location
- Alternative WTG Siting Areas
- Proposed Submarine Cable Route
- Alternative Cable Routes
- Permitted Breakwaters (Not yet Built)

Submarine Cable and Landfall Alternatives

Figure 2.2-1



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Offshore Cape Charles, Virginia

Scale: 1" = 7 Miles

0 7 Miles

Source: 1) VDGIF, BLI - Important Bird Areas, 2008
2) ESS, Turbine & Routing Locations, 2011

Legend

Proposed G11X WTG Location
County Boundaries

Bird Life International Important Bird Areas of Virginia

Figure 3.1-1

Location: J:\G216-000 Gamesa\Permitting\Joint Permit\Draft-Figures\PPT\Final

Recording Data During Aerial Avian Survey

Aerial Avian Survey Plane and Team

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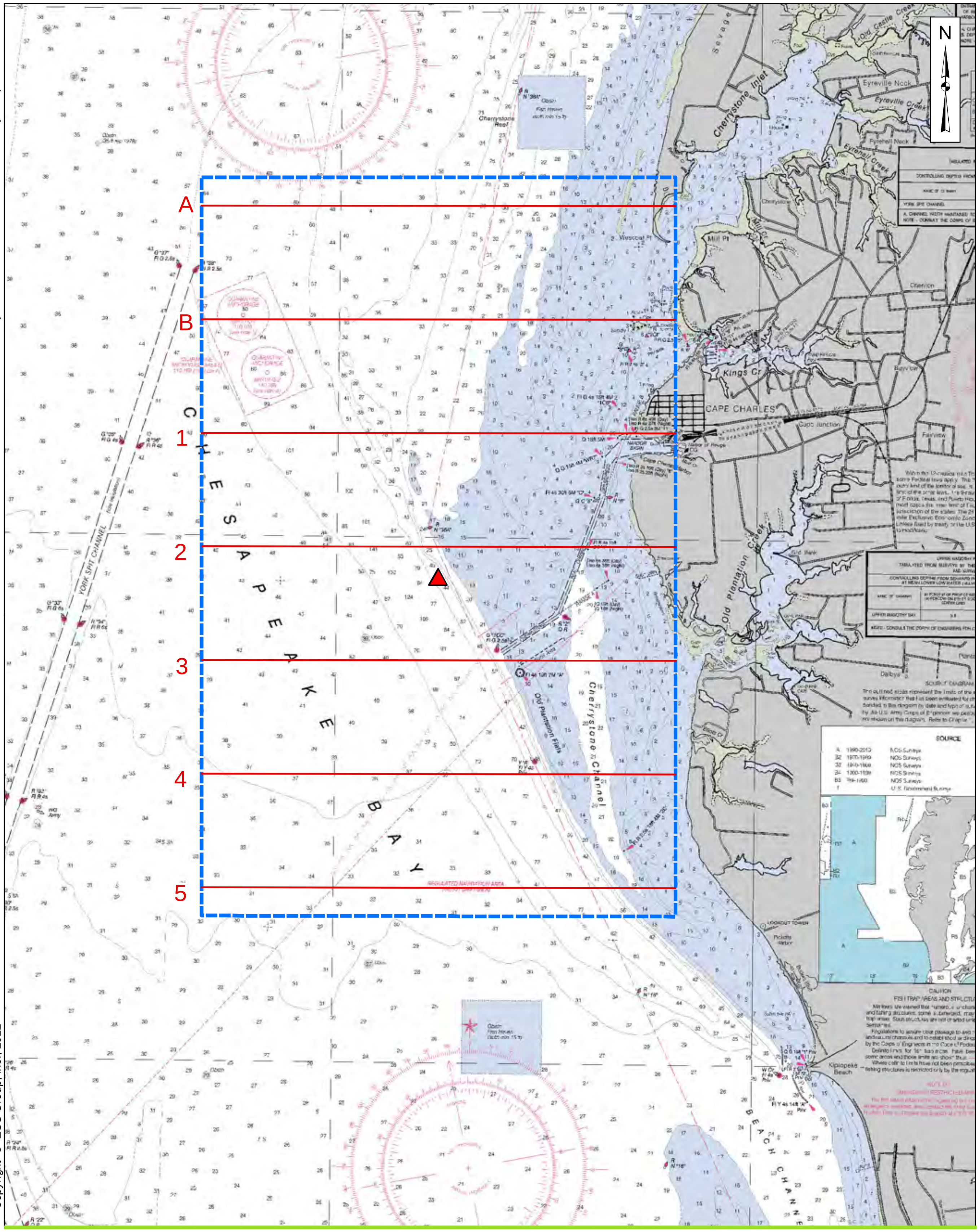
GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

Source: ESS Group, Inc.

Avian Aerial Survey Photos

Figure 3.1-2

Location: G:/GIS-Projects/Gamesa/VA/00-mxd/Avian-Surveys-Cape-Charles1.mxd



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Offshore Cape Charles, Virginia

Scale: 1" = 8,000'

0 8,000 Feet

Source: 1) NOAA, Nautical Chart (12224), 2011
2) ESS, Proposed Survey Area & Transects, 2011

Legend

Proposed G11X WTG Location

Survey Area

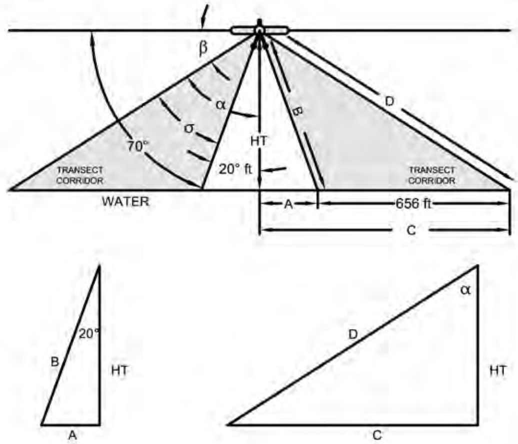
Transects
1 - 5 - Original Survey Transects
A, B - Additional Survey Transects

Avian Aerial Survey Tracklines - Plan View

Figure 3.1-3

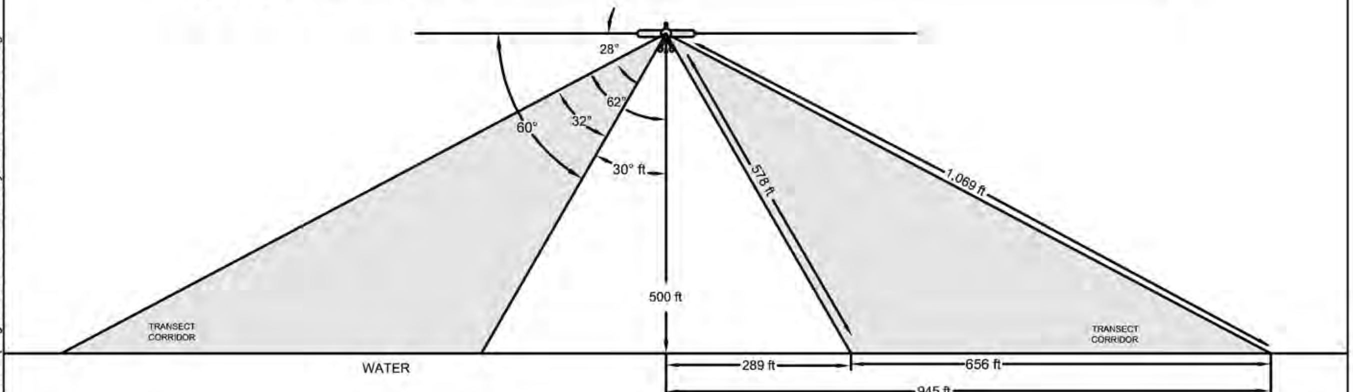
CALCULATION DETAILS

N.T.S.



AERIAL SURVEY AT 500 FEET

SCALE: 1" = 300'



DATE: Jan 26, 2012 – 1:48PM
FILENAME: H:\G216 Gamesa\Figure_Aerial Survey_500ft_rev.dwg

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Offshore Cape Charles, Virginia

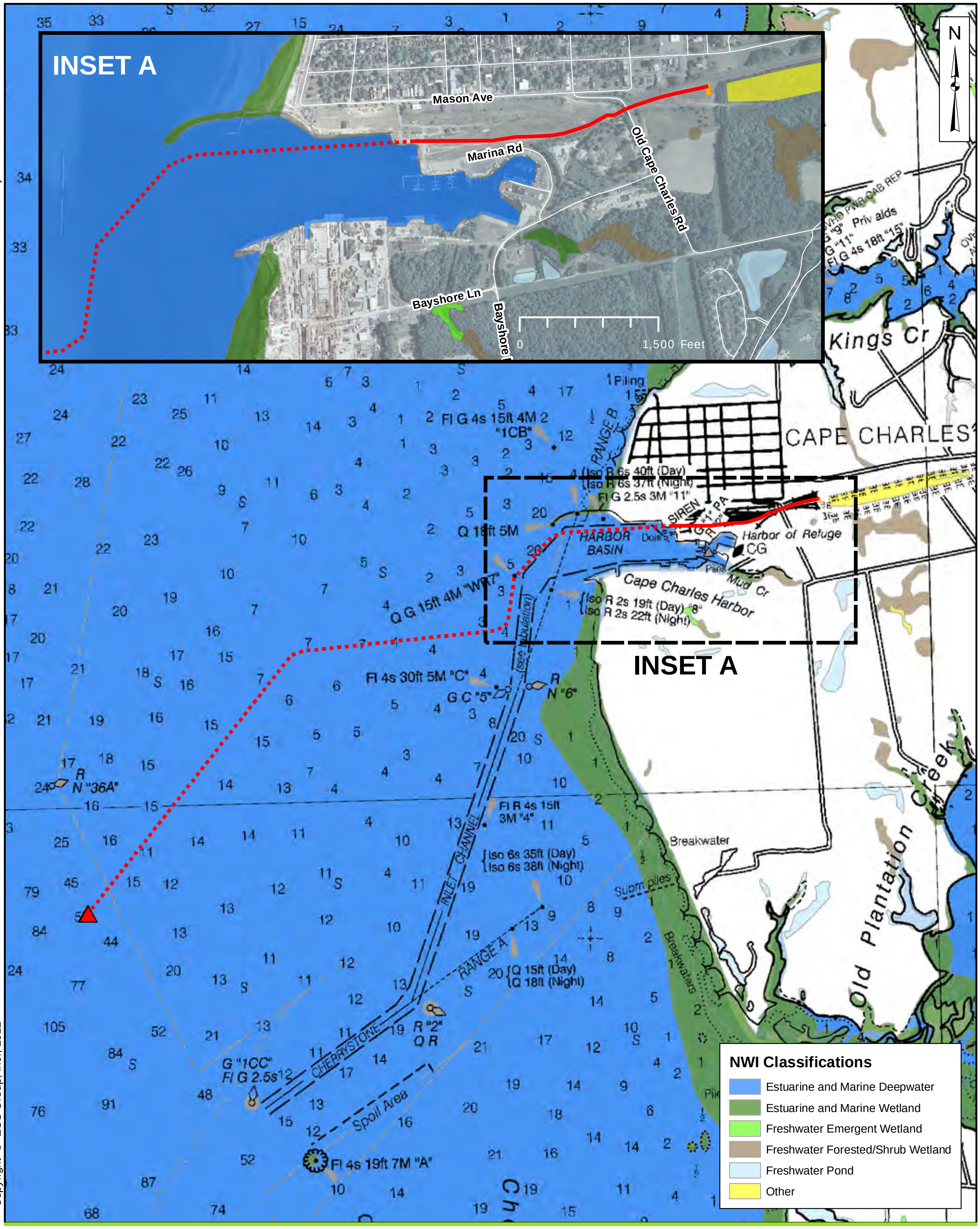
Scale: 1"=300'

0 300 FEET

Source: Derived from a drawing by Doug Forsell, U.S. Fish and Wildlife Service

Avian Aerial Surveys
Profile View

Figure 3.1-4



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Offshore Cape Charles, Virginia

