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Appendix Y: In-Air Acoustic Assessment

Coastal Virginia Offshore Wind Commercial Project

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CONSTRUCTION AND OPERATIONS PLAN

Coastal Virginia Offshore Wind Commercial Project

Appendix Y
In-Air Acoustic Assessment

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APPENDIX Y IN-AIR ACOUSTIC ASSESSMENT

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ACRONYMS AND ABBREVIATIONS

ANSI	American National Standards Institute.
dB	decibel
dBA	A-weighted decibel
Dominion Energy	Virginia Electric and Power Company d/b/a Dominion Energy Virginia
DSPT	Direct Steerable Pipe Thrusting Technique
ft	foot
HDD	horizontal directional drilling
Hz	Hertz
IMO	International Maritime Organization
ISO	International Organization for Standardization
km	kilometer
Lease Area	the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf Offshore Virginia (Lease No. OCS-A-0483)
L_{eq}	equivalent sound level
L_W	sound power level
m	meter
NEMA	National Electrical Manufactures Association
nm	nautical mile
NSA	noise-sensitive area
Project	CVOW Commercial Project
Trenchless Installation	Horizontal directional drilling, Direct Steerable Pipe Thrusting Technique, and microtunneling
WTG	wind turbine generator

Y.1 INTRODUCTION

The Virginia Electric and Power Company, doing business as Dominion Energy Virginia (Dominion Energy) proposes to construct, own, and operate the Coastal Virginia Offshore Wind Commercial Project (hereafter referred to as the Project). The Project will be located in the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf Offshore Virginia (Lease No. OCS-A-0483) (Lease Area). The Lease Area is located 20.45 nautical miles (nm; 11.04 kilometers [km]) from the northwest corner to the Eastern Shore Peninsula and 23.75 nm (43.99 km) from Virginia Beach, Virginia (Figure Y-1).

The Offshore Project Components, including the Wind Turbine Generators (WTGs), Offshore Substations (OSSs), and Inter-Array Cables, will be located in federal waters in the Lease Area, while the Offshore Export Cable Route Corridor will traverse both federal and state territorial waters of Virginia. The Onshore Project Components, including the Cable Landing Location, the Switching Station, Onshore Export Cables, Interconnection Cables, and the Onshore Substation will be located in Virginia Beach and Chesapeake, Virginia. From the Cable Landing Location in Virginia Beach, Virginia, the Onshore Export Cables will be installed underground within a duct bank and Interconnection Cables will be installed as overhead (Preferred Alternative) or a combination of underground within a duct bank and overhead to the Switching Station and existing Onshore Substation. Figure Y-2 provides an overview of the locations of the Onshore Project Components.

This In-Air Acoustic Assessment has been completed to demonstrate how the overall Project has been adequately designed to minimize in-air sound impacts to the surrounding community and comply with state and local noise ordinances. A separate Underwater Acoustic Assessment (Appendix Z) has been prepared to address the sound impacts associated with the Offshore Project Area underwater environment. The objectives of this In-Air Acoustic Assessment include identifying noise-sensitive land uses in the area that may be affected by the Project as well as describing the standards to which the Project will be assessed.

Existing conditions were documented through ambient sound surveys and Project compliance was assessed through the use of predictive acoustic modeling for construction and operations. Practical measures were proposed to minimize adverse effects associated with the construction and operation of the Project, as needed. Mitigation measures are presented to show the feasibility of the Project to meet the specific noise requirements. However, final design may incorporate different mitigation measures in order to achieve the same objective as demonstrated in this analysis.

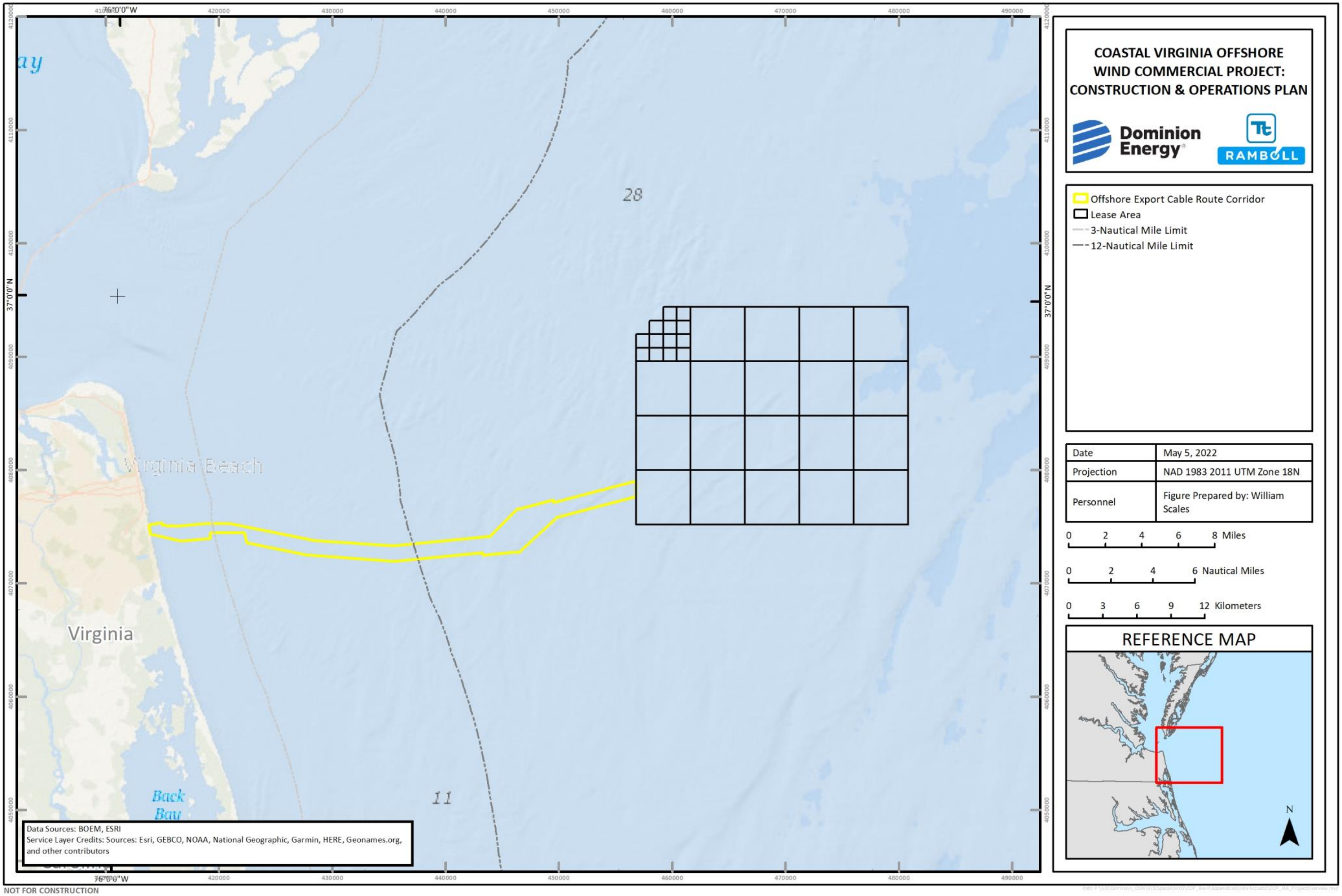


Figure Y-1. Offshore Project Overview

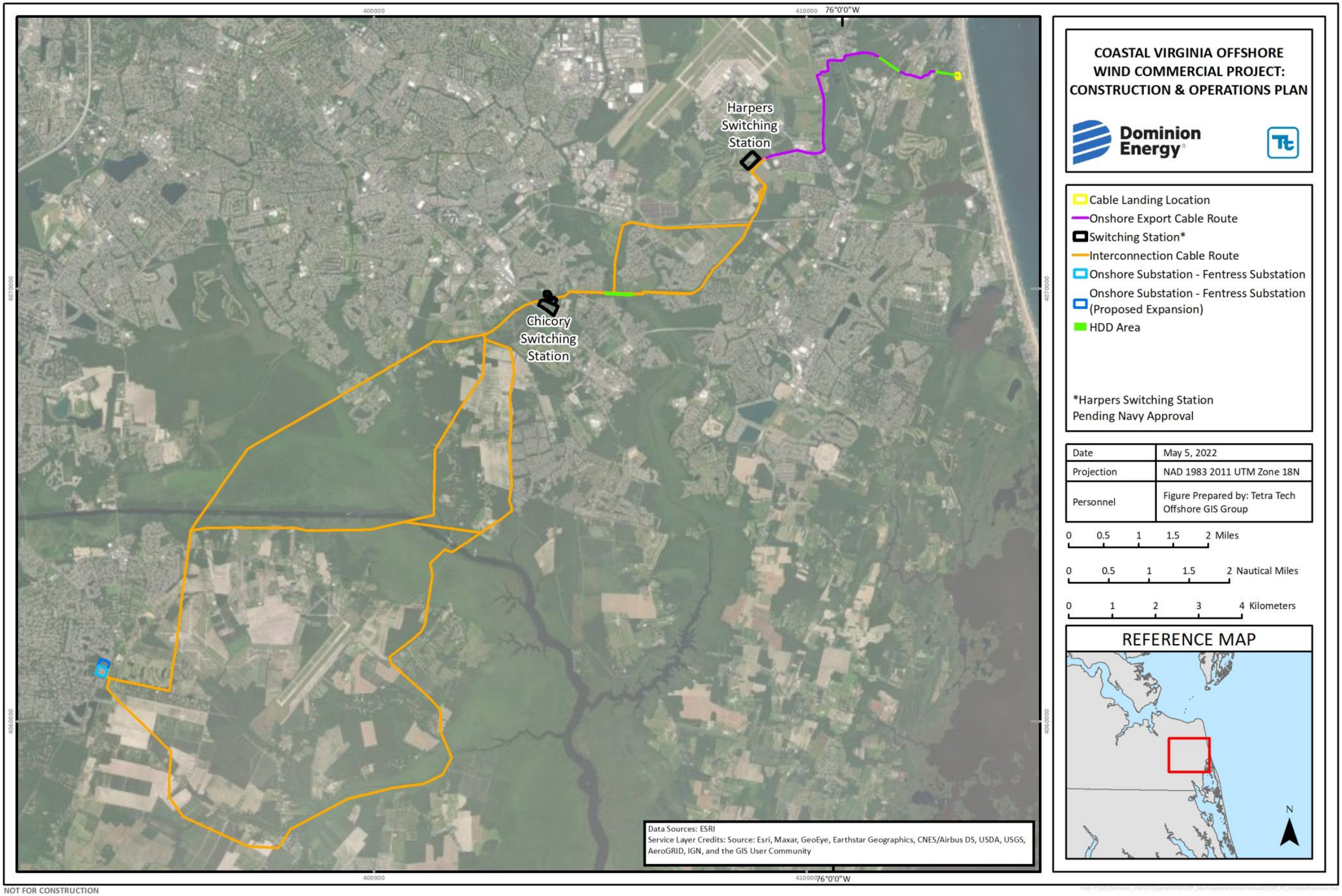


Figure Y-2. Onshore Project Overview

The construction and operational scenarios relevant to the analysis presented in this In-Air Acoustic Assessment include the following:

- Construction and operation of the Onshore Substation and one of two Switching Station options being considered for the Project;
- Construction of the Onshore Export Cable Routes and Interconnection Cable Routes;
- Specialized construction activities including:
    - Horizontal directional drilling (HDD) associated with installation of the Onshore Export Cables and Interconnection Cables; and
    - Impact pile driving of WTG and Offshore Substation Foundations;
- Vessel activity, including vessels associated with the installation of the Offshore Export Cables in the nearshore environment as well as operations and maintenance vessels;
- Construction and operation of up to 205 WTGs, three Offshore Substations, and the associated Inter-Array Cables; and
- Operation of sound signals (i.e., foghorns).

Additional activities may be identified as the Project is further evaluated and refined. Additional sound modeling may be completed, if needed, once final Project components are selected.

Y.1.1 Acoustic Concepts and Terminology

This section outlines some of the relevant acoustic concepts to help the non-specialist reader best understand the modeling assessment and results as presented in this report.

Airborne sound is described as a rapid fluctuation or oscillation of air pressure above and below atmospheric pressure creating a sound wave. Sound energy is characterized by the properties of sound waves, which include frequency, wavelength, amplitude, and velocity. A sound source is defined by a sound power level (L_W), which is independent of any external factors. Sound power is the rate at which acoustical energy is radiated outward and is expressed in units of watts. Sound energy propagates through a medium where it is sensed and then interpreted by a receiver. A sound pressure level is a measure of this fluctuation at a given receiver location and can be obtained through the use of a microphone or calculated from information about the source sound power level and the surrounding environment. Sound power, however, cannot be measured directly. It is calculated from measurements of sound intensity or sound pressure at a given distance from the source.

While the concept of sound is defined by the laws of physics, the term 'noise' has further qualities of being excessive or loud. The perception of sound as noise is influenced by several technical factors such as loudness, sound quality, tonality, duration, and the existing background levels. Sound levels are presented on a logarithmic scale to account for the large range of acoustic pressures that the human ear is exposed to and is expressed in units of decibels (dB). A decibel is defined as the ratio between a measured value and a reference value usually corresponding to the lower threshold of human hearing defined as 20 micropascals. Conversely, sound power is referenced to 1 picowatt.

Broadband sound includes sound energy summed across the frequency spectrum. In addition to broadband sound pressure levels, analysis of the various frequency components of the sound spectrum is completed to determine tonal characteristics. The unit of frequency is Hertz (Hz), measuring the cycles per second of the sound pressure waves and typically the frequency analysis examines nine octave bands from 32 Hz to 8,000 Hz. Since the human ear does not perceive individual frequencies with equal loudness, spectrally varying sounds are often adjusted with a weighting filter. The A-weighted filter (ANSI 2016) is applied to compensate for the frequency response of the human auditory system and sound exposure in acoustic assessments is designated in A-weighted decibels (dBA). Unweighted sound levels are referred to as linear. Linear decibels are used to determine a sound's tonality and to engineer solutions to reduce or control noise as techniques are different for low and high frequency noise. Typical sound pressure levels associated with various in-air activities and environments are presented in Table Y-1.