Scale: 1" = 3,000'
0 3,000 Feet

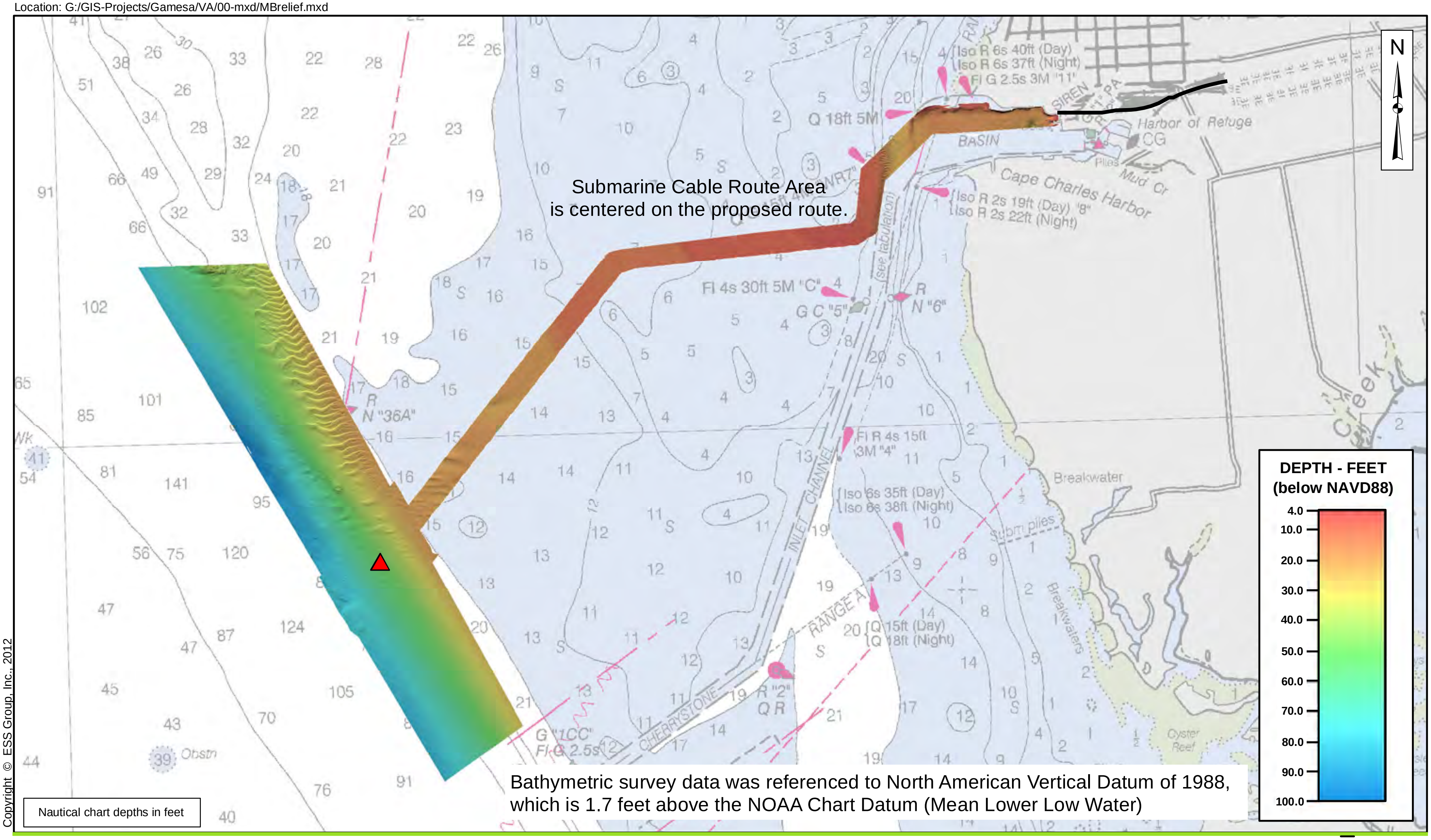
Source: 1) USDA, Ortho, 2011 2) NOAA, Nautical Chart, 2011
3) ESS, Siting Area & Routing, 2011
4) USFWS, NWI, downloaded 2011

Legend
- Proposed G11X WTG Location
- Submarine Cable Route
- Upland Cable Route
- Substation Easement

Federal National Wetlands Inventory Classifications

Figure 3.2-1

Location: G:/GIS-Projects/Gamesa/VA/00-mxd/MBrelief.mxd



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Offshore Cape Charles, Virginia

Scale: 1" = 0.5 mile

0 0.5 1 Miles

Source: 1) ESS, Siting Area & Routing, 2011
2) NOAA, Nautical Chart, 2011 3) OSI, MB Relief Mapping, 2011

Legend

Proposed G11X WTG Location

Upland Cable Route

Project Area and Results of Bathymetric Survey

Figure 3.3-1

Benthic Grab Sampler

Vibracore Sampler

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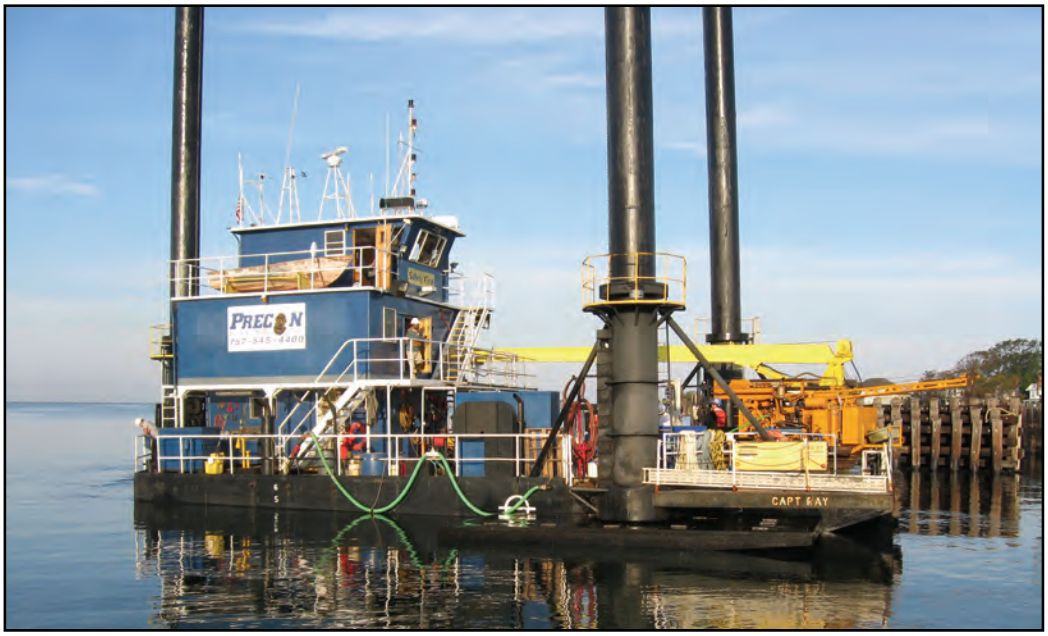
GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

Source: ESS Group, Inc.

Marine Shallow Subsurface Geotechnical Investigation Equipment

Figure 3.3-2



Jack-Up Barge – Deep Geotechnical Investigation Platform

Track Mounted Drill Rig (orange) for Deep Borings

In Situ Cone Penetrometer Probe

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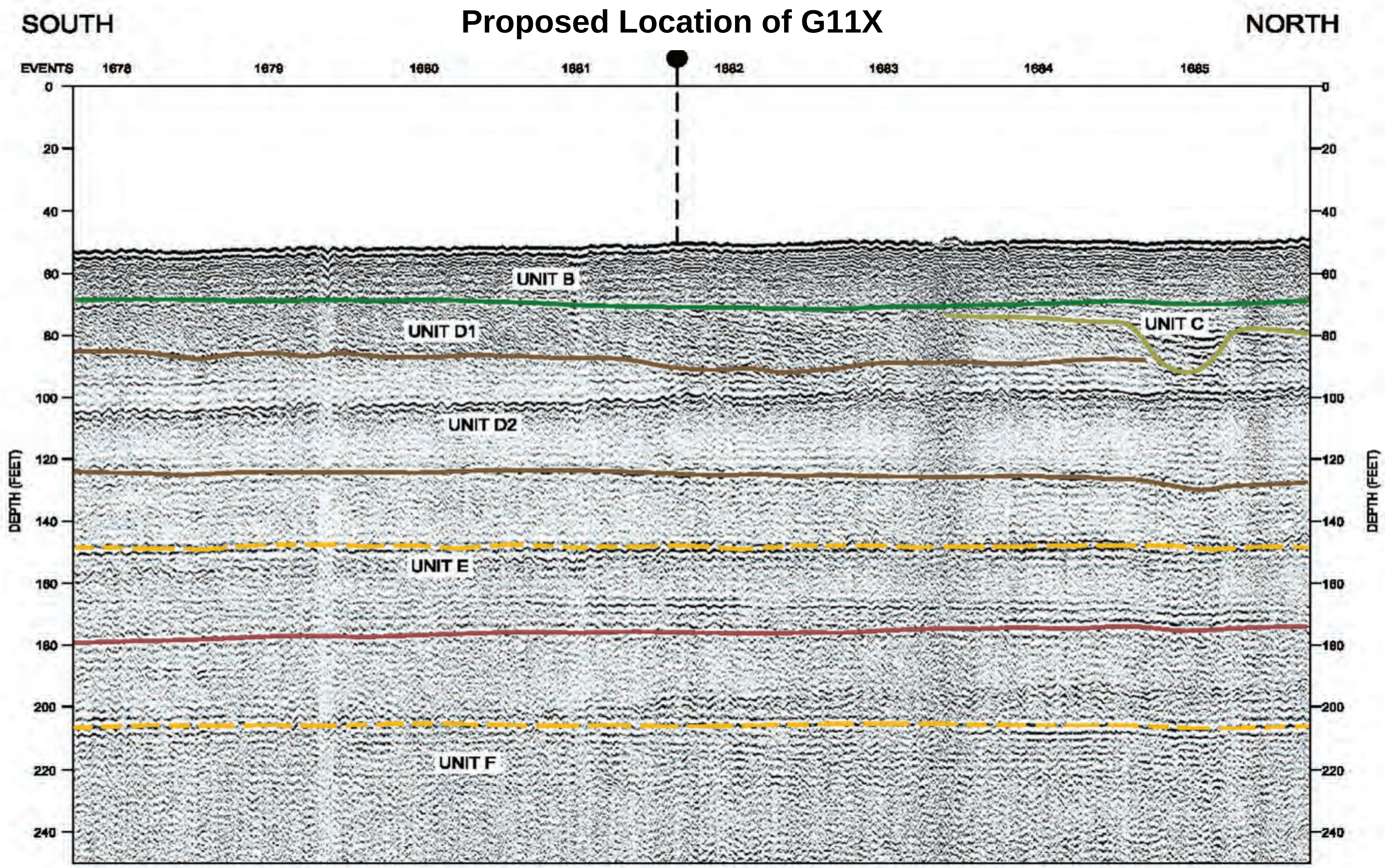
GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

Source: ESS Group, Inc.

Marine Deep Subsurface Geotechnical Investigation Equipment

Figure 3.3-3

Proposed Location of G11X



Results of the boring program are not available at this time. The stratigraphic interpretation shown above is based on the subbottom profiler data and has not be correlated to known geologic units.

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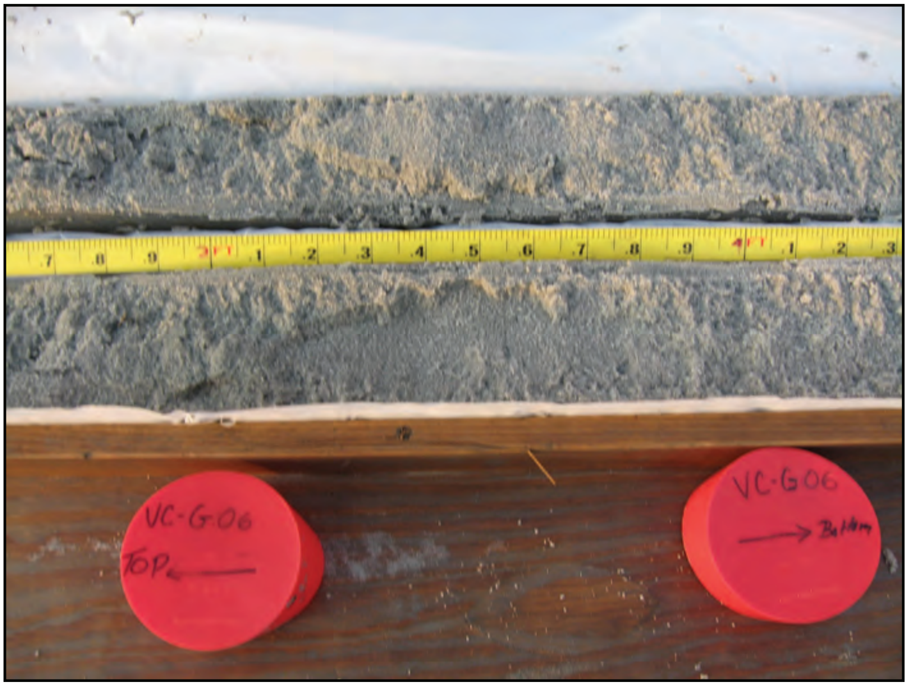
Offshore Cape Charles, Virginia

Source: Ocean Surveys, Inc.

Representative Medium Penetration Subbottom Profile Data in the Vicinity of the Proposed G11X WTG Location

Figure 3.3-4

Location: J:\G216-000 Gamesa\Permitting\Joint Permit\Draft-Figures\PPT\Final



Outside Cape Charles Harbor (Sand)

Inside Cape Charles Harbor (Mud)

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Offshore Cape Charles, Virginia

Source: ESS Group, Inc.