Table Y-1. Sound Pressure Levels of Typical In-Air Noise Sources and Acoustic Environments

Noise Source or Activity	Sound Level (dBA)	Subjective Impression
Jet aircraft takeoff from carrier (15 m)	140	Threshold of pain
50-horsepower siren (30 m)	130	-
Loud rock concert near stage Jet takeoff (61 m)	120	Uncomfortably loud
Float plane takeoff (31 m)	110	-
Jet takeoff (610 m)	100	Very loud
Heavy truck or motorcycle (8 m)	90	-
Garbage disposal Food blender (1 m) Pneumatic drill (15 m)	80	Loud
Vacuum cleaner (3 m)	70	Moderate
Passenger car at 65 mi per hour (8 m)	65	
Large store air-conditioning unit (6 m)	60	
Light auto traffic (31 m)	50	Quiet
Quiet rural residential area with no activity	45	
Bedroom or quiet living room Bird calls	40	Faint
Typical wilderness area	35	
Quiet library, soft whisper (5 m)	30	Very quiet
Wilderness with no wind or animal activity	25	Extremely quiet
High-quality recording studio	20	
Acoustic test chamber	10	Just audible
-	0	Threshold of hearing

Source: Adapted from EPA 1971

To take into account sound fluctuations, environmental sound is commonly described in terms of equivalent sound level (L_{eq}). The L_{eq} value is the energy-averaged sound level over a given measurement period. It is further defined as the steady, continuous sound level, over a specified time, which has the same acoustic energy as the actual varying sound levels. Levels of many sounds change from moment to moment. Some sharp impulses last one second or less, while others rise and fall over much longer periods of time. There are various measures of sound pressure designed for different purposes. To describe the background ambient sound level, the L_{90} percentile metric, representing the quietest 10 percent of any time period is used. Conversely, the L_{10} percentile metric is the sound level exceeded 10 percent of the time and is a measurement of intrusive noises, such as vehicular traffic or aircraft overflights, while the L_{50} metric is the sound level exceeded 50 percent of the time.

Y.2 REGULATORY CRITERIA

Applicable policies and regulations for the Project include regulations at the federal, state and municipal level. These requirements, which help assure that facilities (such as the Project) do not create adverse or nuisance impacts on the community, are discussed below.

Y.2.1 Federal Noise Requirements

There are no federal community noise regulations applicable to the Project.

The federal government has long recognized the potential hazards caused by noise to the health and safety of humans. Project noise during construction and operations are regulated, in a sense, through portions of the Occupational Health and Safety Act of 1970. This regulation establishes standards for permissible sound exposure in the workplace to guard against the risk of hearing loss with sound exposure level of workers regulated at 90 dBA, over an 8-hour work shift. Project construction contractors will readily provide workers with Occupational Health and Safety Act approved hearing protection devices and identify high noise areas and activities when hearing protection will be required (e.g. areas in close proximity to pile driving operations) and further ensuring that personnel and the general public are adequately protected from potential noise hazards and extended exposure to high noise levels.

Y.2.2 State Noise Requirements

The Onshore Project Components will be located in the Commonwealth of Virginia and a portion of the Offshore Export Cable will be located in Virginia state waters. There are no state noise regulations applicable to the Project.

Y.2.3 Local Noise Requirements

The Onshore Project Components will be located in the Cities of Virginia Beach and Chesapeake, Virginia. There are local noise requirements for all proposed onshore locations and those requirements are described below. In addition, some Project activities occur within the State Military Reservation (SMR), which may impose their own policies within the base boundaries. These restrictions will be followed unless work outside of these timeframes is authorized by the appropriate regulatory authority.

Y.2.3.1 The City of Virginia Beach

Article II of Chapter 23 of the Virginia Beach City Code (City of Virginia Beach 2020) includes provisions regulating sounds considered to be a hazard to public health, welfare, peace and safety, and quality of life, which are applicable to the Project. *Sec. 23-69. Maximum sound levels and residential dwellings* provides absolute noise limits for both the nighttime and daytime periods. This section also states that construction activities are exempt from these provisions:

> (a) *Nighttime*. No person shall permit, operate or cause any source of sound to create a sound level that can be heard in another person's residential dwelling during the hours between 10:00 p.m. and 7:00 a.m. in excess of 55 dBA when measured inside the residence at least four (4) feet from the wall nearest the source, with doors and windows to the receiving area closed.
>
> (b) *Daytime*. No person shall permit, operate or cause any source of sound to create a sound level in another person's residential dwelling during the hours between 7:00 a.m. and 10:00 p.m. in excess of 65 dBA when measured inside the residence at least four (4) feet from the wall nearest the source, with doors and windows to the receiving area closed.
>
> (d) *Exemptions*. The following activities or sources of noise shall be exempt from the daytime prohibition set forth in subsection (b) of this section:
>
> > (3) Activities related to the construction, repair, maintenance, remodeling or demolition, grading or other improvement of real property.

Additionally, *Sec. 23-71. Specific prohibitions* cites limits to noise activities within proximity to defined noise-sensitive areas (NSAs) and limits construction activities to between 7:00 a.m. and 9:00 p.m. The following are violations of this article:

> (e) *Noise-sensitive areas*. The making of any unreasonably loud and raucous noise within two hundred (200) feet of any school, place of worship, court, hospital, nursing home, or assisted-living facility while the same is being used as such, that substantially interferes with the workings of the institution.
>
> (f) *Construction equipment*. The operation of any bulldozer, crane, backhoe, front loader, pile driver, jackhammer, pneumatic drill, or other construction equipment between the hours of 9:00 p.m. and 7:00 a.m. except as provided in section 23-67 above, or as specifically deemed necessary and authorized by a written document issued by the city manager or his designee.

Y.2.3.2 The City of Chesapeake

Article V (Noise) of Chapter 26 of the Chesapeake Code includes provisions regulating sounds considered to be a hazard to public health, welfare, peace and safety, and quality of life which are applicable to the Project. Project. Article V (Noise), § 26-124 (Prohibited acts 10:00 p.m. – 6:30 a.m.) of the Chesapeake Code prohibits construction between the hours of 10:00 p.m. and 6:30 a.m. the following day Monday through Saturday and between 10:00 p.m. on Saturday and 8:00 a.m. the following Sunday.

Article V (Noise), § 26-130 (Measurement procedure; maximum permitted levels) of the Chesapeake Code prohibits provides absolute noise limits for both the nighttime and daytime periods. Table Y-2 shows the Chesapeake noise limits.

Table Y-2. Chesapeake Maximum Noise Limits

Area Zoning Classification or Land Use Designation in Mixed Use and Planned Unit Developments	Maximum dBA or Measurement of Overall Sound Pressure Level	Octave Band Limit Center Frequency (Hz)	Maximum dBA or Measurement of Maximum Sound Pressure Level in Each Octave Band
Residential	55	31.5	70
		63	69
		125	64
		250	59
		500	53
		1,000	47
		2,000	42
		4,000	38
		8,000	35

Article V (Noise) § 26-131 (Exemptions) of Chapter 26 of the Chesapeake Code states the following exemptions:

> (13) Noises created by the operation of any power generation facility, provided that such power generation facility is located within an industrial district, that the operation of such facility is conducted less than 2,000 cumulative hours per calendar year and causes no harm to adjacent properties or residents.
>
> (15) Noises generated by the operation of heating, ventilation and air conditioning units (high-voltage alternating-current units) attached to a building or structure.

Y.2.3.3 State Military Reservation

There are no noise requirements or decibel limits associated with SMR that are applicable to the Project.

Y.3 EXISTING AMBIENT CONDITIONS

To characterize existing ambient conditions at the Cable Landing Location and Onshore Substation, baseline sound measurements were conducted with an operator present for a minimum of thirty minutes during daytime and nighttime periods in accordance with American National Standards Institute (ANSI) 12.9: 2013/ Part 3 "Quantities and Procedures for Description and Measurement of Environmental Sound – Part 3: Short-Term Measurements with an Observer Present" (ANSI 2013). The period for nighttime measurements was between 10:00 p.m. and 7:00 a.m. when ambient conditions are typically quietest (i.e., more conservative), while daytime measurements took place between 7:00 a.m. and 10:00 p.m.

Baseline ambient measurement locations were pre-selected to be representative of the surrounding community and other potential NSAs near the Cable Landing Location and Onshore Substation parcel. The measurement locations are shown on Figure Y-3 and Figure Y-4, and include residential areas in proximity to the Project. The sound level analyzers used for the field program met the requirements of ANSI Specification S1.4-1983 and ANSI S1.43-1997 for precision Type 1 sound level analyzers (ANSI 2006). The sound level analyzers were programmed to document broadband and octave band sound level data.

Windscreens recommended by the manufacturer were used. In-situ field calibrations were performed on the equipment at the start and end of each survey period.

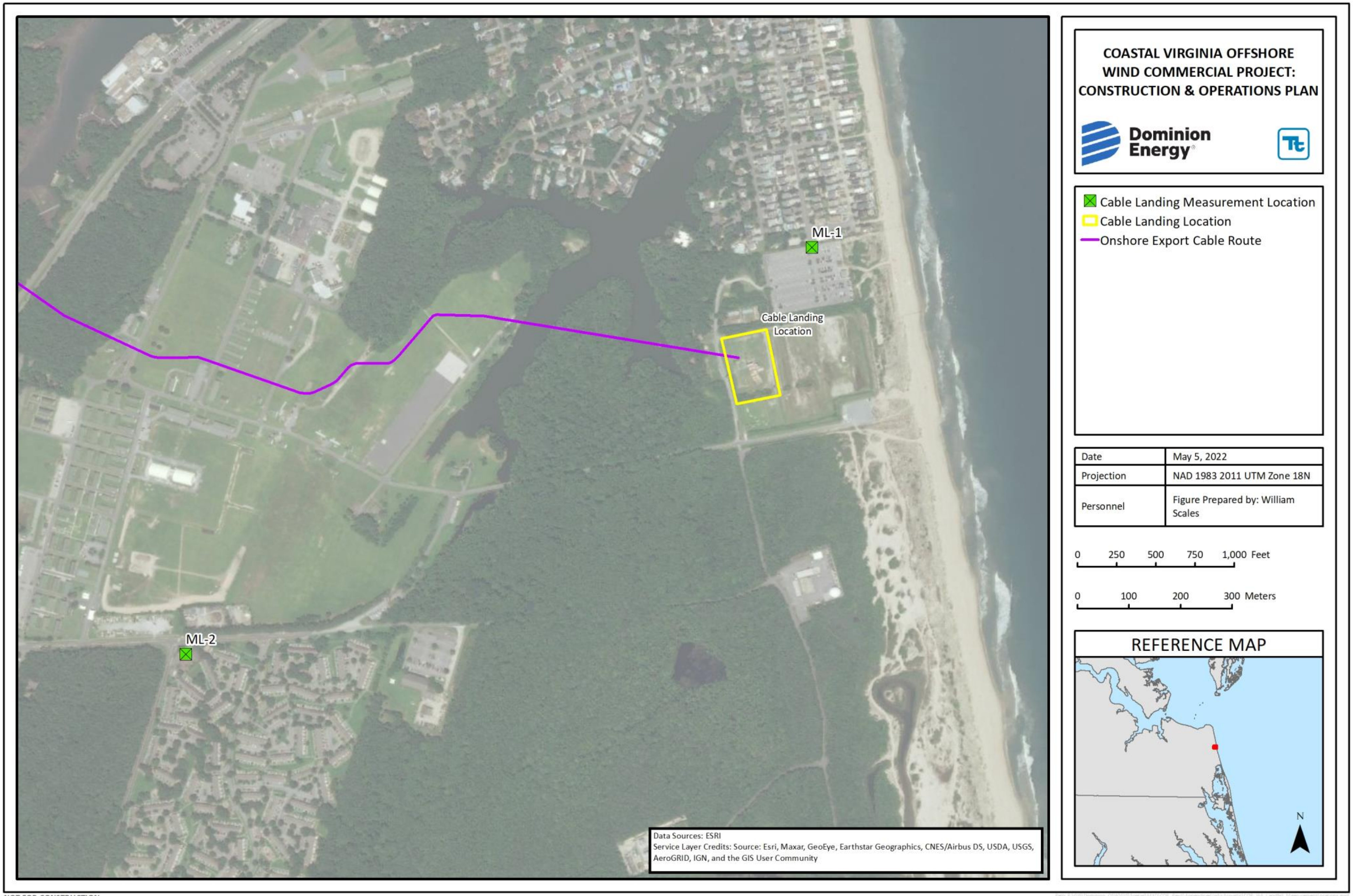
The acoustic environment at most locations was largely influenced by vehicular traffic. Localized traffic was steady during the daytime hours, though fewer cars traversed local roads at night. Noise from jets was observed during both daytime and nighttime at the locations relative to the Cable Landing Location. Natural sounds from birds, trees and other wildlife were also minor sound sources in the area, as were ocean waves in coastal areas.

Weather conditions were considered suitable for acoustic measurements. Table Y-3 summarizes the measured sound levels for each of the time periods as well as location addresses. Sound-level monitoring shows existing nighttime L_{eq} levels are in the range of 34 to 45 dBA. Measured ambient sound levels exhibited typical diurnal patterns, with higher ambient sound levels during the daytime ranging from 42 to 62 L_{eq} dBA.

Table Y-3. Sound Level Monitoring Results

Site	Monitoring Location	UTM Coordinates		Time Period	Sound Level (dBA L_{eq})
		Easting	Northing		
Cable Landing Location	ML-1	413605	4075152	Day	42
				Night	43
Cable Landing Location	ML-2	412387	4074361	Day	53
				Night	45
Onshore Substation Parcel	ML-6	393734	4060943	Day	46
				Night	35
Onshore Substation Parcel	ML-7	394049	4061352	Day	54
				Night	34
Onshore Substation Parcel	ML-8	394024	4060779	Day	62
				Night	39
Onshore Substation Parcel	ML-9	393373	4061137	Day	55
				Night	37
Onshore Substation Parcel	ML-10	393489	4061574	Day	44
				Night	39

Note: Monitoring Locations are not numbered consecutively since locations ML-3 through ML-5 are no longer included in the Project Design Envelope.