Representative Submarine Cable Route
Vibracore Sample Material

Figure
3.3-5

Location: G:/GIS-Projects/Gamesa/VA/VA/00-mxd/ASA/Sed-Thickness.mxd

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Scale: 1" = 2,000'
0 2,000 Feet

Source: 1) ESS, Siting Area & Routing, 2011
2) ASA, Simulations of Sediment Dispersion from Hydraulic Jetting Cable Burial, Lower Chesapeake Bay, 2011

Legend

Proposed G11X WTG Location
Submarine Cable Route

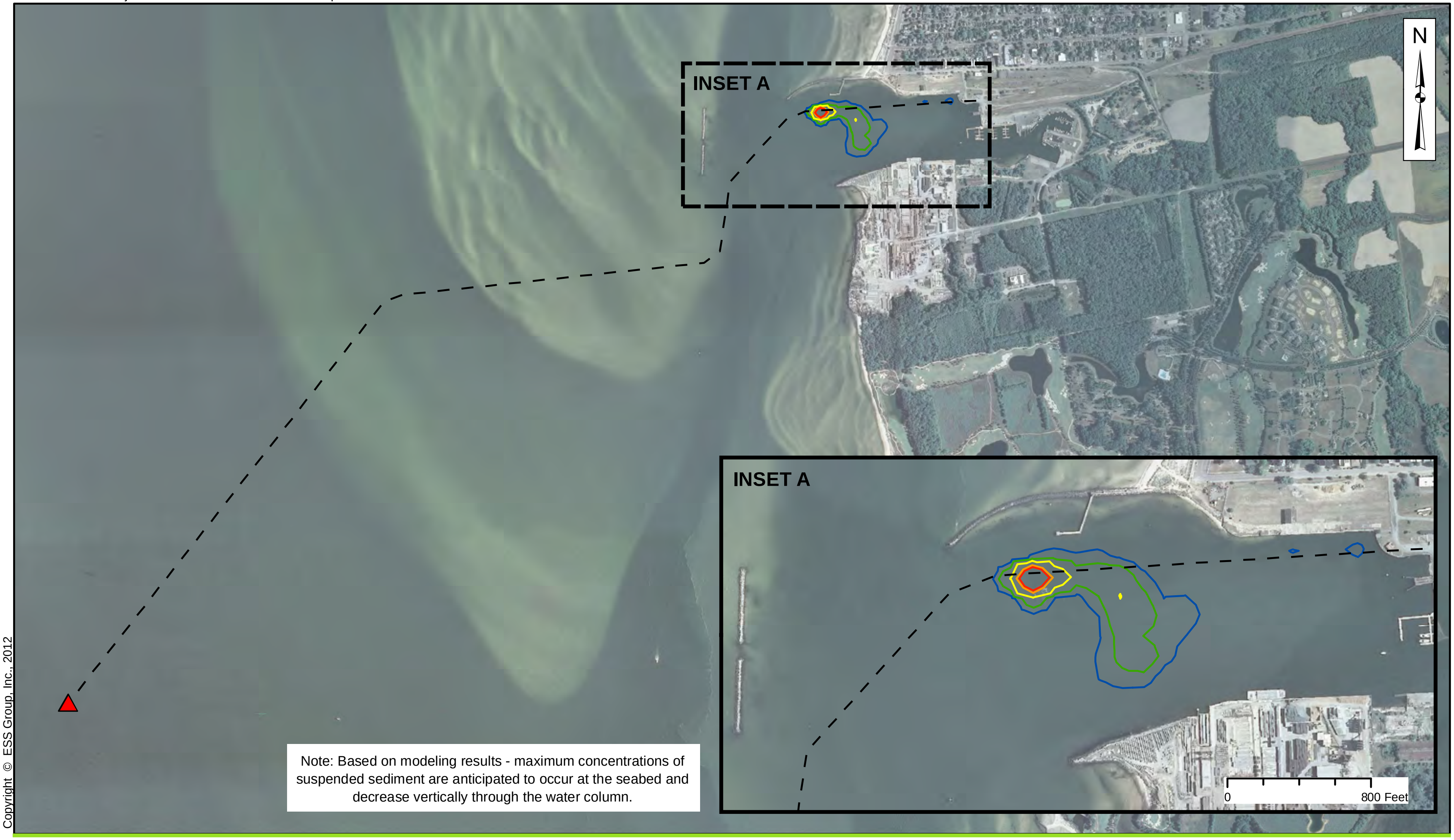
Sediment Deposition Thickness

0.1 mm
0.2 mm
0.5 mm
1 mm
2 mm

Predicted Sediment Deposition Thickness Following Submarine Cable Installation

Figure 3.3-6

Location: G:/GIS-Projects/Gamesa/VA/VA/00-mxd/ASA/Susp-Sed-Harbor.mxd



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Offshore Cape Charles, Virginia

Scale: 1" = 2,000'
0 2,000 Feet

Source: 1) ESS, Siting Area & Routing, 2011
2) ASA, Simulations of Sediment Dispersion from Hydraulic Jetting Cable Burial, Lower Chesapeake Bay, 2011

Legend

Proposed G11X WTG Location
Submarine Cable Route

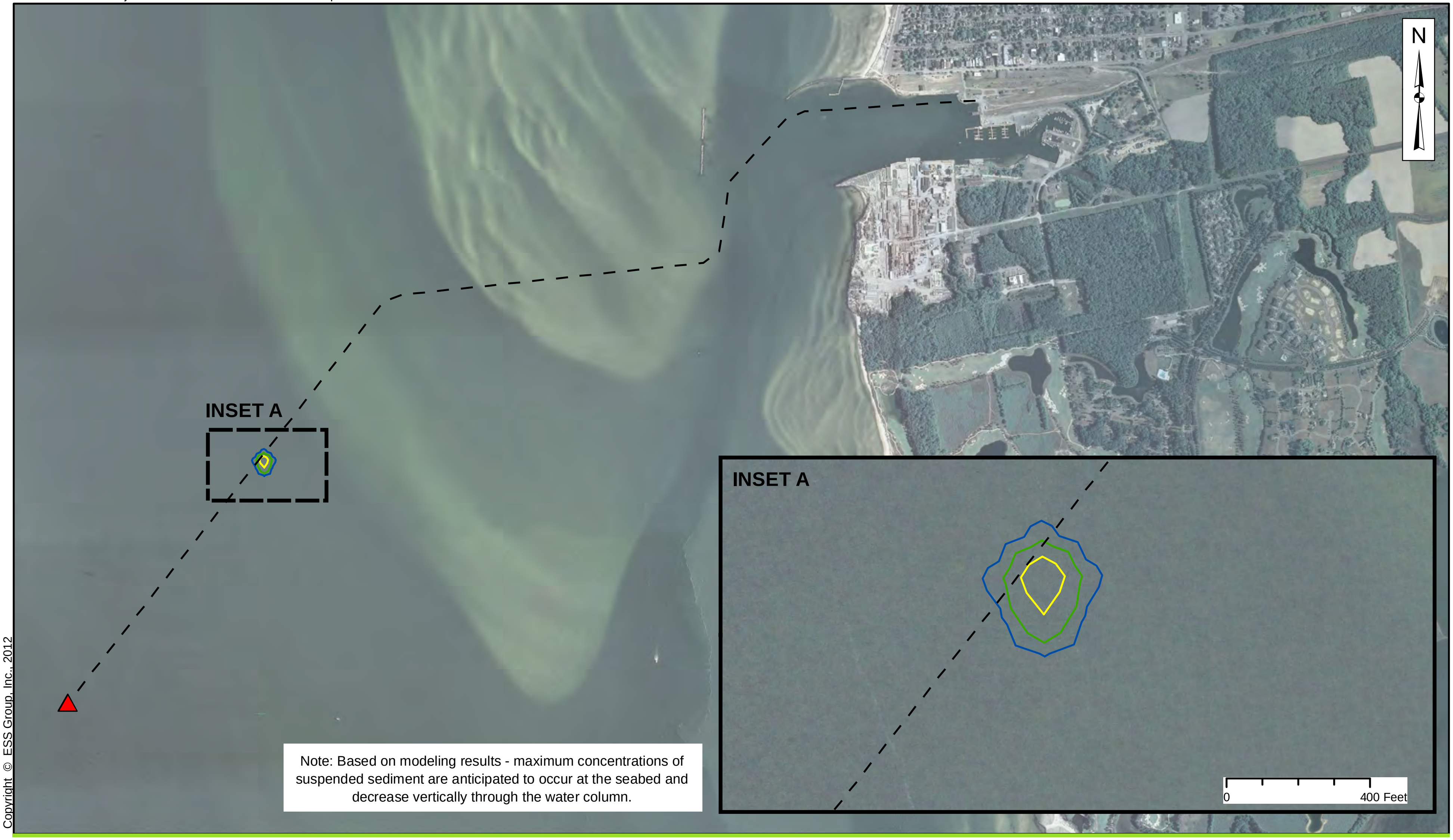
Suspended Sediment Concentration

10 mg/L
20 mg/L
40 mg/L
80 mg/L
100 mg/L

Predicted Instantaneous Maximum Suspended Sediment Concentration during Submarine Cable Installation in Cape Charles Harbor

Figure 3.3-7

Location: G:/GIS-Projects/Gamesa/VA/VA/00-mxd/ASA/Susp-Sed-Offshore.mxd



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Offshore Cape Charles, Virginia

Scale: 1" = 2,000'
0 2,000 Feet

Source: 1) ESS, Siting Area & Routing, 2011
2) ASA, Simulations of Sediment Dispersion from Hydraulic Jetting Cable Burial, Lower Chesapeake Bay, 2011

Legend

Proposed G11X WTG Location
Submarine Cable Route

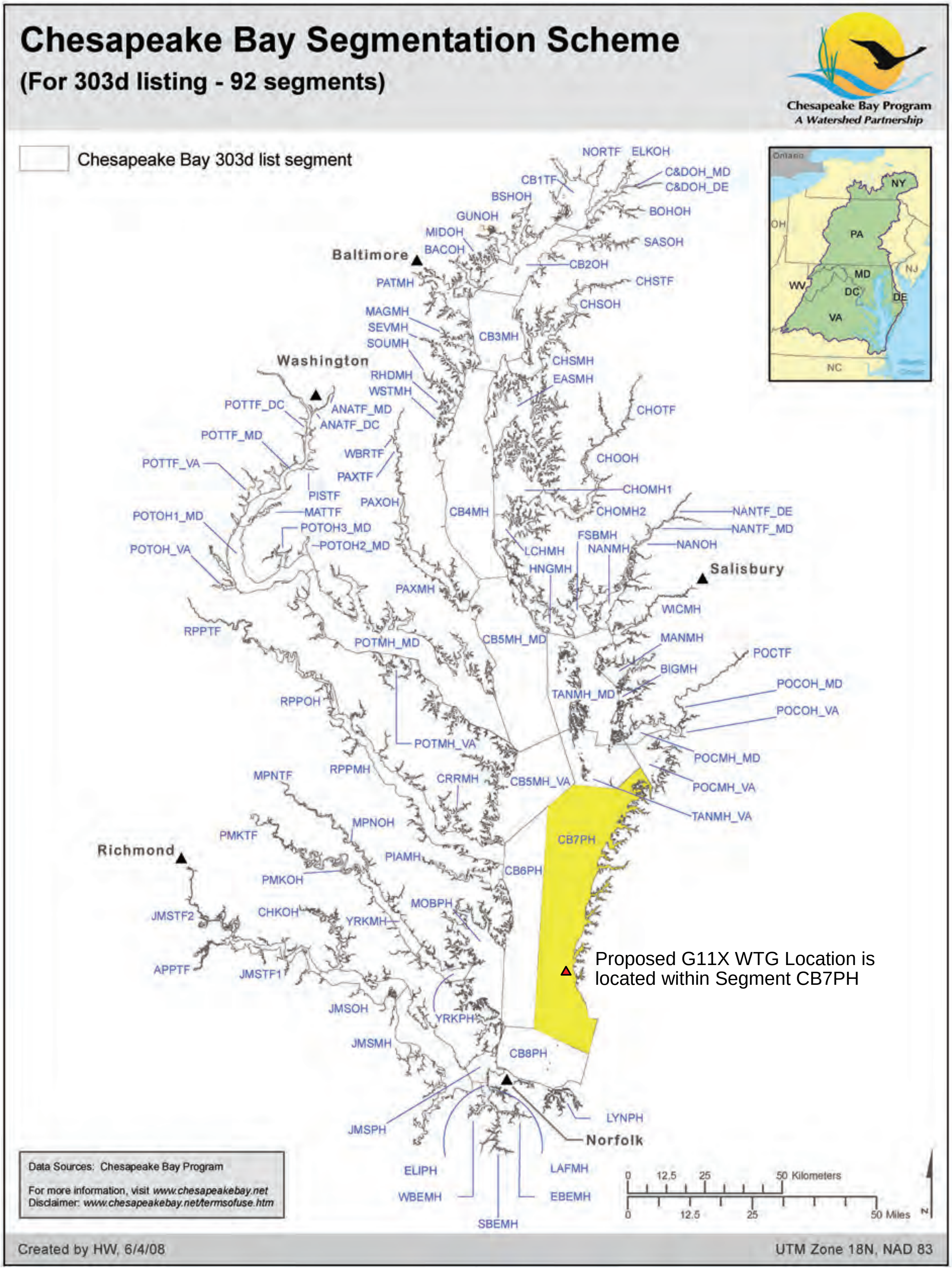
Suspended Sediment Concentration

10 mg/L
20 mg/L
40 mg/L

Predicted Instantaneous Maximum Suspended Sediment Concentration during Submarine Cable Installation in the Offshore Area