NOT FOR CONSTRUCTION

Figure Y-3. Cable Landing Location Measurement Locations

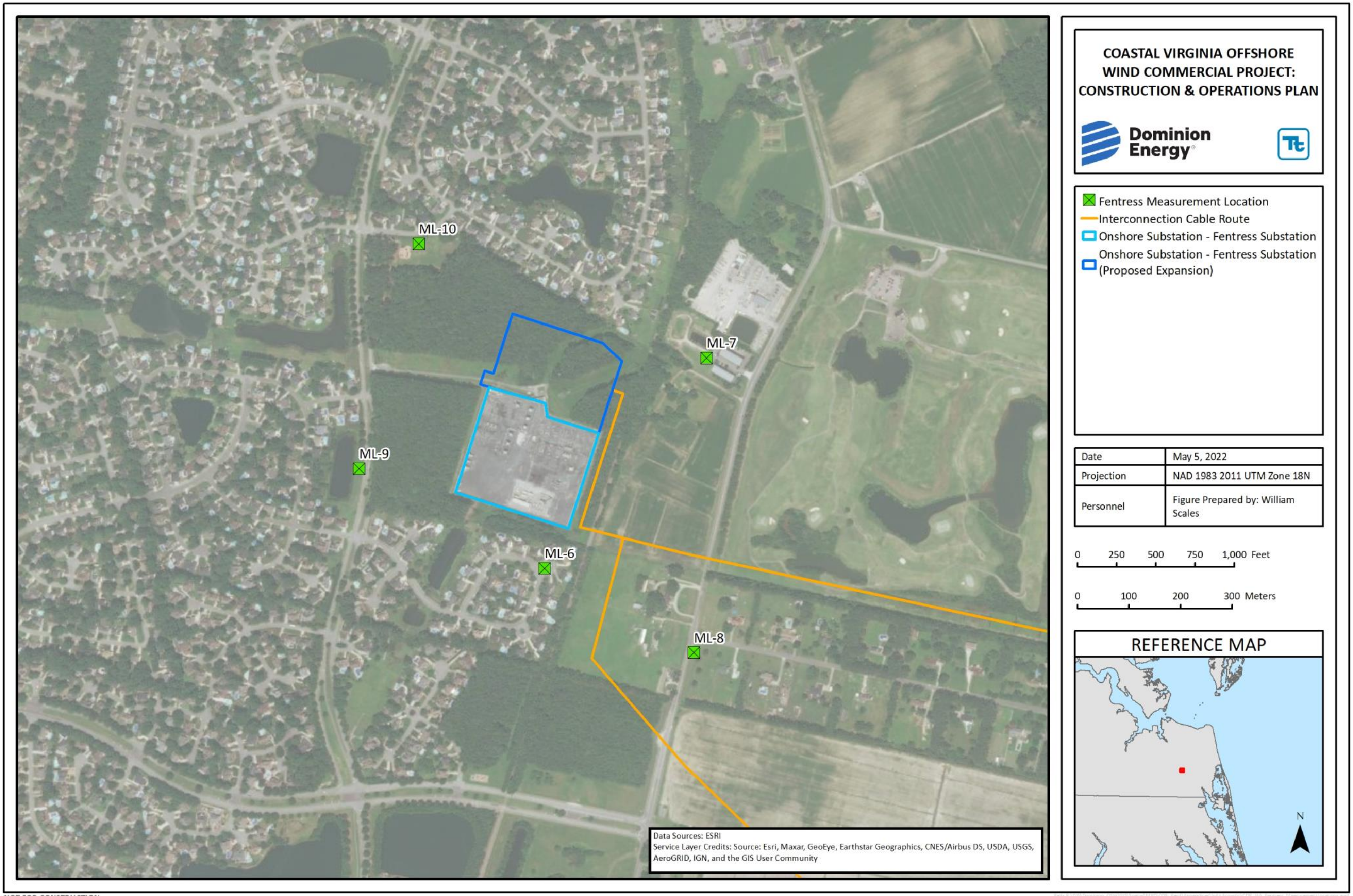


Figure Y-4. Onshore Substation Parcel Measurement Locations

Y.4 ACOUSTIC MODELING METHODOLOGY

The acoustical modeling for the Project was conducted with the Cadna-A® sound model from DataKustik GmbH (Version 2020 MR1, DataKustik 2020). The outdoor acoustic model is based on the International Organization for Standardization (ISO) 9613, Part 1: “Calculation of the absorption of sound by the atmosphere,” (ISO 1993) and Part 2: “General method of calculation,” (ISO 1996). Model predictions are accurate to within 1 dB and/or 1 dBA of calculations based on the ISO 9613 standard, as appropriate.

The ISO 9613 standard was instituted in Cadna-A® to calculate propagation and attenuation of sound energy with distance, surface and building reflection, and shielding effects by equipment, buildings, and ground topography. Offsite topography was determined using U.S. Geological Survey digital elevation data with a 98-foot (ft; 30-meter [m]) interval between height points for the Project Area. The sound model propagation calculation parameters are summarized in Table Y-4.

Table Y-4. Acoustic Model Setup Parameters

Model Input	Parameter Value
Standards	ISO 9613-2, Acoustics – Attenuation of sound during propagation outdoors a/
Terrain Description	Per site grading plan and U.S. Geological Survey topography of surrounding areas
Ground Absorption	0.0 for water surface, onsite area, reflective ground 0.5 for offsite areas, moderately absorptive ground
Receiver Characteristics	5 ft (1.52 m) above ground level
Meteorological Factors	Omnidirectional downwind propagation / mild to moderate atmospheric temperature inversion
Temperature	50°F (10°C)
Relative Humidity	70 percent

Note:
a/ Propagation calculations under the ISO 9613 standard incorporate the effects of downwind propagation (from facility to receptor) with wind speeds of 3 to 16 ft/s (2.0 to 10.9 mph) (1 to 5 m/s; 3.6 to 18 km/hour) measured at a height of 10 to 36 ft (3 to 11 m) above ground level.

Cadna-A® allows for three basic types of sound sources to be introduced into the model: point, line, and area sources. Each sound-radiating element was modeled based on its sound emission pattern. Small dimension sources, such as transformer fans, which radiate sound hemispherically, were modeled as point sources. Larger dimensional sources, such as the onshore transformer walls and rigs, were modeled as area sources. Transformers, firewalls, and onsite buildings and barriers were modeled as solid structures because diffracted paths around and over structures tend to reduce sound levels in certain directions.

Ground absorption rates are described by a numerical coefficient. For pavement and water bodies, the absorption coefficient is defined as G = 0 to account for reduced sound attenuation and higher reflectivity. In contrast, ground covered in vegetation, including suburban lawns, are acoustically absorptive and aid in sound attenuation; i.e., G = 1.0.

Y.5 ACOUSTIC MODELING SCENARIOS

The representative acoustic modeling scenarios were derived from descriptions of the expected construction activities and operational conditions through consultations between the Project design and engineering teams. The subsections that follow provide more detailed information about the parameters used to model the sound sources associated with each scenario.

Y.5.1 Construction Acoustic Assessment

Two types of pile driving may be required during offshore Project construction, impact and vibratory pile driving. Impact pile driving may be used to install the WTG and Offshore Substation Foundations and goal posts to support trenchless installation, while vibratory pile driving may be used to install the nearshore cofferdams. Specialized trenchless installation may also be required at the Cable Landing Location where the Offshore Export Cables come on shore. Construction and installation of the Onshore Export Cable, Switching Station, Interconnection Cable, and Onshore Substation generally consists of site clearing and grading, excavation, foundation work, building erection, and finishing work. During construction, there will also be vessels shuttling workers and equipment to the Offshore Project Area.

Y.5.1.1 Construction of Onshore Project Components

The construction of Onshore Export Cable, Switching Station, Interconnection Cable will result in a temporary increase in sound levels near the activity. The construction process will require the use of equipment that could be periodically audible from off-site locations at certain times. The Switching Station and Onshore Substation installation generally consists of site clearing, grading, excavation and foundation work, building erection, and equipment installation which is anticipated to have a total duration of up to 1.5 years. Construction of the Onshore Export and Interconnection Cables involves site preparation, duct bank installation, restoration, cable installation, cable jointing, and final testing for the underground route while the overhead interconnection cables will involve site clearing, foundation work and structure erection.

The noise levels resulting from construction activities vary greatly depending on factors such as the type of equipment, the specific equipment model, the operations being performed, and the overall condition of the equipment. The U.S. Environmental Protection Agency has published data on the L_{eq} sound levels for typical construction stages (EPA 1971). Following the U.S. Environmental Protection Agency method, sound levels were projected from the acoustic center of the construction footprint. This calculation conservatively assumes that all equipment would be operating concurrently onsite for the specified construction stage and that there would be no sound attenuation for ground absorption or onsite shielding by the existing buildings or structures.

The results of these calculations are presented in Table Y-5 (below) and show estimated construction sound levels in A-weighted decibels will vary depending on construction stage and distance. The highest levels are expected to occur in proximity to the closest neighborhoods during the site grading and compaction stage. Construction noise levels at 152 m and 305 m are similar to existing daytime sound levels exhibited in the ambient noise study. Thus, construction sound would not be expected to create a noise nuisance condition as it will be similar in character to existing daytime sound levels. While construction is exempt from the City of Virginia Beach noise regulations during the day, and limited to daytime hours in

Chesapeake, Dominion Energy will limit onshore construction activities to daytime periods, to the extent practicable, unless deemed acceptable from the appropriate regulatory authority. Dominion Energy will consult with the appropriate regulatory agency regarding nighttime work in the case of an emergency. In addition, Dominion Energy proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Construction will be limited to daytime period unless deemed acceptable from the appropriate regulatory authority;
- Construction equipment will be well-maintained and vehicles using internal combustion engines equipped with mufflers will be routinely checked to ensure they are in good working order;
- Noisy equipment onsite will be located as far as possible from NSAs;
- If noise issues are identified, Dominion Energy will work with local authorities to mitigate as necessary; and
- A Project Communications Plan will be made available to help actively address all noise related issues in a timely manner.

Table Y-5. General Construction Noise Levels (dBA)

Stage No.	Construction Stage	Example Construction Equipment	Equipment Noise Level at 15 meters dBA	Operational Usage Factor (%)	Composite Noise Level, dBA			
					50 ft	250 ft	500 ft	1,000 ft
1	Site Clearing	Tracked Dozer Skid Steer Excavator Wheeled Loader Water Truck	88 70 80 80 80	40 40 40 40 40	85	71	65	59
2	Site Grading	Excavator Tracked Dozer Skid Steer Off-Road Truck Grader Roller-Compactor Wheeled Loader Backhoe-Loader Water Truck	80 88 70 70 82 75 80 80 80	40 40 40 40 40 20 40 40 40	87	73	67	61
3	Excavation and Foundations	Excavator Backhoe-Loader Skid-Steer Loader Wheeled Loader Auger Rig Tracked Dozer Cement Mixer Truck Water Truck	80 80 70 80 85 88 80 80	40 40 40 40 20 40 40 40	87	73	67	61

Stage No.	Construction Stage	Example Construction Equipment	Equipment Noise Level at 15 meters dBA	Operational Usage Factor (%)	Composite Noise Level, dBA			
					50 ft	250 ft	500 ft	1,000 ft
4	Building Erection	Wheeled Loader Mobile Crane Forklift Flatbed Truck Dump Truck Cement Mixer Truck Water Truck	80 82 80 75 80 80 80	40 16 40 40 40 40 40	84	70	64	58
5	Equipment Installation	Compressor Mobile Crane Forklift Wheeled Loader Dump Truck Specialty Truck Water Truck	81 82 80 80 80 75 80	40 16 40 40 40 40 40	84	70	64	58

During the equipment installation stage, a helicopter may be used for transmission line activities. The primary sources of wideband acoustic energy from helicopters or air-cranes are the main and tail rotor. Helicopters generally fly at low altitudes; therefore, potential temporary increases to ambient sound levels would occur in the area where helicopters are operating as well as along their flight path. Helicopter operations will only occur in the Xdaytime.

In addition to the above-listed construction equipment, pile driving may be needed to install the foundation for the Onshore Substation and Switching Station. The pile driving technique, vibratory or impact, has not been selected at this stage of Project design. In the event that vibratory pile driving is selected, noise levels would be expected to be consistent with those reported during the excavation stage of construction. If impact pile driving is required, higher noise levels may be produced for temporary short-term periods.

Due to the character of the impulsive sound they produce, impact pile drivers are not typically analyzed in combination with non-impulsive construction sound sources such as heavy-duty vehicles. Impulsive sounds are typically transient, brief (less than one second), broadband, and consist of high peak sound pressure with rapid rise time and rapid decay. Non-impulsive sound can be broadband, narrowband or tonal, brief or prolonged, continuous or intermittent) and typically do not have a high peak sound pressure with rapid rise/decay time that impulsive sounds do. Noise is generated from pile drivers from both the ram striking the pile as well as the operating steam, air, or diesel exhaust as it is exhausted from the cylinder (this is not present with hydraulic impact hammers). Assuming an approximate impact rate of 1,400 blows per minute, a sound pressure level of 111 dBA at 6 m is estimated. Assuming a load or usage factor of 20 percent, it is expected that sound from pile driving would attenuate to 70 dBA at a distance of approximately 1001 ft (305 m) and would attenuate to below 60 dBA within 1 mile (1.6 linear km) of this construction activity, depending on meteorological and topographical effects.

Y.5.1.2 Vibratory Pile Driving at Offshore Trenchless Installation Punch-Out Location

Vibratory pile drivers install piling into the ground by applying a rapidly alternating force to the pile. This is generally accomplished by rotating eccentric weights about shafts. Each rotating eccentric weight produces a force acting in a single plane and directed toward the centerline of the shaft. The weights are set off-center of the axis of rotation by the eccentric arm. If only one eccentric is used, in one revolution a force will be exerted in all directions, giving the system a good deal of lateral whip. To avoid this problem, the eccentrics are paired so the lateral forces cancel each other, leaving only axial force for the pile. Vibratory sheet pile installation and removal of the temporary cofferdam is estimated to produce sound levels of 78 dBA in air at a distance of approximately 400 ft (122 m) with a corresponding LW of 127 dBA (USDOT 2012). The schedule for vibratory pile driving is expected to be one to two days in duration, but specific details are not available at this time.

There may be nine cofferdam locations that will require vibratory driving. For the purpose of this assessment, the most northern location was modeled, which is the worst-case location due to its proximity to onshore receptors. The resulting received sound level will be 66 dBA at the closest onshore receptor, which is approximately 1,070 ft (326 m) away.