Figure 3.3-8

Location: J:\G216-000 Gamesa\Permitting\Joint Permit\Draft-Figures\PPT\Final



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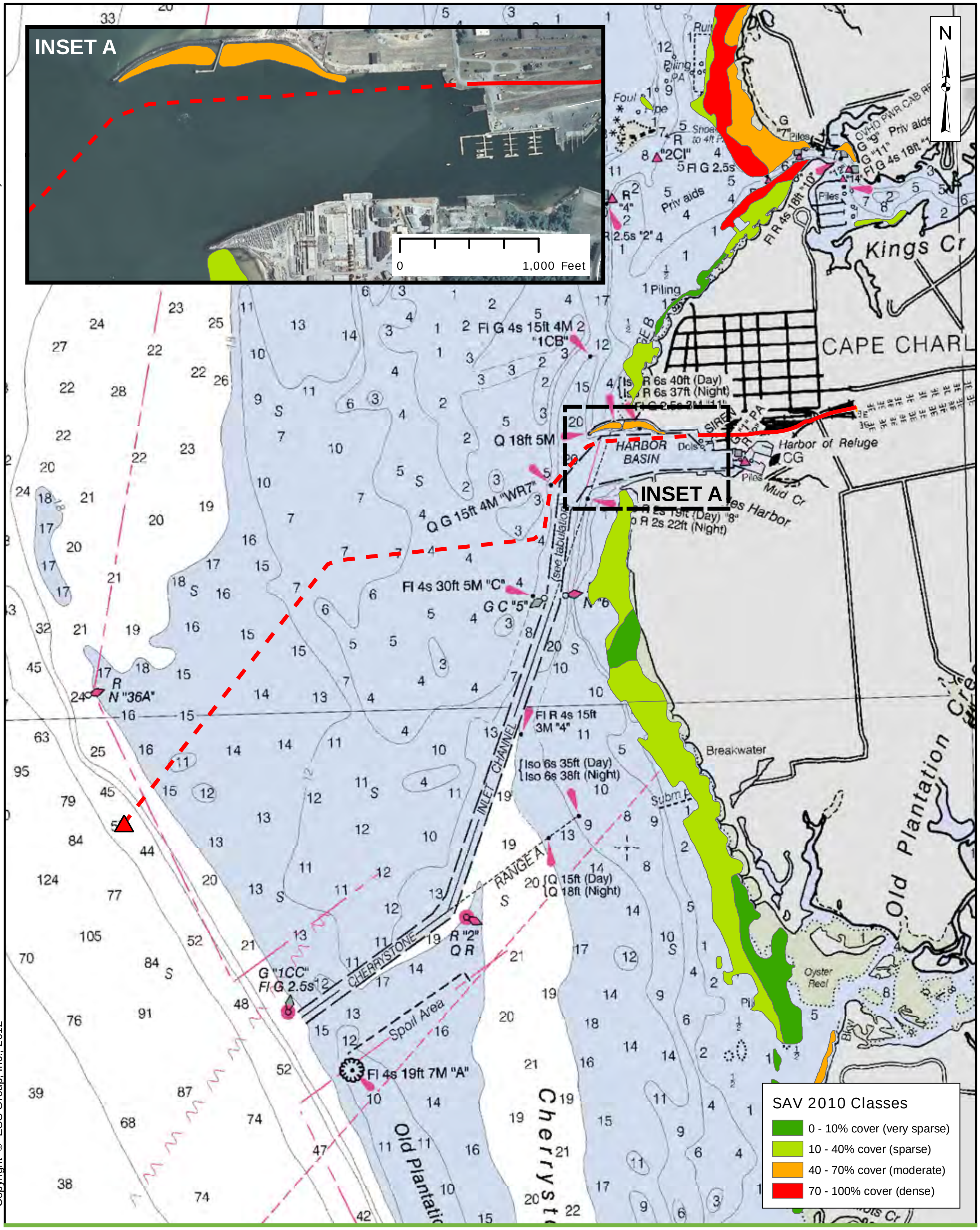
Offshore Cape Charles, Virginia

Scale: See Graphic Scale

Source: Chesapeake Bay Program, 2008

Chesapeake Bay Water Quality Segmentation Scheme (For 303d listing – 92 segments)

Figure 3.6-1



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GAMESA ENERGY USA LLC
Offshore Cape Charles, Virginia

Scale: 1" = 3,000'

0 3,000 Feet

Source: 1) USDA, Ortho, 2011 2) VIMS, SAV, 2010
3) ESS, Siting Area & Routing, 2011
4) NOAA, Nautical Chart, 2011

Legend

- Proposed G11X WTG Location
- Upland Cable Route
- Submarine Cable Route

Virginia Institute of Marine Science - Submerged Aquatic Vegetation (Mapped 2010)

Figure 3.8-1

Location: G:\GIS-Projects\Gamesa\VA\00-mxd\Visual2011-10-27\3_10-1_Vegetation and Topography Viewshed Analysis.mxd

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Offshore Cape Charles, Virginia

Scale: 1" = 3,000'
0 3,000 Feet

Source: 1) USDA, NAIP Ortho, 2011 2) VGIN, TIN/DEM, 2006-07
3) ESS, Turbine & Buffer Locations, 2011
4) DHR, Archaeological/Architectural Resources, 2011-03-25

Legend

- Proposed G11X WTG Location
- 5 Mile Buffer from Proposed Turbine
- Potential Land Areas with Project Visibility *
- DHR Architectural Resources
- VA DCR Lands

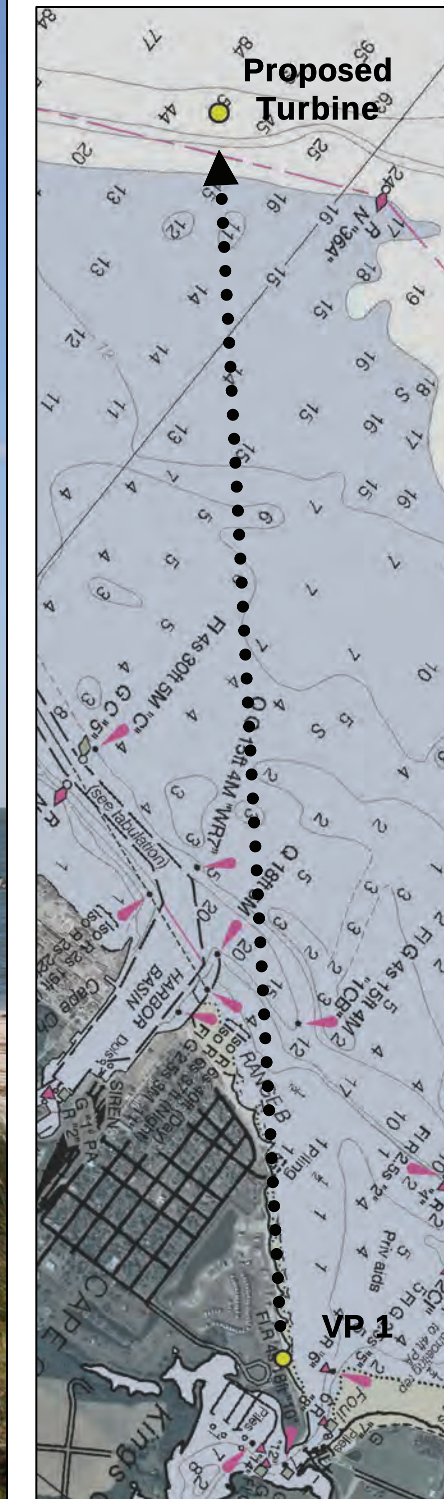
Note: Visiblity results consider the screening effects of topography and vegetation.

Viewshed Analysis Results & Visually Sensitive Resources within Visual Study Area

Figure 3.10-1

Location: J:\G216-000 Gamesa\Permitting\Joint Permit\Draft-Figures\PPT\Final

Southwest



Northeast

Approximate Distance to Turbine: 3.69 Miles

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GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

Scale: Not to Scale

Source: 1) ESS, Photos of Existing Conditions for Image Renderings, 10/30/2011 – 12:00 PM

LEGEND

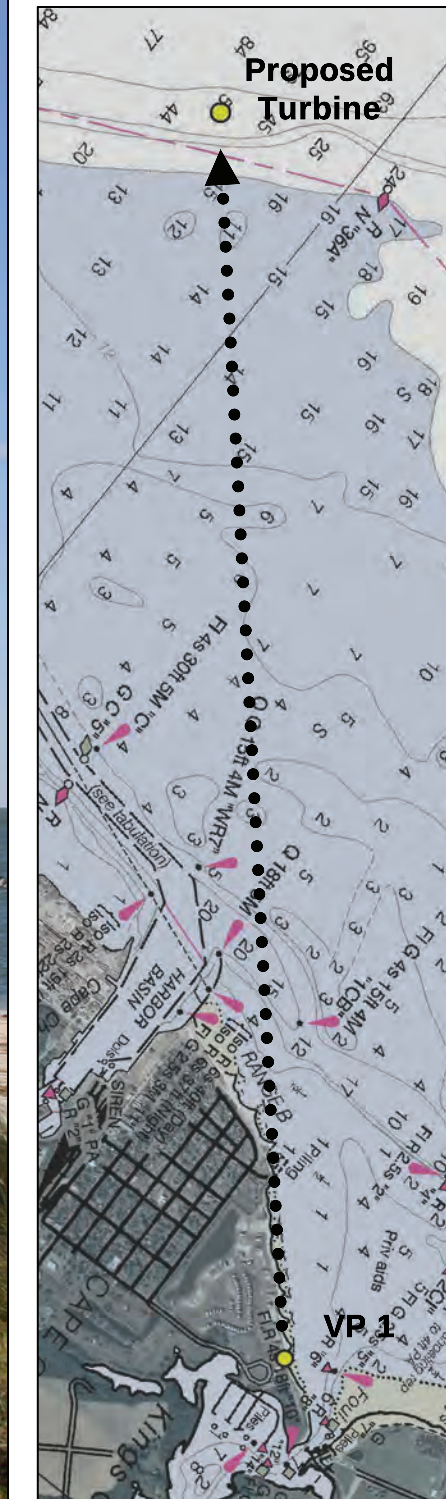
Direction of photo towards proposed turbine location

Existing View Towards Proposed Turbine from VP-1
Looking Southwest from Bay Creek Resort and Club

Figure
3.10-2A

Location: J:\G216-000 Gamesa\Permitting\Joint Permit\Draft-Figures\PPT\Final

Southwest



Northeast

Approximate Distance to Turbine: 3.69 Miles

GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

Scale: Not to Scale

Source: 1) ESS, Photos of Existing Conditions for Image Renderings, 10/30/2011 – 12:00 PM

LEGEND

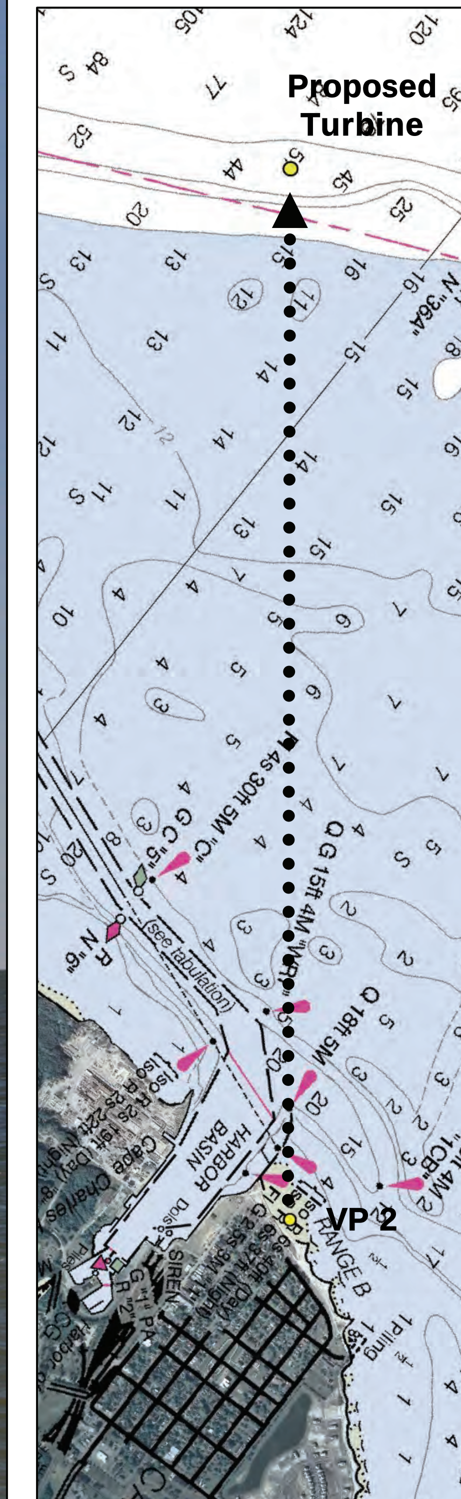
Direction of photo towards proposed turbine location