Considering this construction activity will last for a relatively short duration of time and will be limited to daytime periods, it is not expected to constitute a violation of local nuisance by-laws or ordinances nor result in a potential imminent hazard to public health or the environment.

Y.5.1.3 Cable Landing and Onshore Cable Crossing Work Areas

Sea-to-shore transition of the Offshore Export Cables at the Cable Landing Location will be completed using trenchless installation (Direct Steerable Pipe Thrusting [DSPT]) techniques. Within the Cable Landing Location at the Proposed Parking Lot west of the Firing Range at SMR, there will be a total of nine trenchless installation locations that will operate consecutively and not concurrently. For each landfall area, the most northern and southern trenchless installation locations were modeled, which are the worst-case locations due to their proximity to receptors.

In addition to the trenchless installation construction at the Cable Landing Location, there will be five sections along the Onshore Export Cable Route and Interconnection Cable Route that will require trenchless installation (HDD or microtunneling) for crossings (Figure Y-2). Each of the five sections will have an entry and exit trenchless installation location, which will operate simultaneously.

Equipment used for trenchless installation are comparable and consists of rigs and auxiliary support equipment including electric mud pumps, portable generators, mud mixing and cleaning equipment, forklifts, loaders, cranes, trucks, and portable light plants. Table Y-6 presents the trenchless installation components included in the analysis and Table Y-7 provides candidate noise control mitigation strategies. Once the trenchless installation is complete, noise from the Cable Landing Location and cable crossings will be limited to typical construction activities associated with equipment such as tracked graders, backhoes and pickup trucks trenchless installation construction activities will occur during the daytime period unless a situation arises that would require operation to continue into the night or as deemed acceptable from the appropriate regulatory authority. In the case of night operations, only the rig and power unit will be used unless otherwise deemed acceptable from the appropriate regulatory authority.

Table Y-6. Trenchless Installation Equipment Listing

Equipment Component	Sound Level without Acoustical Treatment	Sound Level with Acoustical Treatment
Drill Rig and Power Unit	102	88
Drilling Mud Mixer/Recycling Unit	90	85
Mud Pumping Unit	102	85
Generator Set, 100 kilowatts	100	80
Generator Set, 200 kilowatts	102	80
Vertical Sump Pump	75	75

Table Y-7. Candidate Noise Control Strategies

Equipment Component	Candidate Noise Control Strategies
Trucks	Restrictions of hours of operations and routes (away from receivers).
Light Plants (electric generators)	Acoustical enclosures or barriers for generators.
Mud Pumping Units	Acoustical enclosures for mud pumps and engines equipped with exhaust silencers.
Loaders/Forklifts	Engines equipped with exhaust silencers. Modification of backup alarms to low volume types. Locating loading bins away from receivers.
Power Unit and Rig	A complete acoustical enclosure for the power unit equipped with a critical grade exhaust silencer. Partial enclosure or barrier for the rig.
Light Plants (Electric Generators)	Acoustical enclosures or barriers for electric generators and exhaust silencers.
Cranes and Boom Trucks	Exhausts equipped with silencers. Engine compartment acoustically treated. Usage restrictions.

Table Y-8 summarize the predicted sound levels experienced at the closest NSAs for each trenchless installation scenario. The distance from each NSA to closest active trenchless installation location is also provided. The resultant sound contour plot displays operational sound levels for the northern and southern trenchless installations and are shown in Figure Y-5 and Figure Y-6 respectively. If necessary, subject to regulatory requirements and stakeholder engagement, Dominion Energy will work with local authorities to mitigate as necessary.

Table Y-8. Sound Levels during Landfall Trenchless Installation Construction

Noise-Sensitive Area	NSA Type	Proposed Parking Lot, West of the Firing Range at the State Military Reservation			
		Distance to Northern Trenchless Installation (feet)	Northern Trenchless Installation Sound Level/ (dBA)	Distance to Southern Trenchless Installation (feet)	Southern Trenchless Installation Sound Level (dBA)
NSA L-1	Residential	260	53	320	48
NSA L-2	Residential	225	55	290	53
NSA L-3	Residential	200	56	270	54
NSA L-4	Residential	170	57	245	55
NSA L-5	Residential	160	58	240	55

Noise-Sensitive Area	NSA Type	Proposed Parking Lot, West of the Firing Range at the State Military Reservation			
		Distance to Northern Trenchless Installation (feet)	Northern Trenchless Installation Sound Level/ (dBA)	Distance to Southern Trenchless Installation (feet)	Southern Trenchless Installation Sound Level (dBA)
NSA L-6	Residential	155	56	245	52
NSA L-7	Residential	158	51	245	48
NSA L-8	Residential	245	51	300	47
NSA L-9	Residential	385	47	460	43
NSA L-10	Residential	960	38	915	40

Table Y-9 summarizes the acoustic modeling results at NSAs associated with the five sections along the Onshore Export Cable Route and Interconnection Cable Route that will require trenchless installation for crossings (Figure Y-2). The resultant sound contour plot displays operational sound levels for the trenchless installation installations and are shown in Figure Y-7, Figure Y-8, Figure Y-9, Figure Y-10 and Figure Y-11, respectively.

Table Y-9. Sound Levels during Onshore Export Cable Route and Interconnection Cable Route Trenchless Installation Construction

Noise-Sensitive Area	NSA Type	Section 1		Section 2		Section 3		Section 4		Section 5	
		Distance	Sound Level (dBA)	Distance	Sound Level (dBA)	Distance	Sound Level (dBA)	Distance	Sound Level (dBA)	Distance	Sound Level (dBA)
NSA HDD-1	Residential	380	47	758	38	-	-	-	-	-	-
NSA HDD-2	Residential	1115	36	660	43	-	-	-	-	-	-
NSA HDD-3	Residential	-	-	575	44	-	-	-	-	-	-
NSA HDD-4	Residential	-	-	615	43	-	-	-	-	-	-
NSA HDD-5	Residential	-	-	-	-	465	47	-	-	-	-
NSA HDD-6	Residential	-	-	-	-	1500	35	155	58	-	-
NSA HDD-7	Residential	-	-	-	-	1350	36	60	64	-	-
NSA HDD-8	Residential	-	-	-	-	1350	36	90	61	-	-
NSA HDD-9	Residential	-	-	-	-	1420	35	64	65	-	-
NSA HDD-10	Residential	-	-	-	-	1520	34	63	64	-	-
NSA HDD-11	Residential	-	-	-	-	1680	33	62	57	-	-
NSA HDD-12	Residential	-	-	-	-	-	-	170	36	440	46
NSA HDD-13	Residential	-	-	-	-	-	-	-	-	280	51
NSA HDD-14	Residential	-	-	-	-	-	-	-	-	265	51
NSA HDD-15	Residential	-	-	-	-	-	-	-	-	265	52
NSA HDD-16	Residential	-	-	-	-	-	-	-	-	265	52
NSA HDD-17	Residential	-	-	-	-	-	-	-	-	450	46
NSA HDD-18	Residential	-	-	-	-	-	-	-	-	450	47
NSA HDD-19	Residential	-	-	-	-	-	-	-	-	415	48
NSA HDD-20	Residential	-	-	-	-	-	-	-	-	111	59
NSA HDD-21	Residential	-	-	-	-	-	-	-	-	105	59
NSA HDD-22	Residential	-	-	-	-	-	-	-	-	85	61
NSA HDD-23	Residential	-	-	-	-	-	-	-	-	95	60

Trenchless installation (HDD, DSPT, or microtunneling) may also be required at other locations depending on Project design and terrain encountered throughout the Project Area. The equipment and noise produced by other trenchless installation methods are comparable to that of HDD. Further acoustic analysis will be conducted as needed to evaluate potential noise impacts associated with additional locations requiring trenchless installation.

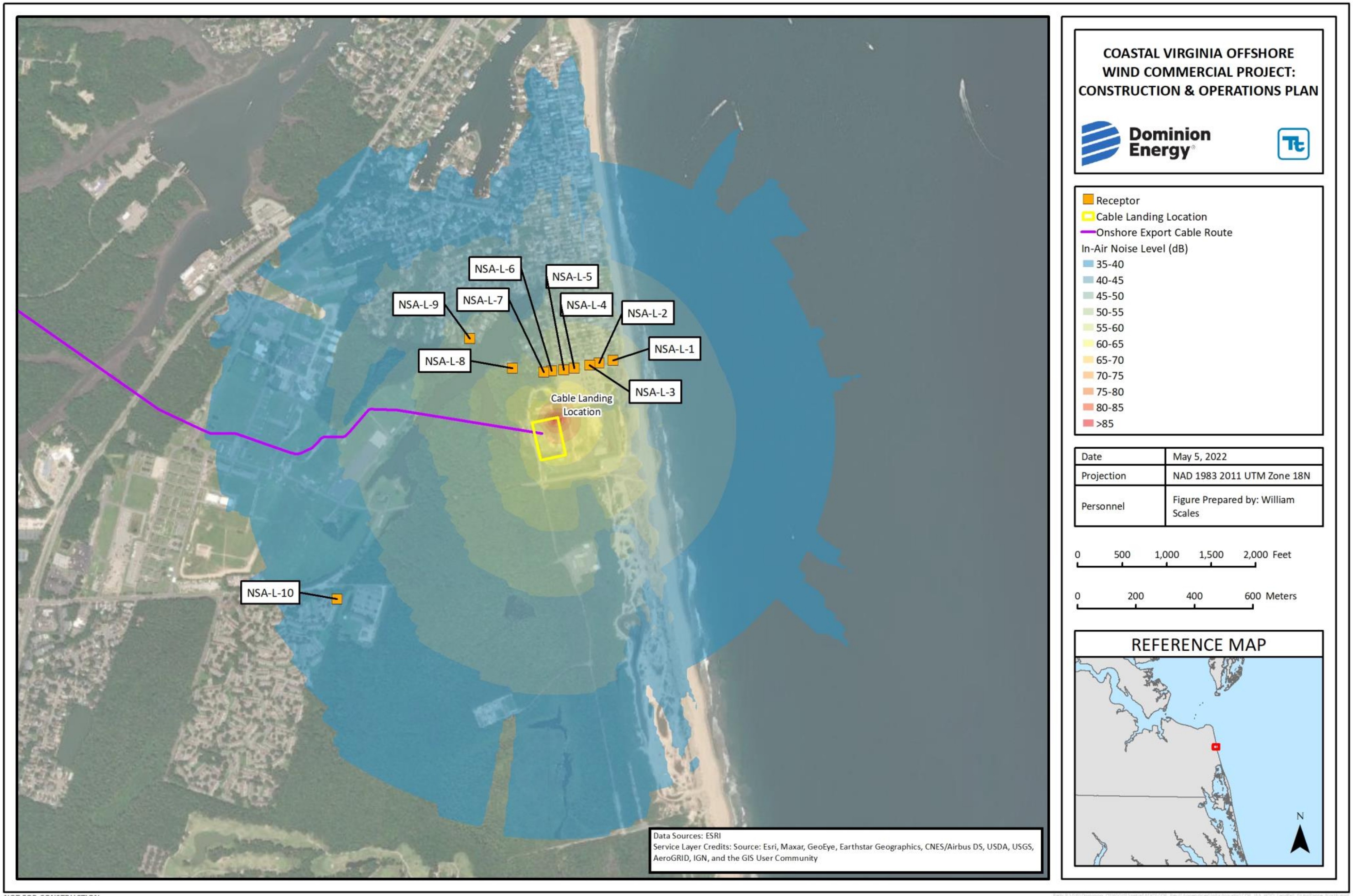


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Figure Y-5. Cable Landing Location Trenchless Installation Construction Sound Levels (Northern Location)

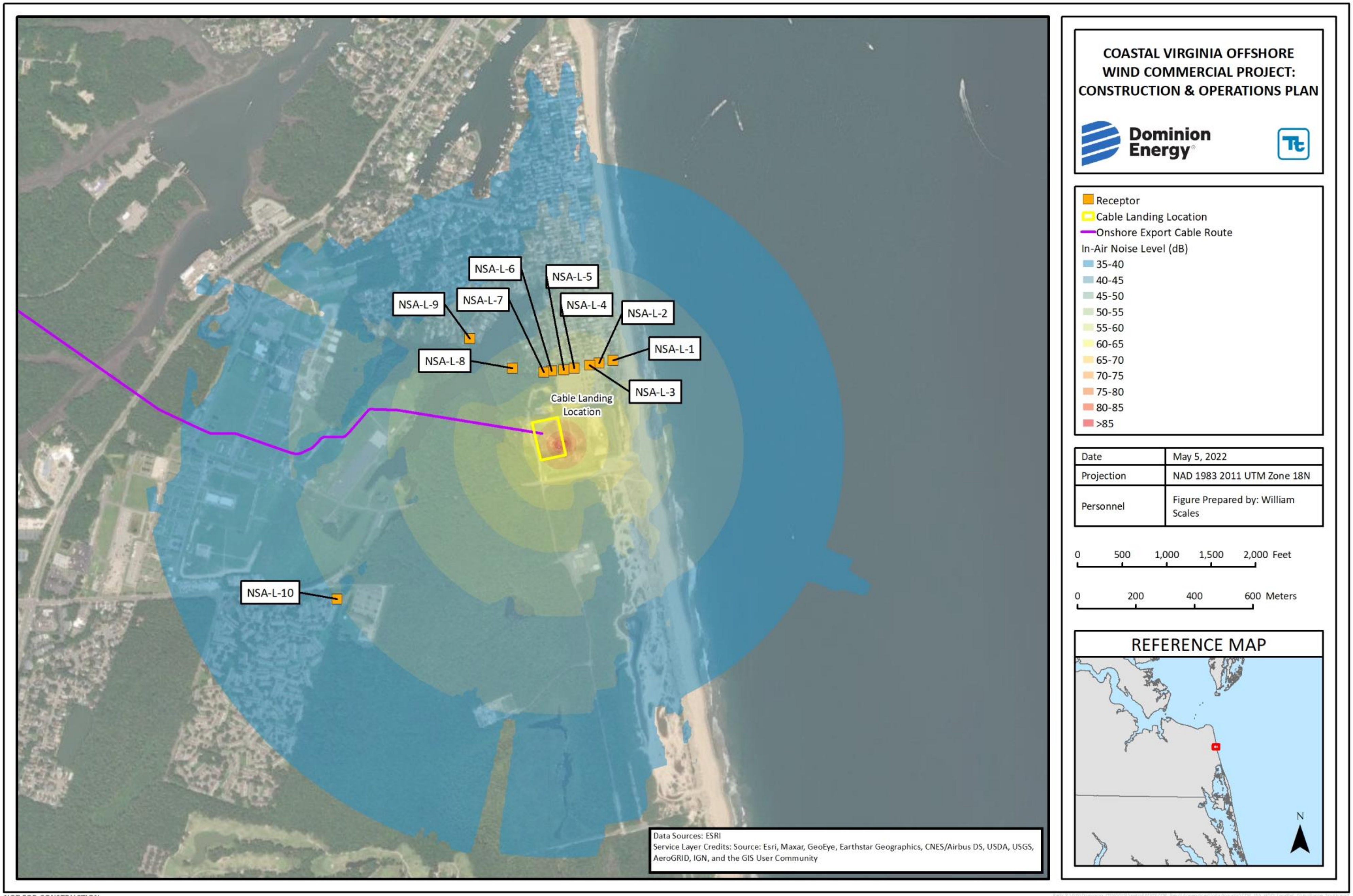

Figure Y-6. Cable Landing Location Trenchless Installation Construction Sound Levels (Southern Location)