Proposed View Towards Proposed Turbine from VP-1
Looking Southwest from Bay Creek Resort and Club

Figure 3.10-2B

Location: J:\G216-000 Gamesa\Permitting\Joint Permit\Draft-Figures\PPT\Final

Southwest



Northeast

Approximate Distance to Turbine: 2.81 Miles

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GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

Scale: Not to Scale

Source: 1) ESS, Photos of Existing Conditions for Image Renderings, 3/25/2011 – 9:58 AM

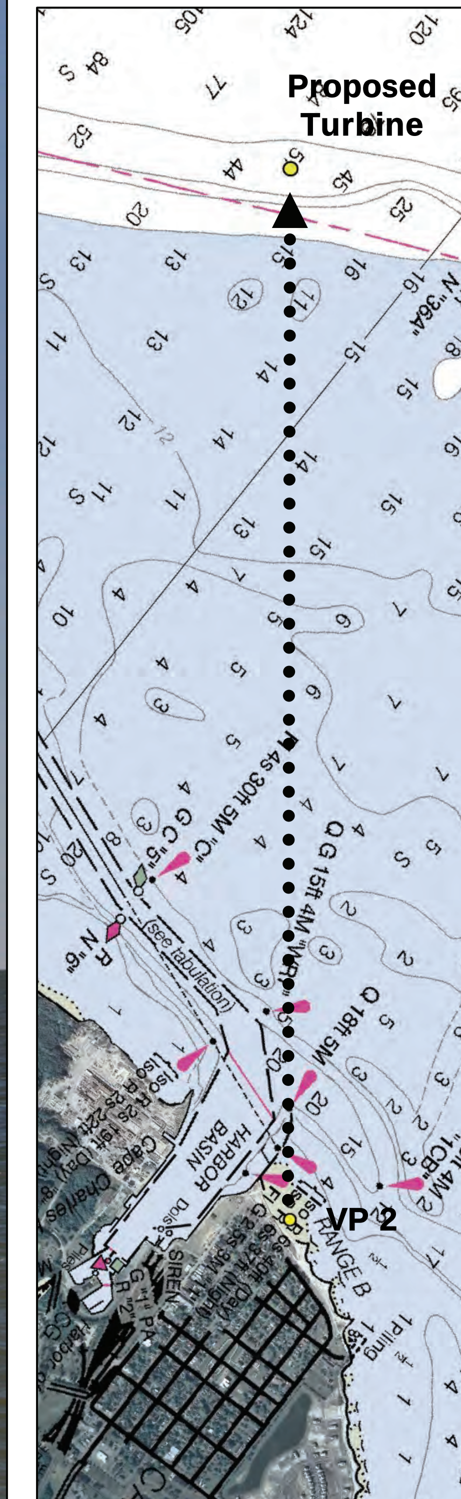
LEGEND

Direction of photo towards proposed turbine location

Proposed View Towards Proposed Turbine from VP-2
Looking Southwest from Cape Charles Historic District

Figure 3.10-3A

Southwest



Northeast

Approximate Distance to Turbine: 2.81 Miles

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GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

Scale: Not to Scale

Source: 1) ESS, Photos of Existing Conditions for Image Renderings, 3/25/2011 – 9:58 AM

LEGEND

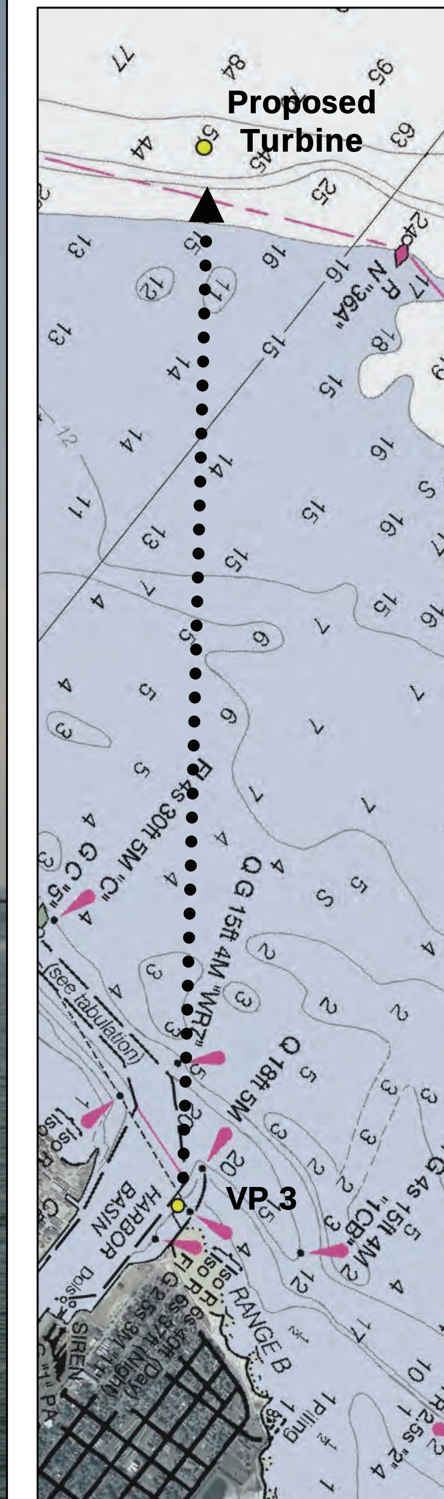
• • • ► Direction of photo towards proposed turbine location

Proposed View Towards Proposed Turbine from VP-2
Looking Southwest from Cape Charles Historic District

Figure 3.10-3B

Location: J:\G216-000 Gamesa\Permitting\Joint Permit\Draft-Figures\PPT\Final

Southwest



Northeast

Approximate Distance to Turbine: 2.57 Miles

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GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

Scale: Not to Scale

Source: 1) ESS, Photos of Existing Conditions for Image Renderings, 3/25/2011 – 3:31 PM

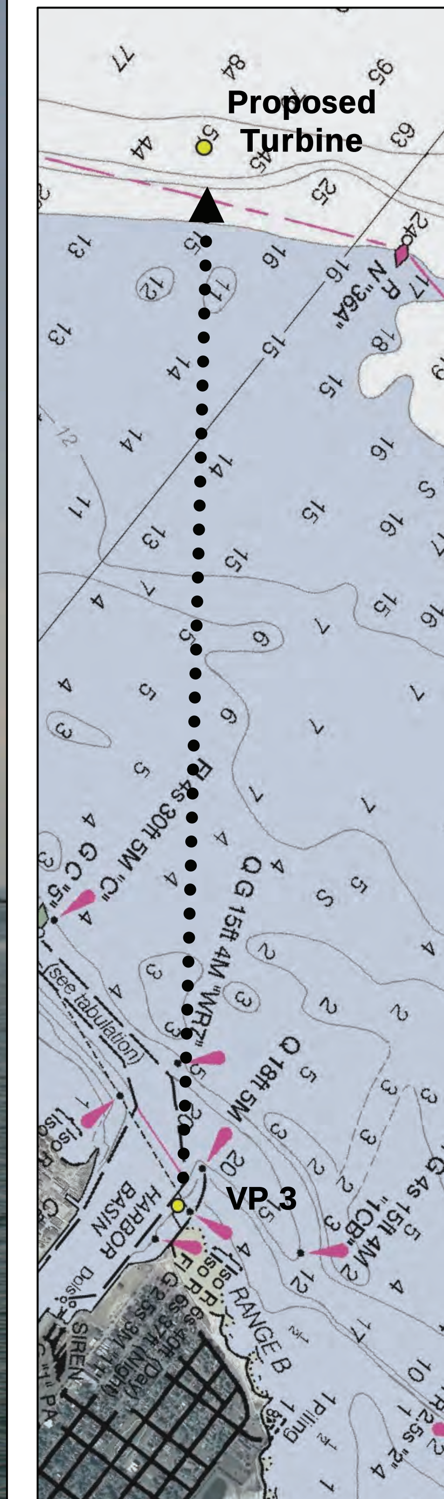
LEGEND

Direction of photo towards proposed turbine location

Existing View Towards Proposed Turbine from VP-3
Looking Southwest from Cape Charles Pier

Figure
3.10-4A

Southwest



Northeast

Approximate Distance to Turbine: 2.57 Miles

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GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

Scale: Not to Scale

Source: 1) ESS, Photos of Existing Conditions for Image Renderings, 3/25/2011 – 3:31 PM

LEGEND

Direction of photo towards proposed turbine location

Proposed View Towards Proposed Turbine from VP-3
Looking Southwest from Cape Charles Pier

Figure 3.10-4B

Location: J:\G216-000 Gamesa\Permitting\Joint Permit\Draft-Figures\PPT\Final

Photo 1 - 182-0002 - Cape Charles Historic District
Cape Charles Central Park

Photo 2 - 182-0002 - Cape Charles Historic District
Cape Charles Harbor

Photo 3 - 182-0002 - Cape Charles Historic District
Mason Avenue

Photo 4 - 065-0066 - Custis Tombs

Photo 5 - 182-0003 - Cape Charles Colored School

Photo 6 - 065-0090 - Belle Vue

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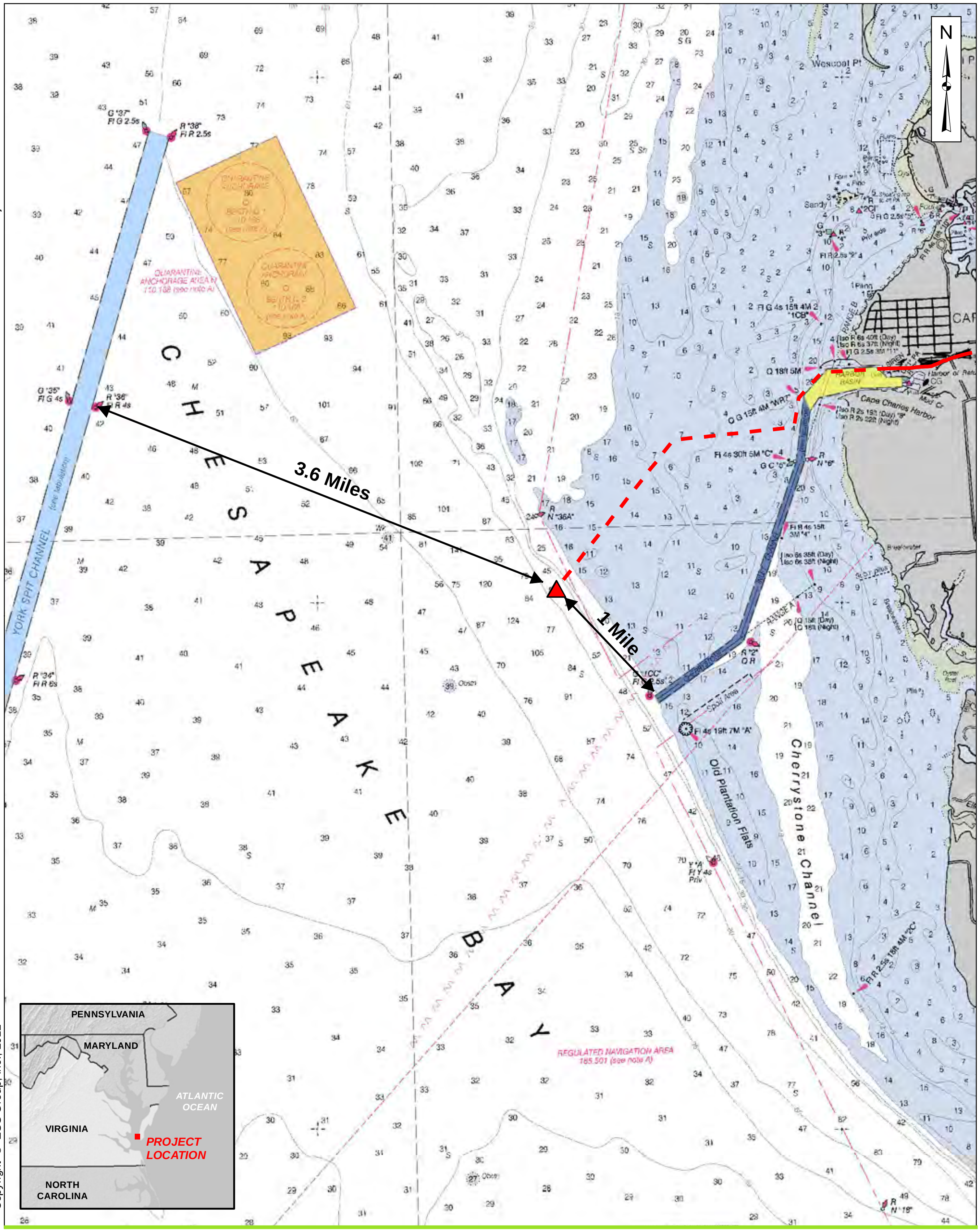
GAMESA ENERGY USA, LLC
Offshore Cape Charles, Virginia

Source: ESS Group, Inc. / JMA

Visually Sensitive Resource Photos

Figure 3.10-5

Location: G:/GIS-Projects/Gamesa/VA/00-mxd/Channels.mxd



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Offshore Cape Charles, Virginia

Scale: 1" = 1 Mile

0 1 Miles

Source: 1) ESS, Siting Area & Routing, 2011
2) NOAA, Nautical Chart, 2011

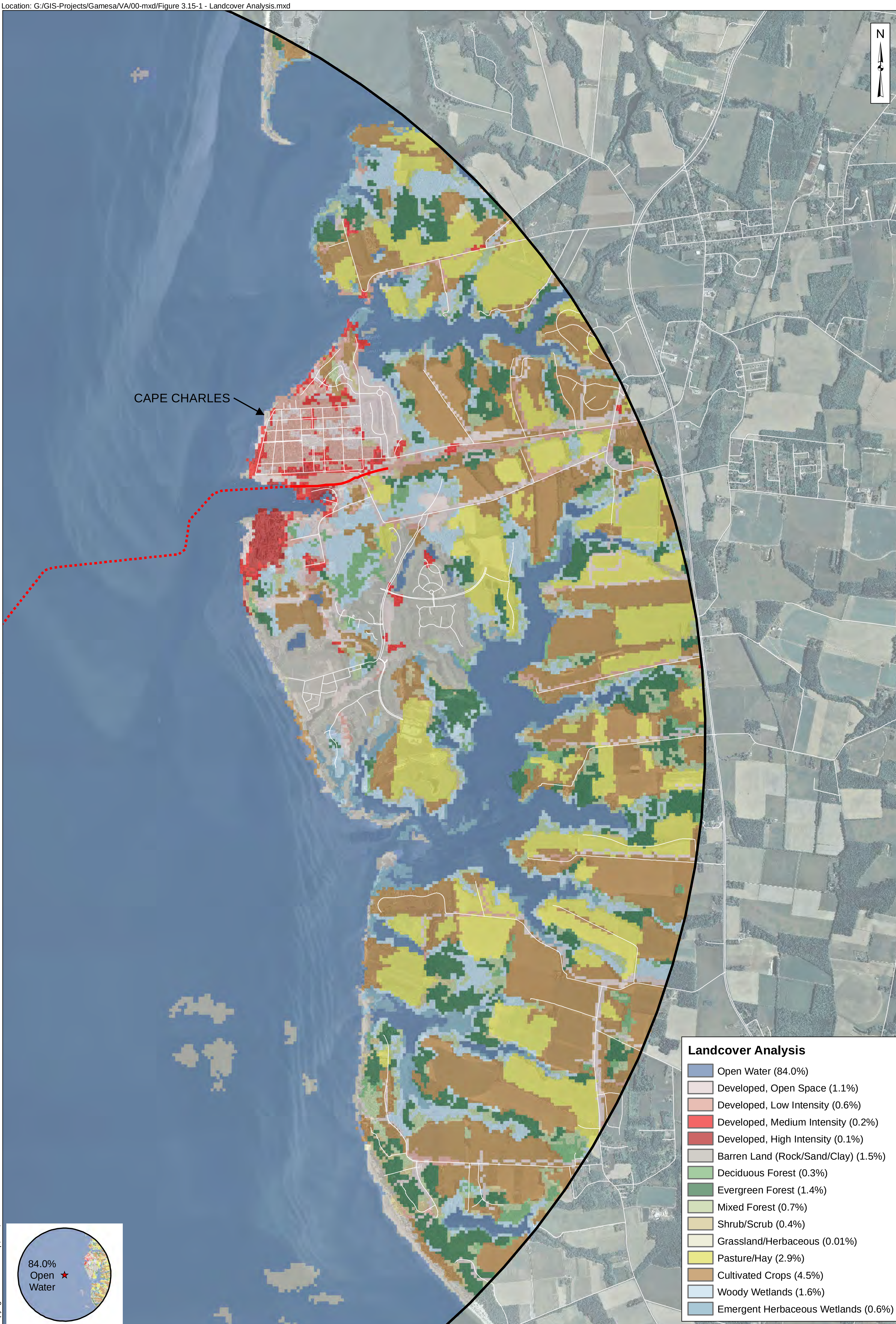
Legend

- Proposed G11X WTG Location
- Submarine Cable Route
- Upland Cable Route
- Cherrystone Inlet Channel
- York Spit Channel
- Anchorage Area
- Cape Charles Harbor

Channel Approaches

Figure 3.11-1

Location: G:/GIS-Projects/Gamesa/VA/00-mxd/Figure 3.15-1 - Landcover Analysis.mxd



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GAMESA ENERGY USA LLC
Offshore Cape Charles, Virginia

Scale: 1" = 3,000 Feet
0 3,000 Feet

Source: 1) USDA, NAIP Ortho, 2011 2) VADOT, Roads, 2010
2) ESS, Turbine & Buffer Locations, 2011
3) MRLC, Landcover, 2006

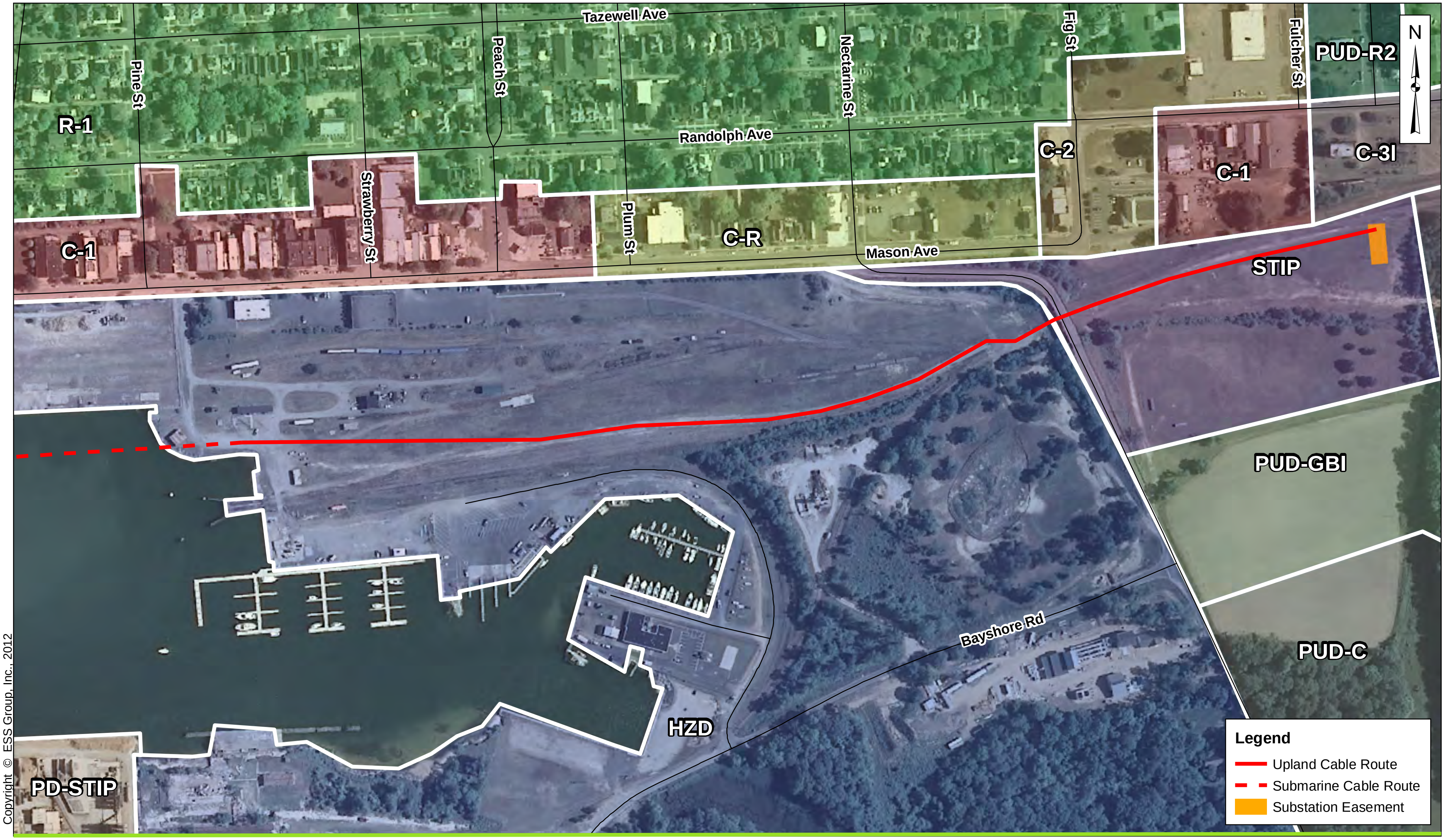
Legend

Upland Cable Route
Submarine Cable Route
Study Area - 5 Mile Buffer from Proposed Turbine

Landcover Analysis

Figure 3.15-1

Location: G:/GIS-Projects/Gamesa/VA/00-mxd/Zoning.mxd



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Offshore Cape Charles, Virginia

Scale: 1" = 400'

0 400 Feet

Source: 1) ESS, Siting Area & Routing, 2011 2) USDA, Ortho, 2011
3) Town of Cape Charles, Zoning Map, 2008

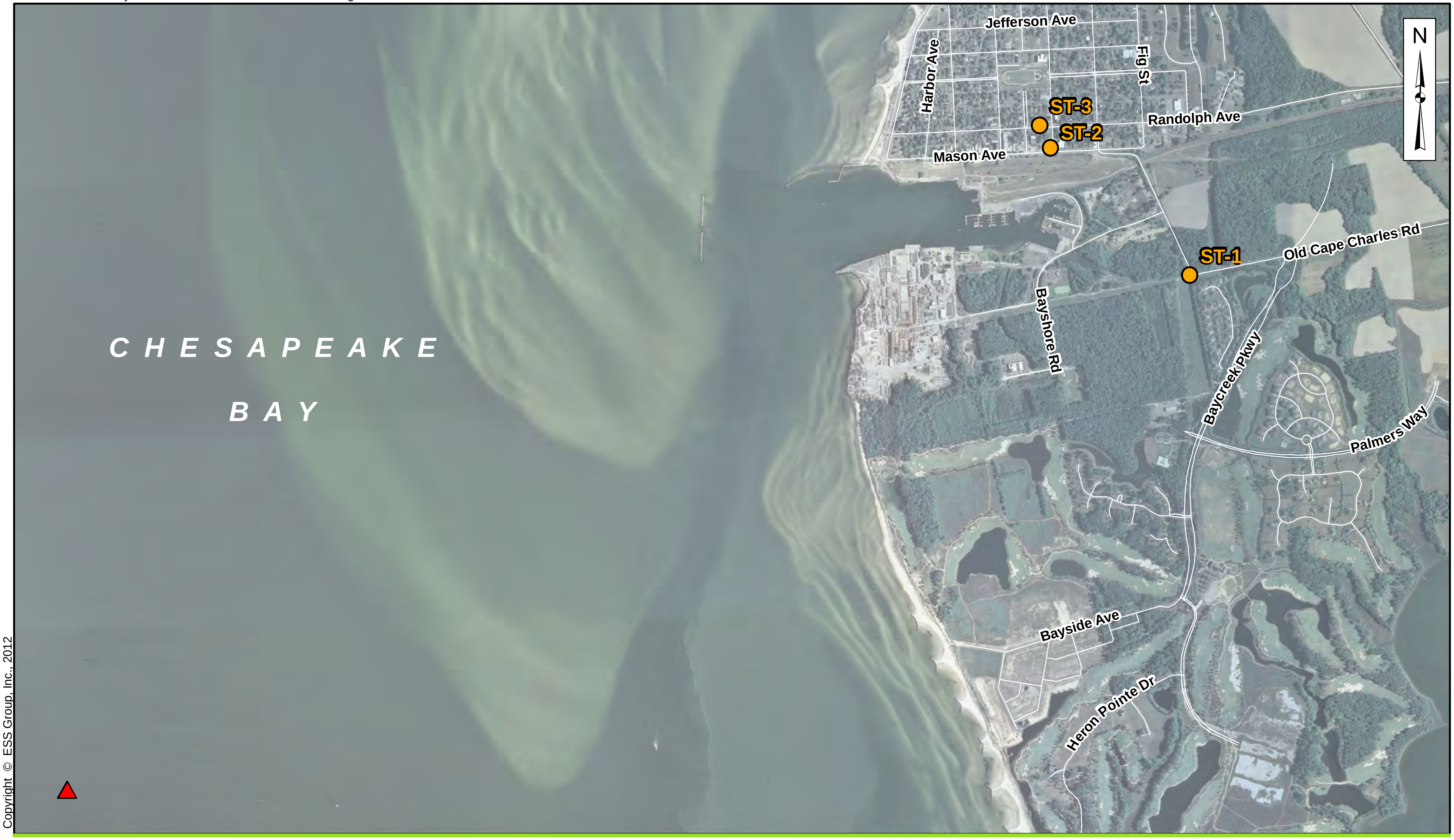
Zoning Classification

- Commercial District (C-1)
- Commercial District (C-2)
- Commercial Residential (C-R)
- Harbor Zoning District (HZD)
- Industrial (M-1)
- PD-STIP District (PD-STIP)
- PUD-Medium Density Residential (PUD-R2)
- PUD - General Business/Industrial (PUD-GBI)
- PUD - Commercial (PUD-C)
- STIP District (STIP)
- Single Family Residential District (R-1)