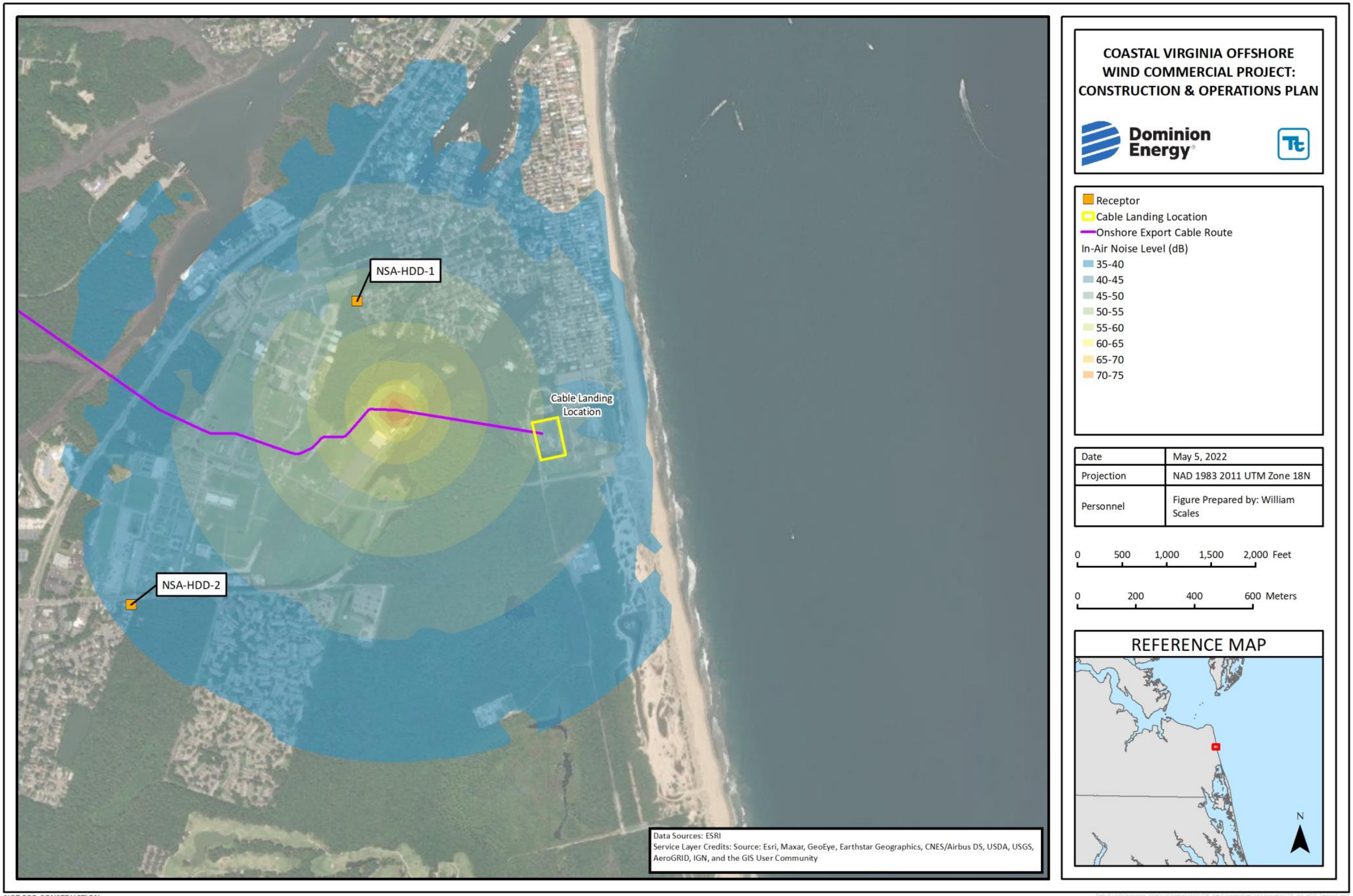

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Figure Y-7. Trenchless Installation Construction Sound Levels, Section 1