Zoning Classification

Figure 3.15-2

Location: G:/GIS-Projects/Gamesa/VA/00-mxd/Noise-Monitoring-L.mxd



ess group
environmental consulting & engineering services

GAMESA ENERGY USA LLC
Offshore Cape Charles, Virginia

Scale: 1" = 2,000'

0 2,000 Feet

Source: 1) USDA, Ortho, 2011 2) ESS, Turbine Location, 2011
3) ESS, Noise Receivers & Routing, 2011

Legend

- Proposed G11X WTG Location
- Short-Term Noise Receptor Location

Locations of Ambient Sound Measurement Sites and Prediction-only Sites

Figure 3.16-1

Attachment A

Common Fish Species in Lower Chesapeake Bay

Attachment A – Common Fish Species in the Lower Chesapeake Bay

Species	Habitat Preferences and Potential Occurrence in Project Area*
American eel (*Anguilla rostrata*)	Found throughout the Bay watershed, from creeks and ponds to the deep, swift channels of the Bay. Adults usually live in fresh to brackish rivers and streams, but some remain in the Bay's shallow waters. In October, sexually mature eels swim from streams and rivers down the Bay and out to the Sargasso Sea for spawning. Tiny eel larvae drift in the ocean; after about nine to 12 months, they transform from larvae to the “glass eel” stage. Before entering the Bay, the glass eels become pigmented and are called elvers. Some elvers stay in the Bay, but most continue to swim many miles up the Bay's rivers and streams to fresh water. No early life stages would occur in the Project Area since larvae are found at sea.
American halfbeak (*Hyporhamphus meeki)*	Halfbeaks visit the Chesapeake Bay during summer and autumn, venturing as far north as Baltimore Harbor. In the Chesapeake Bay, halfbeaks spawn during the summer months. Their eggs attach themselves to blades of eelgrass. Any eggs would be associated with eelgrass, which is not found in the areas directly affected by Project construction.
American shad (*Alosa sapidissima*)	American shad visit the Bay each spring to spawn in its freshwater tributaries, including the James, Potomac and Susquehanna rivers. After spawning, American shad move downstream and, by summer, leave the Bay for the ocean. No early life stages should be present in the Project Area since spawning occurs in tributaries and young of year stay in fresh/brackish water.
Atlantic croaker (*Micropogonias undulates*)	Atlantic croakers are found in the Bay and its tidal tributaries from March through October. They are bottom dwellers preferring sandy/muddy areas. They spawn offshore during August to October. Eggs are pelagic and hatch in less than one week. Larvae spend time in the plankton, but soon become demersal (Lassuy, 1983).
Atlantic menhaden (*Brevoortia tyrannus*)	Large schools of Atlantic menhaden can be found throughout the Bay from spring through autumn. They leave for deeper, warmer ocean waters in the winter, though juveniles sometimes overwinter in the Bay. The Bay is an important nursery area for juvenile menhaden because of its rich supply of plankton. In the Mid-Atlantic, menhaden spawn in shelf waters in the spring and fall. Eggs hatch at sea and larvae move into brackish waters where they grow into juveniles. By late fall, they leave the Bay for ocean waters. Eggs would not be present in the Project Area since they hatch at sea. Larvae could pass through the Project Area, but they would move into brackish waters north of the Project Area.
Atlantic needlefish (*Strongylura marina)*	Atlantic needlefish are found in shallow areas throughout the Bay from early spring through fall. They school at the surface of the water around docks, marshes, beaches and underwater grass beds. Atlantic needlefish spawn in the Bay during May and June. Females release thread-like eggs that sink to the bottom and attach to each other. Eggs are demersally oriented, but both eggs and larvae would be found only in the shallow areas of the Bay.

Species	Habitat Preferences and Potential Occurrence in Project Area*
Atlantic sturgeon (*Acipenser oxyrhynchus)*	Atlantic sturgeon travel through the Chesapeake Bay in April and May on their way to the Bay's freshwater rivers, which serve as spawning and nursery areas. They spawn in April and May in the fresh to brackish waters of the Chesapeake Bay's tidal tributaries. Once hatched, juvenile Atlantic sturgeon stay in their natal river for several years before moving into the open waters of the Bay, and eventually the ocean. In autumn, Atlantic sturgeon leave the Bay to spend the winter in coastal ocean waters. Atlantic sturgeon used to be common throughout the Bay and its tributaries but are now very rare. Atlantic sturgeon could migrate through the Project Area on their way to northern freshwater spawning and nursery areas. No early life stages would be present in the Project Area, but migrating adults and juveniles could pass through the Project Area.
Bay anchovy (*Anchoa mitchilli*)	The bay anchovy is the most abundant and commonly found fish in the Chesapeake Bay. Anchovies school in deep waters during winter and move into the shallows in warmer months. Bay anchovies spawn from spring through late summer, once water temperatures reach at least 54 degrees. The peak of spawning occurs in July. The pelagic eggs of the bay anchovy are found throughout the water column, but tend to be concentrated near the surface (Morton, 1989). Larval bay anchovy are planktonic (Peebles et al., 1996). Adult bay anchovy could be present year-round.
Black drum (*Pogonias cromis*)	Black drums enter the Bay in April to spawn near Cape Charles, Virginia. Spawning is typically complete by early to mid-June. Females lay eggs every three days of the spawning season and eggs hatch within 24 hours. Larvae feed on plankton as they grow. Eggs and larvae are both planktonic (SCDNR, 2011). After spawning, adults move further into the Bay to feed. Black drum are often associated with oyster bars, but also found around rocks and wrecks in the Bay's deep channels. They leave the Bay in late fall for warmer waters.
Black sea bass (*Centropristis striata*)	Black sea bass are found from spring through late autumn in the middle to lower Bay. They are solitary fish that hover around wrecks, jetties, pilings and rocky bottoms. In the winter, black sea bass leave the Bay for southern offshore waters. Black sea bass spawning begins around June in the coastal ocean waters of the Mid-Atlantic Bight, primarily between the Chesapeake and Long Island. Black sea bass eggs are pelagic. Larvae begin as pelagic and then become demersal once they reach a certain size (Mercer, 1989). The lower Bay is an important nursery and feeding ground for young black sea bass. Juveniles may enter the Bay during spring, summer and fall and remain until December, living among bay grasses and feeding on tiny crustaceans.
Blennies (*Chasmodes bosquianus* and *Hypsoblennius hentz)*	Blennies are abundant, year-round residents of the Bay. During the warmer months they live in shallow waters, mostly among oyster reefs but also over mud flats and grass beds. In the winter they move to the Bay's deep channels. Blennies spawn from early spring to August. Females lay round, amber-colored eggs inside of empty oyster shells, preferably within live oyster reefs. Early life stages of blennies could be present in areas with oyster reefs and grass beds; however, the Project Area does not have the optimum habitat for these life stages. Adult blennies could be present in the Project Area year-round.
Bluefish (*Pomatomus saltatrix*)	Bluefish visit the Chesapeake region from spring to autumn. Schools are abundant in the lower Bay and common most years in the upper Bay, as far north as Baltimore. In early autumn they migrate out of the Bay to overwinter off the Florida coast. Bluefish spawn off the mid-Atlantic coast during the summer. Juveniles from this spawning period and a more southerly spring spawning period enter the lower Bay and its tributaries in late summer.

Species	Habitat Preferences and Potential Occurrence in Project Area*
Cobia (*Rachycentron canadum)*	Cobia are found in the deep waters of the lower Bay from May through October. They are often found in the shade of wrecks, buoys and pilings. They are mostly solitary but sometimes form small groups. Cobia spawn from June through mid-August near the mouth of the Bay or just offshore. Eggs collect near the surface of the water and usually hatch within 24 hours. Around October, cobia migrate out of the Bay to warmer southern waters. All life stages of cobia, including eggs and larvae could be present in the Project Area; however, it is more likely that early life stages would be found in offshore waters.
Cownose ray (*Rhinoptera bonasus*)	Cownose rays visit the Bay from May through October. They travel in large schools near the surface of the water. In late fall they leave the Bay for coastal waters to the south. Cownose rays give birth to live young. Mating takes place in late summer before the rays leave the Bay for the winter. A single pup is born to each female around mid-June of the following summer.
Gobies (Gobiidae)	Gobies can be found year-round throughout most of the Chesapeake Bay and its tidal tributaries, usually around oyster reefs and other aquatic communities. Naked gobies are the most abundant goby in the Bay. They are found in shallow waters around vegetation and oyster reefs, as well as among growth on rocks, pilings and seawalls. In winter, they move to deep channels or bury themselves in the muddy bottom. Seaboard gobies are common in the lower Bay and range to the upper Bay. They are the most common goby in the Bay's open waters. They move to deep channels in the winter. Green gobies are found throughout the Bay and the lower tidal portions of most tributaries. They are often found around colonies of redbeard sponges. Gobies spawn from May through late fall. Females lay bundles of eggs inside of empty oyster shells and the male goby guards the eggs until they hatch. Goby larvae are planktonic and school around oyster reefs before settling into the reefs. Early life stages of gobies could be present in areas with oyster reefs; however, the Project Area does not have the optimum habitat for these life stages. Adult gobies could be present in the Project Area year-round.
Hickory shad (*Alosa mediocris)*	Hickory shad enter the Chesapeake Bay in spring to spawn in the Bay's tidal freshwater tributaries. They spawn in these tributaries from May through early June. After spawning, adults move downstream and leave the Bay. Young hickory shad grow quickly as they gradually move downstream in the spring and summer. Most young migrate out of the Bay to the ocean in the fall. Therefore, adults will enter the lower Bay and pass through the Project Area while migrating back and forth to their northern spawning areas. Young hickory shad may also pass through the Project Area as they move downstream.
Hogchoker (*Trinectes maculates*)	Hogchokers are abundant year-round residents of the Chesapeake Bay, from tidal freshwater areas to the mouth of the Bay. They are bottom-dwellers in shallow and deep waters with a sandy, silty or muddy bottom. Hogchokers spawn from May through September in inshore waters. Therefore, juvenile or adult life stages of hogchokers may be found in the Bay year-round and early life stages could be present during the spawning period. Hogchoker eggs are pelagic (Bigelow and Schroeder, 2002) and larvae are demersal (Able and Fahay, 1998).
Lined seahorse (*Hippocampus erectus)*	Lined seahorses can be found year-round in the middle to lower Chesapeake Bay. During warm-weather months, seahorses live among eelgrass beds in the Bay's shallows. In the winter, seahorses move to deeper waters. Breeding spans from May to October for populations in the Chesapeake Bay (Sweat, 2009). The female seahorse lays her eggs in the male's brood pouch. After two weeks, the male releases tiny fully formed seahorses.