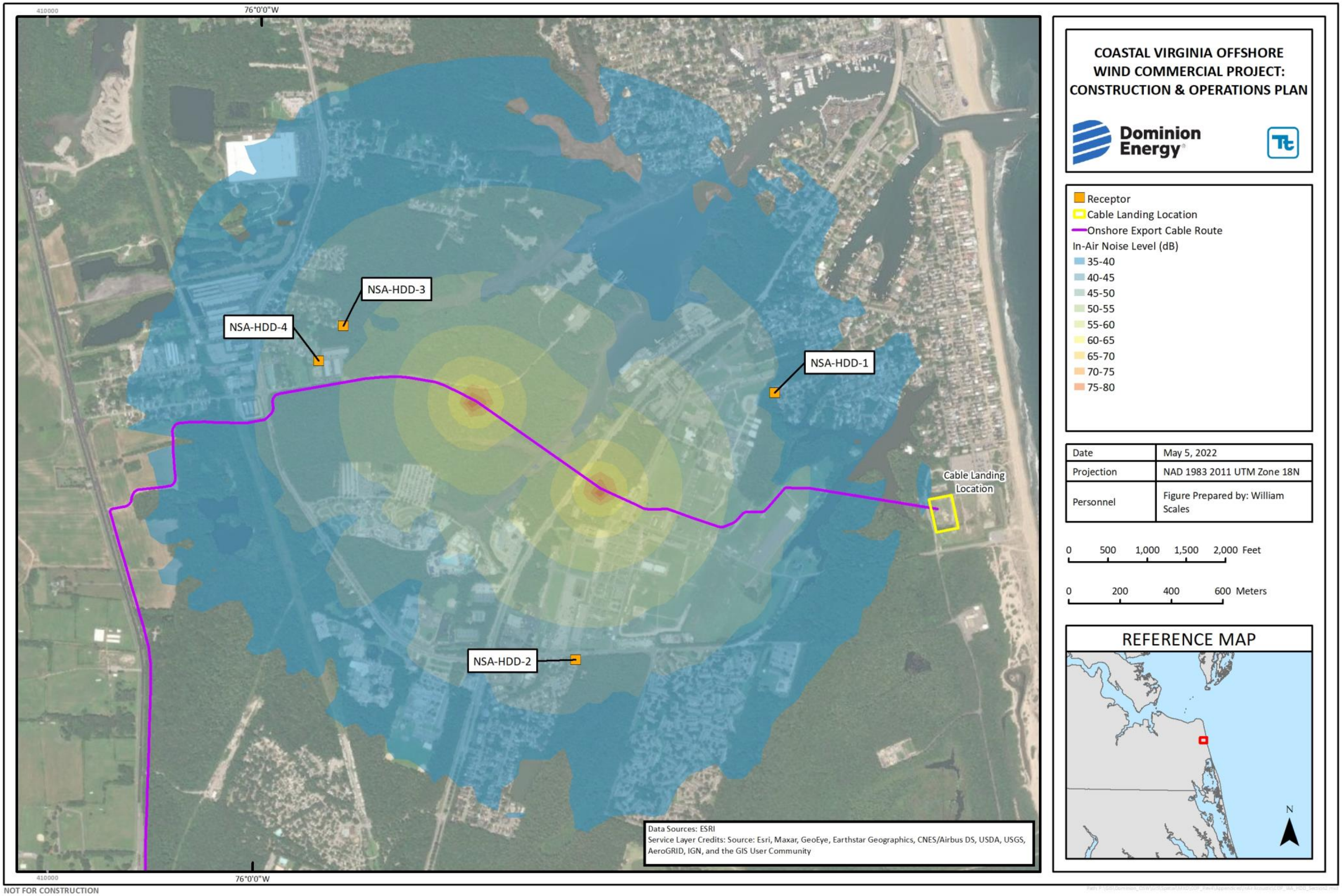

Figure Y-8. Trenchless Installation Construction Sound Levels, Section 2

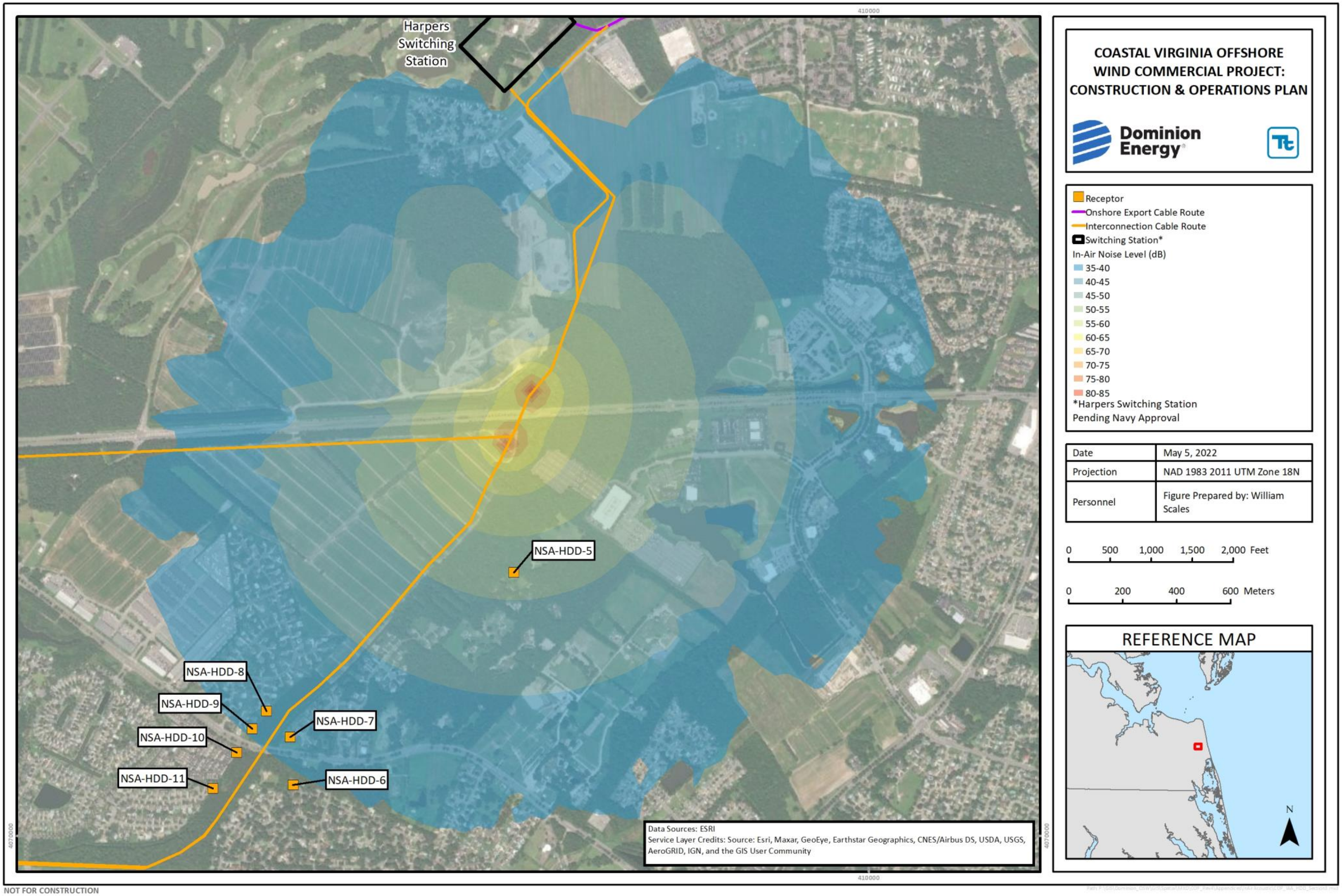

Figure Y-9. **Trenchless Installation Construction Sound Levels, Section 3**

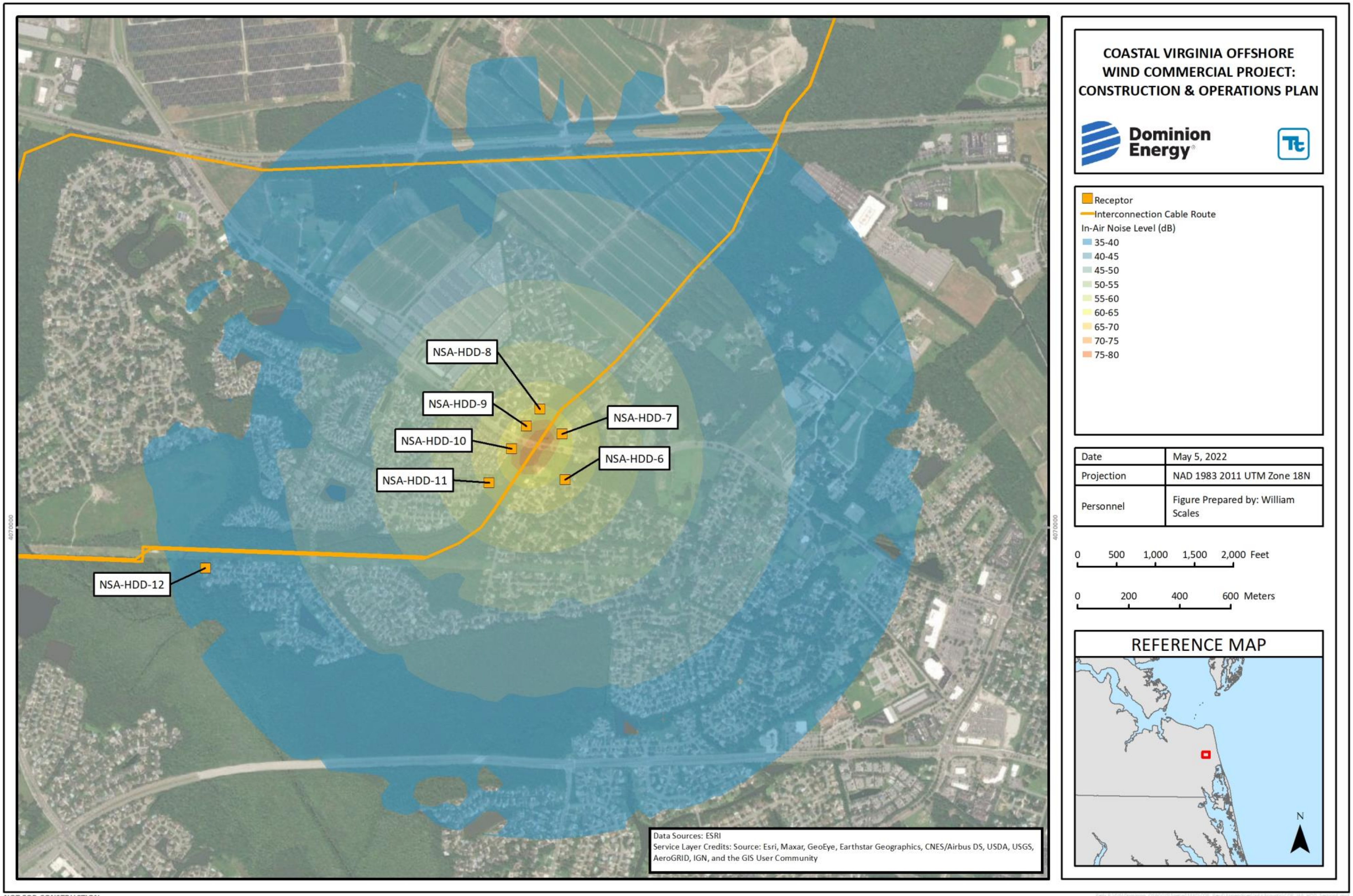

Figure Y-10. Trenchless Installation Construction Sound Levels, Section 4

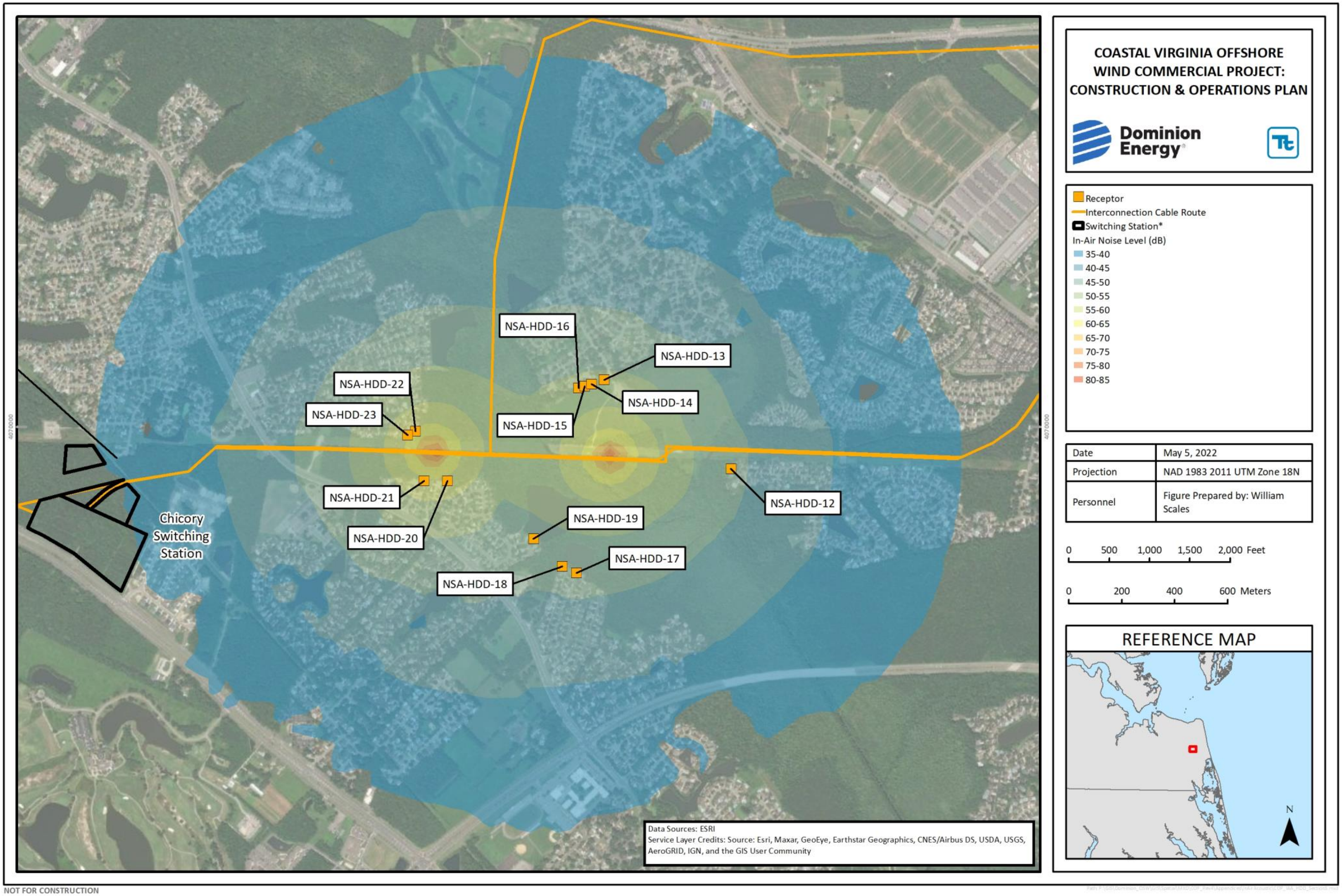

Figure Y-11. Trenchless Installation Construction Sound Levels, Section 5

Y.5.1.4 Impact and Vibratory Driving of the WTG and Offshore Substation Foundations

Both impact and vibratory pile driving are being considered to install WTG and Offshore Substation foundations; however, for the purposes of a conservative in-air acoustic assessment, potential noise impacts were analyzed for impact pile driving activities. Impact pile driving is performed by using hammers that drive a pile into the ground by first inducing downward velocity in a metal ram. Upon impact with the pile accessory, the ram creates a force far larger than its weight, which moves the pile into the ground by increments.

Generating higher sound levels than vibratory pile driving, impact pile installation of the monopile foundation is estimated to produce sound levels of 87 dBA in air at a distance of 122 m with a corresponding L_W at the source of 137 dBA (USDOT 2012). This is analyzed as a worst-case scenario. Acoustic modeling was conducted for noise produced from impact pile driving of two WTG monopile foundations at the closest and furthest representative location relative to the shoreline, as this is anticipated to represent the maximum design scenario for this activity. Impact pile driving of the monopile, as opposed to the piled jacket design, was analyzed because it is considered the maximum design scenario for potential onshore noise impacts. The separate Underwater Acoustic Assessment results can be found in Appendix Z.

Received sound levels generated from impact pile driving during foundation installation are shown in Figure Y-12. The highest predicted received sound level at any onshore location during pile driving is less than 30 dBA, which is well below applicable noise regulations. Given the extended distances between the Project and coastal shorelines (approximately 24 nm and 36 nm [45 km and 67 km]), no negative impacts are expected from either WTG or Offshore Substation foundation installation.

Y.5.1.5 Support Vessels

Helicopters and vessels will transport crews and materials to the Offshore Project Area during construction, and to a lesser extent during ongoing operations and maintenance. Helicopters may also be used for periodic access and/or for visual inspections. The helicopters would be based at a general aviation airport near the Lease Area. The installation of the Offshore Export Cables, Inter-Array Cables, and WTG, Offshore Substation foundations will require a number of different types of construction vessels, including heavy lift vessels, cable installation and crew transport vessels. The vessels used for nearshore work will have sound emissions similar to vessels currently in use in nearby waterways.

The International Maritime Organization (IMO) has established noise limits for vessels as a specialized agency of the United Nations whose primary purpose is to develop and maintain a regulatory framework for shipping including issues pertaining to safety, environmental concerns, legal matters, technical cooperation, maritime security, and the efficiency of shipping. The IMO publishes regulatory guidance documents on these issues (IMO 1975, 1981) and published "Noise Levels on Board Ships", which contains the Code on Noise Levels on Board Ships (Resolution A.468(XII)), developed to promote noise control at a national level within the framework of internationally agreed-upon guidelines. In terms of sound generation limits of vessels, resolution A.468 limits received noise levels to 70 dBA at designated listening stations at the navigation bridge and windows during normal sail and operational conditions. In addition, the IMO further limits noise to 75 dBA at external areas and rescue stations with recommended limits 5 dBA lower. The vessels used for nearshore work and vessels transiting between construction ports and the Lease Area are expected to comply with these IMO noise standards.

Nearshore, activities associated with installation of the Offshore Export Cable move along the cable laterally. Therefore, no shoreline NSAs will be exposed to significant noise levels for an extended period of time. Due to the relatively short duration, it is not anticipated that construction activities associated with the installation of the Offshore Export Cables will cause any significant impact in the communities along the shoreline. It is also unlikely that helicopter noise will adversely impact onshore receptors as the helicopter flight path is predominantly offshore.

Y.5.2 Operational Acoustic Assessment

The operational components of the Project consist of WTGs, Offshore Substations, Inter-Array and Offshore Export Cables, the Onshore Export Cable, Switching Station, Interconnection Cable, and Onshore Substation, and sound signals (i.e., foghorns). Of these sources, only the Switching Station and Onshore Substation and associated transformers and auxiliary equipment are regulated under applicable noise policy.

Y.5.2.1 WTGs and Offshore Substations

The expected WTG sound level will be below audibility thresholds at all coastal areas. Sound generated by an operating wind turbine is comprised of both aerodynamic and mechanical sound with the dominant sound component from utility scale WTGs being largely aerodynamic. Aerodynamic sound refers to the sound produced from air flow and the interaction with the wind turbine tower structure and moving rotor blades.

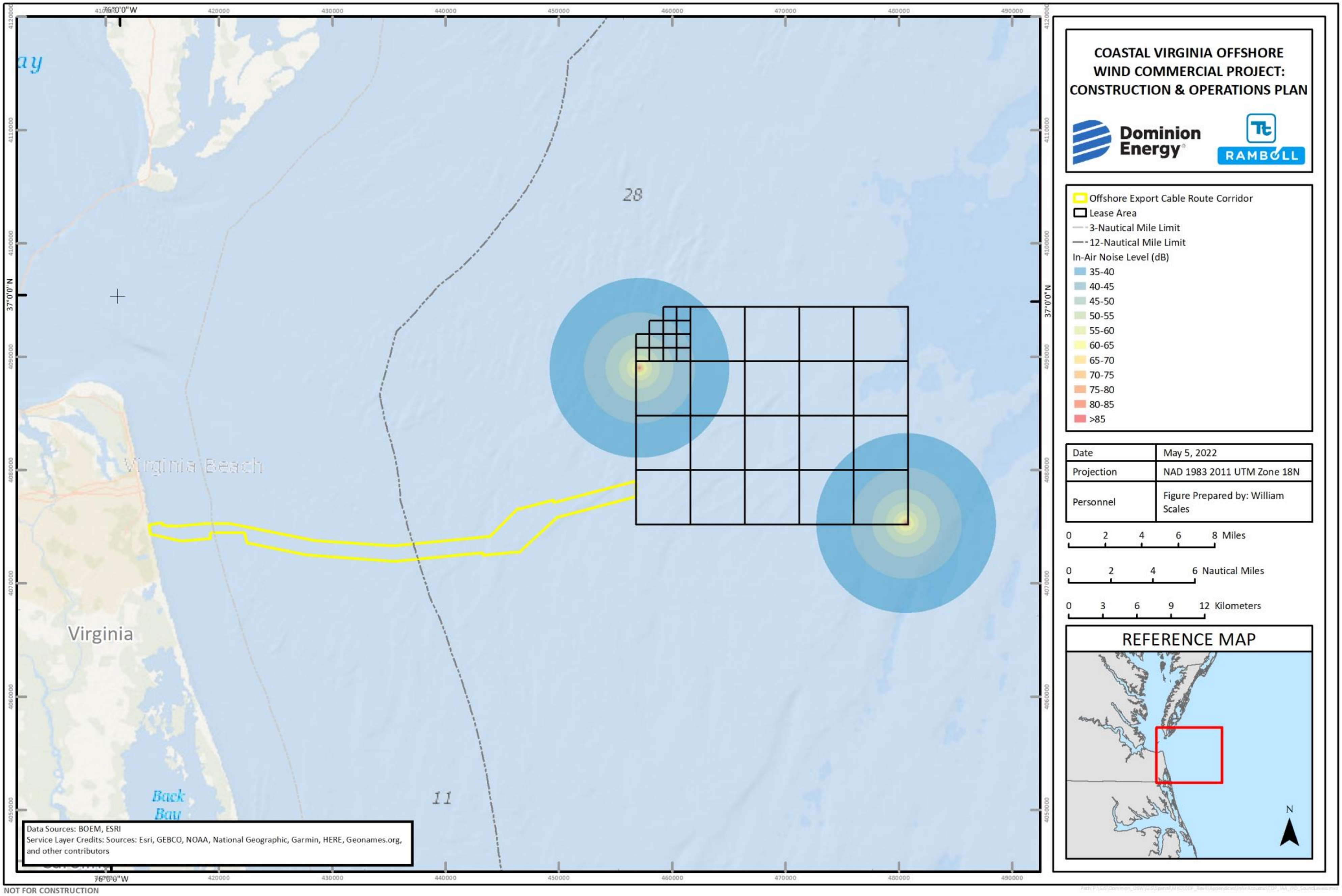

Figure Y-12. Impact Pile Driving Received Sound Levels (In-Air)

Wind facilities, in comparison to conventional energy projects, are somewhat unique in that the sound generated by each individual wind turbine will increase as the wind speed across the site increases. Wind turbine sound is negligible when the rotor is at rest, increases as the rotor tip speed increases, and is generally constant once rated power output and maximum rotational speed are achieved. Under maximum rotational wind speed the assumed maximum sound power level will be reached, generally occurring at approximately 7 to 9 meters per second depending on wind turbine type and according to manufacturer specifications. It is important to recognize, as wind speeds increase, the background ambient sound level will likely increase as well, resulting in acoustic masking effects. The net result is that during periods of elevated wind when higher wind turbine sound emissions occur, the sound produced from a wind turbine operating at maximum rotational speed may well be largely or fully masked by wind generated sounds of foliage or by increased sound related to waves crashing on the shoreline. In practical terms, this means that a nearby receptor may hear these other sound sources (i.e., foliage, ocean waves) rather than the sound of a wind turbine.

Offshore wind facility operations are unique due to reflective nature of sounds surrounded by water and the impact of the shoreline on sound attenuation. As sound waves reach the coastline, a modification of the ground boundary occurs. This sudden change produces a supplementary sound attenuation due to the partial reflection of sound waves. In addition, the wind and temperature gradients are modified as the sea and the land are not always at the same temperature, thus generating friction at the ground surface. These effects result in a variation in the speed and curve of the sound waves. Few studies have been made of the shoreline effect and its effect on acoustical propagation. However, an average attenuation for low frequencies has been documented at 3 dB (Johansson 2003) up to 1,000 m, and then increasing with distance.

In addition, sound propagation from offshore WTGs is different than propagation from land-based WTGs. Sound propagation over water at large distances (generally above 2,000-3,000 m) involves a completely reflective surface and is dependent of the distance between the receiver and the sound source. As this distance increases, the effect of water reflection also increases. The influence of the reflecting water on the received sound level may be just as strong as the direct contribution from the sound source. In addition, downwind refractive effects result in a cylindrical wave spreading to form a reflecting layer in the atmosphere at a specified height. Strong reflection may occur during certain periods of the year with higher gradients in wind speed and direction at relatively low heights. Due to this reflecting layer, the sound from a source may be enclosed and form spherical waves that appear at certain distances as a cylindrical wave. This cylindrical spreading of sound energy due to multiple reflections from the sea surface generates a reduced sound at large distances with a slower rate of reduction than sound propagating over land, similar to the effect created by atmospheric temperature and wind gradients. Therefore, sound propagation over water is variable and dependent on a number of factors including:

- The distance over water from the sound source to the receiver;
- The height of the sound source above the completely reflective water surface;
- The height of the atmospheric inversion layer trapping the sound waves below the height of the source, thus creating the cylindrical wave;
- The atmospheric absorption coefficient due to the shoreline effect; and
- The attenuation due to the ground damping and the damping of sound.

As a result, the transmission loss between the received sound pressure at the receiver point and at the sound source may vary considerably due to these noted factors that are unique to offshore sound sources such as offshore WTGs.

Similarly, sound levels from Offshore Substation operations will be inaudible at all coastal areas. The Offshore Substations will house equipment for high-voltage transmission, including switchgears, transformers, reactors, and control and monitoring equipment. This equipment will not operate at high enough levels to impact any coastal area.

Offshore receptors (boaters) may be subject to higher sound levels resulting from wind turbine operation depending on their distance relative to the WTGs. However, even within the immediate proximity of the WTGs and Offshore Substations, these levels will be well below the relevant Occupational Safety and Health Act health and safety requirements.

Y.5.2.2 Switching Station and Onshore Substation

For the purpose of the environmental assessment presented in this Construction and Operations Plan, there are currently two Switching Station parcel locations and one Onshore Substation parcel under consideration: the proposed Switching Station located either north of Harpers Road or north of Princess Anne Road; and the Onshore Substation at Fentress. Figure Y-13, Figure Y-14, and Figure Y-15 describes the onshore Project features at the Onshore Substation and Switching Station site.

- **Switching Station**: The Switching Station will either be located north of Harpers Road (Harpers Switching Station – Preferred Alternative) or north of Princess Ann Road (Chicory Switching Station) in Virginia Beach, Virginia. Only one switching station will be constructed; the Chicory Switching Station would only be constructed if Interconnection Cable Route Alternative 6 is selected. The Switching Station will transfer the power to the Onshore Substation at the existing Dominion Energy Fentress Substation in Chesapeake, Virginia for delivery into the electric grid.
- **Onshore Substation**: The Onshore Substation, will include an expansion of the existing Fentress Substation, located northwest of the intersection at Centerville Turnpike and Etheridge Manor Boulevard in Chesapeake, Virginia. This Onshore Substation will serve as the final Point of Interconnection for power distribution to the grid.

Electrical onshore substations have switching, protection and control equipment, as well as one or more transformers which can generate sound, generally described as a 'low humming'. There are three main sound sources associated with a transformer: core sound, load sound, and sound generated by the operation of the cooling equipment. The core is the principal sound source, predominately occurring within the intermediate frequency range between 100 Hz and 600 Hz. The relative magnitudes of the sound at these different frequency levels are dependent on the design of the transformer (i.e., core material, core geometry). However, the sound generated is largely independent of the transformer load. The load sound is primarily caused by the load current in the transformer's conducting coils (or windings), and the main frequency of this sound is equal to twice the supply frequency; 100 Hz for 50 Hz transformers and 120 Hz for 60 Hz transformers. The cooling equipment (fans and pumps) typically dominates when operating in secondary cooling modes.

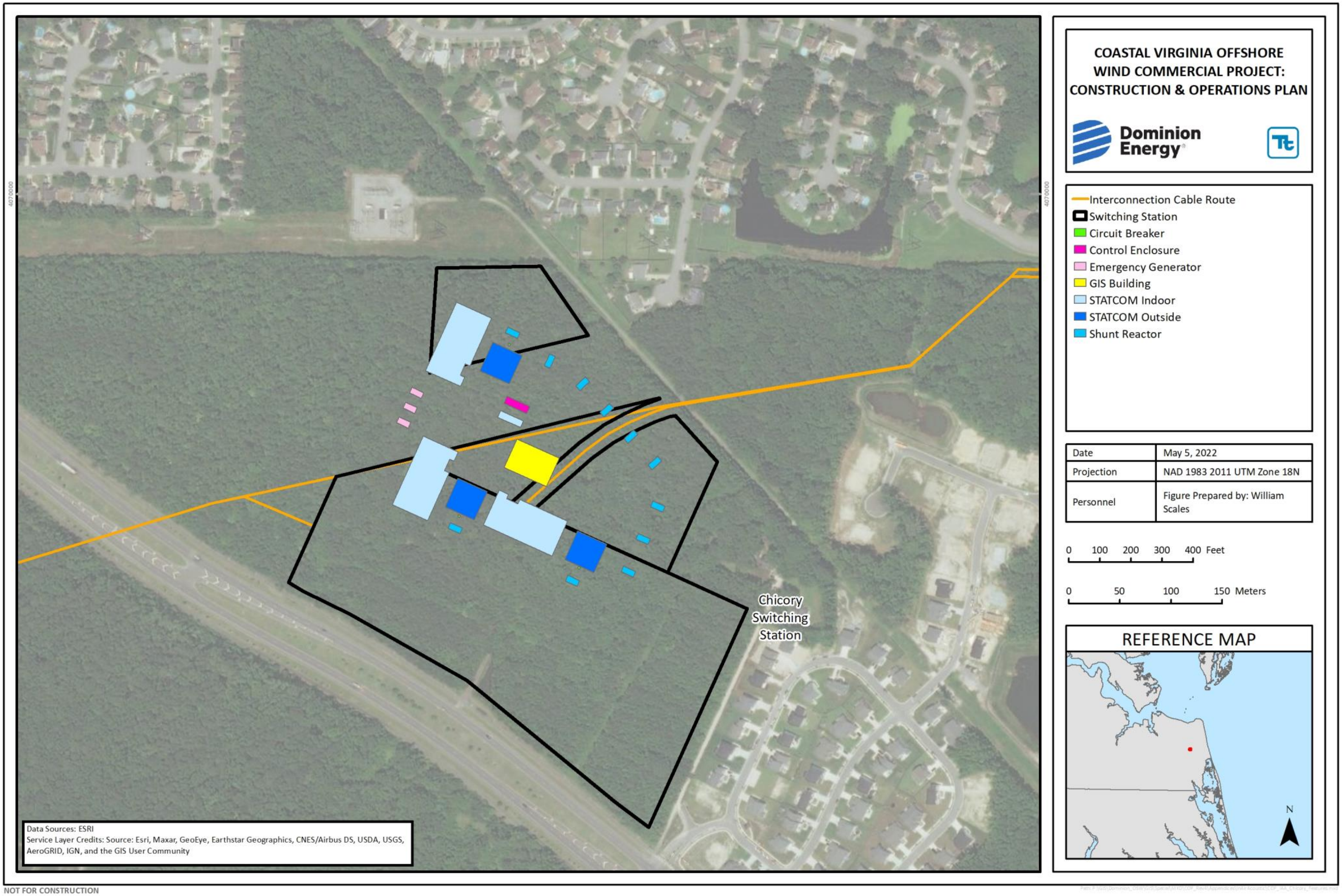

Figure Y-13. Chicory Switching Station Features

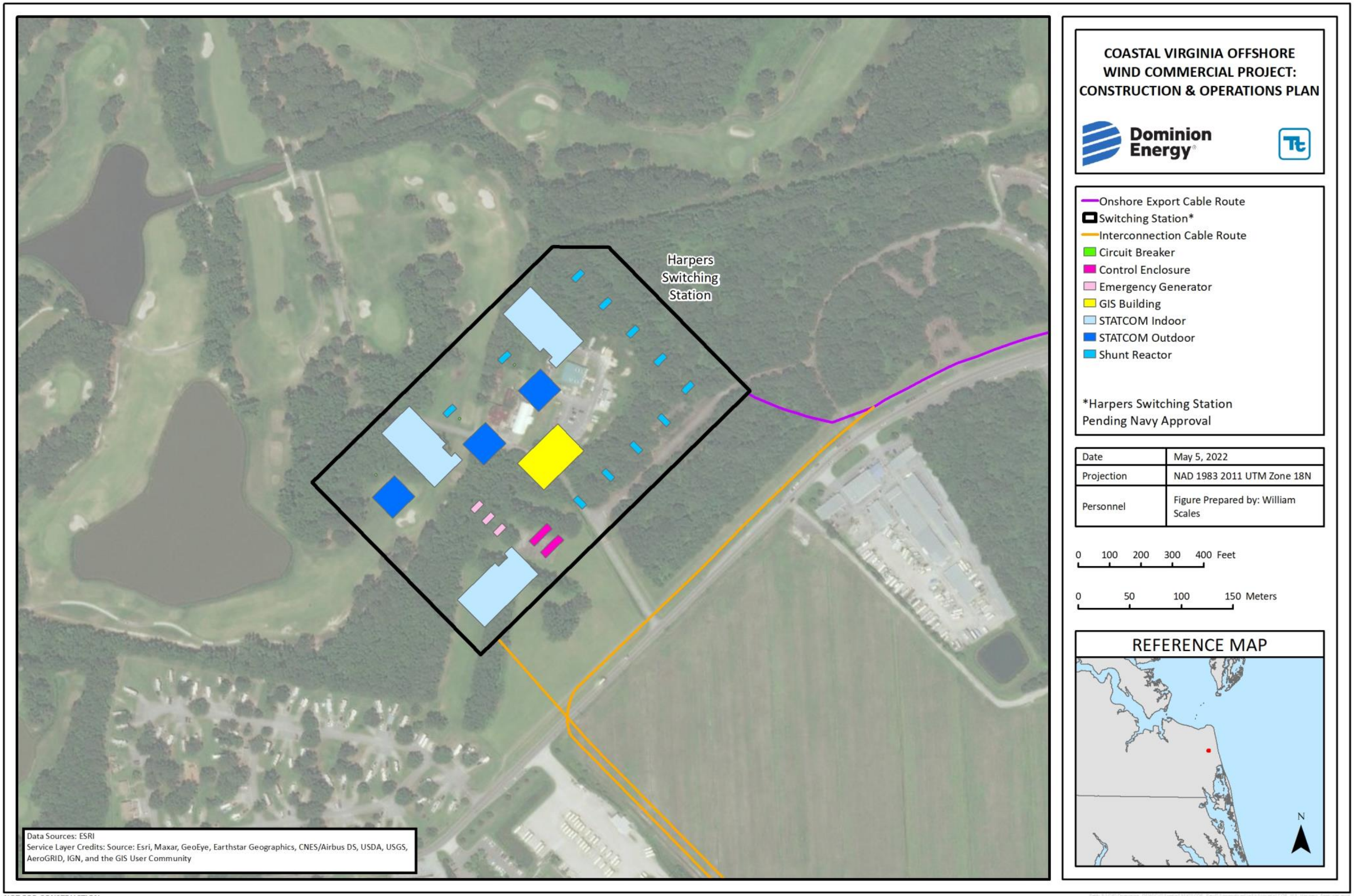

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Figure Y-14. Harpers Switching Station Features