Species	Habitat Preferences and Potential Occurrence in Project Area*
Lookdown (*Selene vomer)*	Lookdowns visit the lower Chesapeake Bay in summer and autumn. They are most often found in small schools over sandy bottoms near bridges and pilings. Lookdowns spawn by laying eggs in the water column. There is little additional information available about spawning or early life stages.
Mackerels (*Scomberomorus maculates* and *Scomberomorus cavall)*	Two species of mackerels can be found in the Chesapeake Bay: the Spanish mackerel, *Scomberomorus maculates*, and the king mackerel, *Scomberomorus cavalla*. Mackerels visit the middle and lower Chesapeake Bay between spring and autumn. Large schools can be seen near the surface of the water, close to the shore. King mackerels can also be found near reefs, wrecks and other hard structures. During the rest of the year, mackerels live in coastal ocean waters, mostly south of the Chesapeake Bay. Mackerels spawn along the Atlantic coast during warm-weather months. It is unlikely that mackerel eggs or larvae will be found in the Chesapeake Bay (see EFH Assessment). Juvenile and adult mackerels could be present in the Project Area.
Northern puffer (*Sphoeroides maculates)*	Northern puffers visit the Chesapeake Bay from spring through autumn. They are more common in the lower Bay. Puffers are bottom-dwelling fish, common in the Bay's flats and channel margins. In the winter, northern puffers leave the Bay for deep offshore waters. They spawn from May through August in shallow waters near the shore. The female lays adhesive eggs that attach to the bottom and the male guards the eggs until they hatch.
Northern stargazer (*Astroscopus guttatus)*	Northern stargazers live in the deep waters of the Atlantic Coast between the states of North Carolina and New York. They are known to swim into the Chesapeake Bay to find prey. Northern stargazers spawn in the lower Chesapeake Bay in May and June. They lay transparent eggs on the bottom of the Bay, which eventually float to the surface and hatch into larvae. After growing to approximately 12 to 15 millimeters long, the larvae swim to the bottom of the Bay, where they mature into adults.
Northern searobin (*Prionotus carolinus*)	Northern searobins can be found in the Chesapeake Bay from spring through early winter, when they leave the Bay for offshore or southern waters. During their annual stay in the Bay, searobins are most common in the lower part of the estuary. Searobins are bottom-dwellers, found over the Bay's deep flats and channels. They spawn from late spring through summer, laying eggs over a sandy area. Eggs and larvae are pelagic in nature (Bigelow and Schroeder, 2002; Able and Fahay, 1998).
Oyster toadfish (*Opsanus tau)*	The bottom-dwelling oyster toadfish is abundant throughout the Chesapeake Bay year-round. During most of the year they live among wrecks, debris, vegetation, oyster reefs and rocky or muddy bottoms. In winter, oyster toadfish move to the Bay's deep channels. Oyster toadfish spawn from April through October in the Chesapeake Bay's shallows. After about one month, the eggs hatch. The tadpole-like young remain attached to the nest by a yolk. Once the yolk is fully absorbed, the male guards the young toadlets for a few more weeks, though they are free to swim in and out of the nest.
Pipefish *(Syngnathus focus* and *Syngnathus floridae*)	Two species of pipefish can be found in the Bay: the northern pipefish, *Syngnathus fuscus* and the dusky pipefish, *Syngnathus floridae*. Pipefish are year-round residents of the Chesapeake Bay. They live in shallow bay grass beds in the summer and retreat to deeper channel waters in the winter. Northern pipefish are found throughout the Bay into fresh waters. Dusky pipefish are restricted to the middle and lower Bay. Pipefish reproduce between April and October, with a peak from May to June. The female pipefish transfers her eggs to the male's brood pouch. After about two weeks, the male releases tiny fully formed pipefish.

Species	Habitat Preferences and Potential Occurrence in Project Area*
Red drum (*Sciaenops ocellatus*)	Red drums can be found in the Chesapeake Bay from May through November. Schools of red drums are common near the Bay's mouth in spring and fall during the coastal population's migrations. Young move up into the middle Bay, as far north as the Patuxent River. Red drums are usually found in waters near the shoreline. Red drums spawn from late summer through fall in coastal waters near the shore. Young red drums can be found in the Chesapeake Bay in August and September. They move farther up the Bay into shallow, fresher waters, where they feed on zooplankton and small invertebrates.
Sandbar shark (*Carcharhinus plumbeus)*	The Chesapeake Bay serves as one of the most important nursery areas on the East Coast for young sandbar sharks. After birth, large schools of juvenile sandbar sharks move into the Chesapeake Bay in the summer and fall. Sandbar sharks are most often found in the Bay's shallow grass beds and over sand bars. Sandbar sharks are most common in the Virginia portion of the Chesapeake Bay, though some may move northward into Maryland waters. In the fall, sandbar sharks leave the Bay for warmer southern waters.
Shortnose sturgeon (*Acipenser brevirostrum)*	Historically, shortnose sturgeon were found in the fresh and brackish waters of the Chesapeake Bay and its tributaries, including the Potomac and Susquehanna rivers. But today they are classified by the U.S. Fish and Wildlife Service as an endangered species, making them a rare find in the Bay. Between February and April, shortnose sturgeon migrate to freshwater tidal tributaries north of the Project Area. Early life stages will not occur in the Project Area since they occur in the freshwater tributaries. It is possible that transient adult or juvenile shortnose sturgeon could be present in the Project Area during certain times of year.
Skilletfish (*Gobiesox strumosus)*	Skilletfish can be found throughout the Chesapeake Bay and its rivers. During the warmer months, skilletfish live in shallow waters, mostly among oyster reefs but also over mud flats and eelgrass beds. In the winter, skilletfish move to the Bay's deep channels. Skilletfish are almost always found clinging to rocks or shells with their suction disk. Skilletfish spawn from April through August. The female lays a few hundred small, amber-colored eggs into empty oyster shells. The male then guards the eggs until they hatch. Therefore, juvenile or adult life stages of skilletfish may be found in the Bay year-round. Early life stages could be present in areas with oyster reefs; however, the Project Area does not have the optimum habitat for these early life stages.
Spot (*Leiostomus xanthurus)*	Spot are one of the most abundant species in the Chesapeake Bay and can be found throughout its waters from April or May to late fall. They are usually found near oyster reefs or around pilings and jetties, but have been collected from all depths and bottom types. Once water temperatures decrease in autumn, spot leave the Bay for coastal southern waters. Spot spawn over the continental shelf from late September through March. After spawning, adults may stay offshore, while tiny spot larvae enter the Chesapeake Bay and move to low-salinity shallows and tidal creeks. Juvenile spot grow throughout the summer as they feed on tiny crustaceans in their nursery areas. Most young spot leave the Bay by December. It is possible that pelagic spot larvae may enter the Chesapeake Bay on their way to lower salinity waters to the north. Juvenile and adult spot may also be present in the Project Area.

Species	Habitat Preferences and Potential Occurrence in Project Area*
Spotted seatrout (*Cynoscion nebulosus*)	Spotted seatrout live in both inshore and nearshore waters where the bottom is grassy or sandy. They are most commonly found in brackish or marine waters to depths of up to 32 feet. Spotted seatrout visit the Chesapeake Bay beginning in spring and can be found as far north as Annapolis. Spotted seatrout spawn in the salty waters near the Chesapeake Bay's mouth from April to September (MD DNR, 2007). Eggs have been reported to be both demersal and pelagic depending on salinity. They are buoyant at higher salinities (30 ppt), but sink around 25 ppt (Johnson and Seaman, 1986). Spotted seatrout larvae hatch 18 hours after fertilization and are carried by currents to brackish water nursery areas, commonly in shallow sea grass beds. At six to eight weeks of age, juveniles begin to form schools with individuals of similar size. Young of the year are found in shallow tidal creeks and beds of submerged aquatic vegetation (MD DNR, 2007). Therefore it is possible that early life stages (both pelagic and demersal) could be present in the Project Area. Juvenile and adult life stages could also be present.
Sticklebacks (*Gasterosteus aculeatus* and *Apeltes quadracus)*	Two species of sticklebacks can be found in the Chesapeake Bay: the threespine stickleback, *Gasterosteus aculeatus* and the fourspine stickleback, *Apeltes quadracus*. Sticklebacks are mostly found in shallow, vegetated areas of the Chesapeake Bay, along with pipefish and lined seahorses. Threespine sticklebacks visit the Chesapeake Bay during winter and spring, moving as far north as Kent Island. Fourspine sticklebacks are year-round residents of the entire Chesapeake Bay. They move to the Bay's deeper channels in the winter. Threespine sticklebacks are anadromous and spawn from late February through September in the fresh to brackish waters of western shore rivers. Fourspine sticklebacks spawn in late April and early May among bay grass beds along the Bay's shoreline. Demersal early life stages (eggs and larvae) of the fourspine stickleback may be present in the Bay; however, they would tend to be found in areas of bay grass which are not found within the immediate Project Area. The early life stages of the threespine stickleback would be found in fresh and brackish tributaries of the Bay, not in the Project Area.
Striped bass (*Morone saxatilis*)	Striped bass are found year-round throughout the Chesapeake Bay and its tributaries. In spring they move upstream to spawn, and in summer and winter they are found in the Bay's deep channels. Striped bass spawn from March through early May; however, the ELMR report indicates they spawn in April and May and in low (rare) numbers in June. Striped bass spawn and lay eggs in fresh to brackish waters near the shore. After spawning, adult striped bass swim back downstream to the Bay. Some of the fish will continue on to the ocean. After hatching, striped bass larvae move slowly downstream as they grow. Juveniles live in the shallows throughout the summer, feeding on small planktonic crustaceans. Most juvenile striped bass remain in their natal tributaries for the first two years of life. Therefore, eggs and larval stages of striped bass will likely occur north of the Project Area in fresh and brackish waters. Juvenile or adult stages of striped bass may be found in the Bay year-round.
Summer flounder (*Paralichthys dentatus*)	Summer flounder visit the Chesapeake Bay from spring through autumn. Most remain in the lower Bay. Summer flounder are bottom-dwellers and usually live in the Bay's deep channels and ridges, as well as sandbars. Most summer flounder migrate offshore for the winter, though some will remain in the Bay. Summer flounder spawn from late summer to mid-winter in coastal ocean waters. Summer flounder larvae enter the Chesapeake Bay from October through May. They use the Bay as a nursery area as they grow into juveniles. Juvenile summer flounder live among eelgrass beds in the Bay's shallows. Juvenile or adult summer flounder could be present year-round.

Species	Habitat Preferences and Potential Occurrence in Project Area*
Tautog (*Tautoga onitis*)	Tautogs are year-round residents of the Bay. They are locally abundant in the lower Bay and near the Bay's mouth from autumn to spring, but can range as far north as the Chester River during the winter. During the summer (and perhaps also in January and February) there is a population shift to colder offshore locations. They are often found around reefs, wrecks, rocks and pilings. Tautogs spawn from late April to early August in the lower Bay and offshore. After hatching, they drift in the Bay for about three weeks before finding a home among shallow grass beds. Tautog eggs are pelagic and buoyant. Tautog larvae are planktonic for approximately three weeks before settling on the bottom and becoming demersal (Bigelow and Schroeder, 2002).
Weakfish (*Cynoscion regalis*)	Weakfish are found throughout the Chesapeake Bay during spring and summer, when the coastal weakfish population migrates northward. Schools of adult weakfish live throughout the Bay, but are most often found in shallow, sandy bottom areas. In autumn, weakfish leave the Bay to migrate southward. Weakfish spawn from April through August in nearshore waters near the mouth of the Chesapeake Bay. Eggs are buoyant. Newly hatched larvae are planktonic until they reach between 1.5 and 8mm in total length when they become demersal. Larvae spend the late summer drifting through the waters of the lower Bay, gradually finding their nursery areas in low-salinity rivers. Young weakfish then begin to swim towards saltier waters, eventually leaving the Bay by early winter.

* All information from CBP (2009) unless otherwise noted.

OTHER REFERENCES:

Able, K.W. and M.P. Fahay. 1998. The first year in the life of estuarine fishes in the Middle Atlantic Bight. Rutgers Univ. Press, N.J.

Bigelow, H.B., and W.C. Schroeder, 3rd edition. 2002. Fishes of the Gulf of Maine. Smithsonian Institution Press. Washington.

Chesapeake Bay Program (CBP). 2009. Chesapeake Bay Program Bay Field Guide – Fish. http://www.chesapeakebay.net/bfg_fish.aspx?menuitem=14340. Accessed on November 9, 2011.

Johnson, D.R., and W. Seaman, Jr. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (south Florida)--spotted seatrout. U. S. Fish Wildl. Serv. Biol. Rep. 82(11.43). U.S. Army Corps of Engineers, TR EL-82-4. 18 pp. [http://www.nwrc.usgs.gov/wdb/pub/species_profiles/82_11-043.pdf]

Lassuy, D.R. 1983. Species profiles : life histories and environmental requirements (Gulf of Mexico) -- Atlantic croaker. U.S. Fish and Wildlife Service, Division of Biological Services. FWS/OBS-82/11.3. U.S. Army Corps o f Engineers, TR EL-82-4. 12 pp.

Maryland Department of Natural Resources (MD DNR). 2007. Maryland Fish Facts. Spotted Seatrout (*Cynoscion nebulosus*). [http://www.dnr.state.md.us/fisheries/fishfacts/spottedseatrout.asp]. Accessed on December 7, 2011.

Mercer, L.P. 1989. Species profiles : life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic)—black sea bass. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.99). U.S. Army Corps of Engineers, TR EL-82-4. 16 pp.

Morton, T. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic) --bay anchovy. U. S. Fish Wildl. Serv. Biol. Rep. 82(11.97). 13 pp. [http://www.nwrc.usgs.gov/wdb/pub/species_profiles/82_11-097.pdf]

Peebles, E.B., J.R. Hall, and S.G. Tolley. 1996. Egg production by the bay anchovy Anchoa mitchilli in relation to adult and larval prey fields. Marine Ecology Progress Series. Vol. 131:61-73. [http://www.int-res.com/articles/meps/131/m131p061.pdf].

South Carolina Department of Natural Resources (SCDNR). 2011. Marine Resources Research Institute (MRRI). ACE Basin Species Gallery. Black drum. [http://www.dnr.sc.gov/marine/mrri/acechar/specgal/blackdru.htm]. Accessed on December 8, 2011.

Sweat, L.H. 2009. Smithsonian Marine Station at Fort Pierce. Species Name: *Hippocampus erectus*. [http://www.sms.si.edu/IRLSpec/Hippoc_erectu.htm]. Accessed on December 7, 2011.