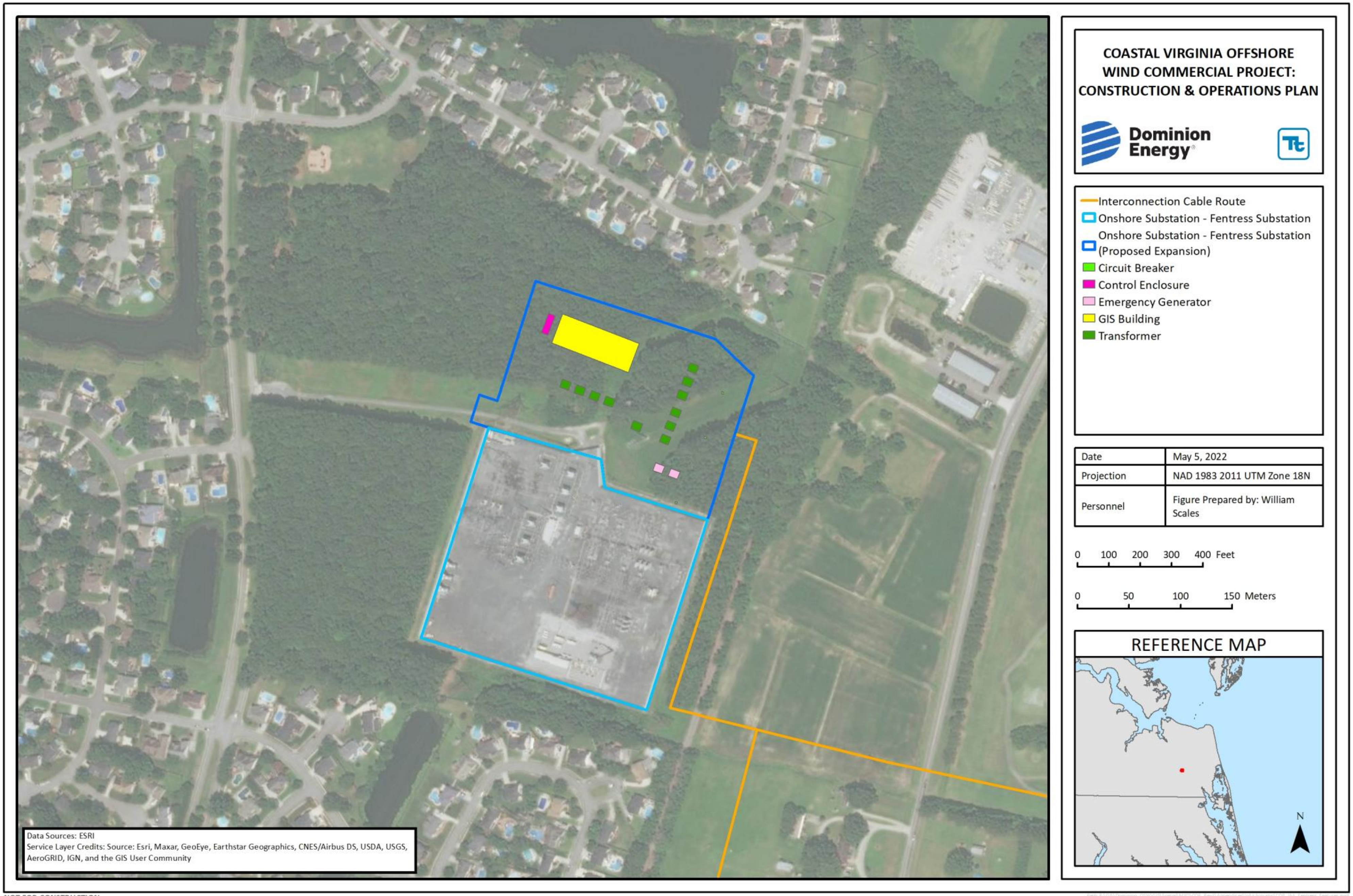

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Figure Y-15. Onshore Substation Features

Transformers are designed and catalogued by either kilovolt ampere or megavolt ampere ratings. Just as horsepower ratings designate the power capacity of an electric motor, a transformer's ampere rating indicates its maximum power output capacity. The transformer industry uses the National Electrical Manufacturers Association (NEMA) published NEMA Standards TR1-1993 (R2000) (NEMA 1993). These standards establish noise ratings to designate the maximum sound emitted from transformers, voltage regulators, and shunt reactors based on the equipment's method of cooling, its dielectric fluid (air-cooled versus oil-cooled) type and its electric power rating. The NEMA methodology for measuring sound involves A-weighted sound measurements using microphones positioned from a tautly drawn string that encircles the device at a height that is one-half the overall height of the device. The equipment sound output is the average of all measurements taken around the perimeter, incorporating contributions from both cooling fans and transformer casing.

Shunt reactors contain components similar to power transformers, but its sound is primarily generated from vibrational forces resulting from magnetic "pull" effects at iron-air interfaces. Also, unlike transformers, the operation of shunt reactors is typically intermittent, occurring only when voltage stabilization is needed during load variation. Both transformers and shunt reactors were included in the acoustic modeling analysis. Circuit-breaker operations may also cause audible sound. Particularly the operation of air-blast breakers, characterized as an impulsive sound event of very short duration. These are expected to occur no more than a few times throughout the year. Because of its short duration and infrequent occurrence, circuit breaker sound was not considered in this sound modeling analysis.

While the Onshore Substation and Switching Station engineering designs are only at a conceptual level, it is reasonable to expect that any transformer installed as part of the Project will conform to all relevant NEMA standards. However, it is possible that the final warranty sound specifications could vary slightly. Representative octave band center frequencies were derived from standardized engineering technical guidelines and based on measurements from similar equipment types.

Dominion Energy has provided the estimated number and sound power levels for the Switching Station equipment, presented below in Table Y-10**,** and Onshore Substation equipment, presented below in Table Y-11. For the Onshore Substation, Dominion Energy will only be installing new equipment in the expansion area, and no new equipment will be installed within the current Onshore Substation footprint.

Table Y-10. Sound Ratings of Switching Station Components

Equipment	Quantity	Sound Power Level (dBA)
Static Synchronous Compensator (STATCOM)/Static Volt-Ampere Reactive Compressor (SVC) Indoor Equipment	3	85
Reactors (and Other Outdoor STATCOM equipment and Coolers)	3	85
Shunt Reactor	11	95
230 kV Circuit Breaker	3	60
180'x120' GIS Building - Climate Controlled	1	N/A
80'x24' Control Enclosure - Climate Controlled	2	N/A
Emergency Generator - 150 kVA	3	84
Exhaust Fans (per Building)	6	65
Air Handling Units (per Building)	6	75

Table Y-11. Sound Ratings of Onshore Substation Components (Expansion Only)

Equipment	Quantity	Sound Power Level (dBA)
230 kV Circuit Breaker	3	60
288/384/480 MVA 230-500 kV Single-Phase Transformer	11	95
260'x90' GIS Building - Climate Controlled	1	N/A
70'x24' Control Enclosure - Climate Controlled	1	N/A
Emergency Generator - 150 kVA	2	84
Exhaust Fans (per Building)	6	65
Air Handling Units (per Building)	6	75

The received sound levels were evaluated at the NSAs located closest to the Switching Station and Onshore Substation parcel. The resultant sound contour plot displays operational sound levels for the Chicory Switching Station in Figure Y-16, for Harpers Switching Station in Figure Y-17, and for the Onshore Substation in Figure Y-18.

As shown in Table Y-12, Table Y-13, and Table Y-14, compliance is demonstrated with the most conservative applicable regulatory limit, which is the Virginia Beach nighttime noise limit of 55 dBA L_{eq} for the Switching Station, and the Chesapeake nighttime noise limit of 55 dBA L_{eq} for the Onshore Substation. The Chesapeake octave-band noise limits are addressed in Table Y-15 for the Onshore Substation. During operations, the Project will be in compliance with relevant City of Virginia Beach and City of Chesapeake noise requirements; however, if the final design engineering requires sound mitigation measures, they will be implemented within the Project footprint, as necessary.

Table Y-12. Chicory Switching Station: Night-time L_{eq} Sound Levels at the Closest NSAs

Location	NSA Type	Distance (meters)	Regulatory Limit (dBA L_{eq})	Modeling Results (dBA L_{eq})
NSA-CH-1	Residential	510	55	35
NSA-CH-2	Residential	100	55	53
NSA-CH-3	Residential	35	55	39
NSA-CH-4	Residential	475	55	36
NSA-CH-5	Residential	560	55	31

Table Y-13. Harper's Switching Station: Night-time L_{eq} Sound Levels at the Closest NSAs

Location	NSA Type	Distance (meters)	Regulatory Limit (dBA L_{eq})	Modeling Results (dBA L_{eq})
NSA-HA-1	Residential	520	55	37
NSA-HA-2	Residential	370	55	40
NSA-HA-3	Residential	440	55	39
NSA-HA-4	Residential	100	55	43
NSA-HA-5	Residential	120	55	41
NSA-HA-6	Residential	220	55	37

Table Y-14. Onshore Substation (Expansion Only): Night-time L_{eq} Sound Levels at the Closest NSAs

Location	NSA Type	Distance (meters)	Regulatory Limit (dBA L_{eq})	Modeling Results (dBA L_{eq})
NSA-FE-1	Residential	110	55	48
NSA-FE-2	Residential	50	55	50
NSA-FE-3	Residential	85	55	48
NSA-FE-4	Residential	70	55	48
NSA-FE-5	Residential	80	55	47
NSA-FE-6	Residential	90	55	46
NSA-FE-7	Residential	90	55	45
NSA-FE-8	Residential	100	55	44
NSA-FE-9	Residential	110	55	42
NSA-FE-10	Residential	130	55	41
NSA-FE-11	Residential	150	55	40
NSA-FE-12	Residential	160	55	40
NSA-FE-13	Residential	185	55	39
NSA-FE-14	Residential	210	55	39
NSA-FE-15	Residential	220	55	38
NSA-FE-16	Residential	255	55	38
NSA-FE-17	Residential	280	55	37
NSA-FE-18	Residential	295	55	37
NSA-FE-19	Residential	320	55	37
NSA-FE-20	Residential	370	55	37
NSA-FE-21	Residential	350	55	37
NSA-FE-22	Residential	375	55	37
NSA-FE-23	Residential	420	55	37
NSA-FE-24	Residential	400	55	37
NSA-FE-25	Residential	390	55	38
NSA-FE-26	Residential	360	55	38
NSA-FE-27	Residential	355	55	39
NSA-FE-28	Residential	355	55	39
NSA-FE-29	Residential	260	55	41
NSA-FE-30	Residential	275	55	40
NSA-FE-31	Residential	310	55	40
NSA-FE-32	Residential	340	55	39
NSA-FE-33	Residential	345	55	39
NSA-FE-34	Residential	355	55	39
NSA-FE-35	Residential	365	55	39
NSA-FE-36	Residential	380	55	39
NSA-FE-37	Residential	395	55	39
NSA-FE-38	Residential	420	55	38

Location	NSA Type	Distance (meters)	Regulatory Limit (dBA L_{eq})	Modeling Results (dBA L_{eq})
NSA-FE-39	Residential	430	55	38
NSA-FE-40	Residential	410	55	39
NSA-FE-41	Residential	390	55	39
NSA-FE-42	Residential	350	55	40
NSA-FE-43	Residential	360	55	40
NSA-FE-44	Residential	315	55	41
NSA-FE-45	Residential	300	55	42
NSA-FE-46	Residential	310	55	42
NSA-FE-47	Residential	340	55	41
NSA-FE-48	Residential	370	55	40
NSA-FE-49	Residential	400	55	40
NSA-FE-50	Residential	360	55	40
NSA-FE-51	Residential	340	55	41
NSA-FE-52	Residential	290	55	42
NSA-FE-53	Residential	260	55	43
NSA-FE-54	Residential	240	55	43
NSA-FE-55	Residential	230	55	43
NSA-FE-56	Residential	250	55	43
NSA-FE-57	Residential	230	55	43
NSA-FE-58	Residential	345	55	40
NSA-FE-59	Residential	490	55	37

Table Y-15. Onshore Substation: Night-time Octave Band L_{eq} Sound Levels at the Closest NSAs

Location	Distance (meters)	Modeling Results (dbA L_{eq}) per Octave Band (Hz)								
		31.5	63	125	250	500	1,000	2,000	4,000	8,000
Noise Limit		**70**	**69**	**64**	**59**	**53**	**47**	**42**	**38**	**35**
NSA-FE-1	110	9	28	38	37	43	42	38	28	3
NSA-FE-2	50	11	30	40	40	46	45	40	32	14
NSA-FE-3	85	10	28	38	38	44	42	38	29	8
NSA-FE-4	70	10	29	38	38	44	43	38	30	10
NSA-FE-5	80	9	28	37	37	43	42	37	28	6
NSA-FE-6	90	8	27	36	36	42	41	36	27	2
NSA-FE-7	90	7	26	35	35	41	40	35	25	0
NSA-FE-8	100	6	25	34	34	40	38	34	23	0
NSA-FE-9	110	5	24	33	32	38	37	32	21	0
NSA-FE-10	130	5	23	32	31	37	36	31	19	0
NSA-FE-11	150	4	22	31	30	36	35	29	17	0
NSA-FE-12	160	3	22	30	30	35	34	28	16	0
NSA-FE-13	185	3	21	30	29	35	33	27	14	0

Location	Distance (meters)	Modeling Results (dbA L_{eq}) per Octave Band (Hz)								
		31.5	63	125	250	500	1,000	2,000	4,000	8,000
Noise Limit		**70**	**69**	**64**	**59**	**53**	**47**	**42**	**38**	**35**
NSA-FE-14	210	2	21	29	29	35	33	27	14	0
NSA-FE-15	220	2	20	28	28	34	32	26	12	0
NSA-FE-16	255	2	20	28	28	33	32	26	12	0
NSA-FE-17	280	1	20	28	27	33	31	25	10	0
NSA-FE-18	295	1	20	28	28	33	32	25	10	0
NSA-FE-19	320	1	20	28	28	33	31	25	9	0
NSA-FE-20	370	1	19	27	27	33	31	24	8	0
NSA-FE-21	350	1	20	28	28	34	32	25	9	0
NSA-FE-22	375	1	20	28	28	33	32	25	8	0
NSA-FE-23	420	1	19	27	27	33	31	24	7	0
NSA-FE-24	400	1	19	27	27	33	31	24	7	0
NSA-FE-25	390	1	20	28	28	34	32	25	9	0
NSA-FE-26	360	1	20	28	28	34	32	26	9	0
NSA-FE-27	355	2	21	29	29	35	33	27	10	0
NSA-FE-28	355	2	21	29	29	35	33	27	10	0
NSA-FE-29	260	3	22	31	31	37	35	29	15	0
NSA-FE-30	275	3	22	31	31	36	35	29	14	0
NSA-FE-31	310	2	21	30	30	36	34	28	12	0
NSA-FE-32	340	2	21	29	29	35	33	27	11	0
NSA-FE-33	345	2	21	29	29	35	33	27	11	0
NSA-FE-34	355	2	21	29	29	35	33	27	10	0
NSA-FE-35	365	2	21	29	29	35	33	27	10	0
NSA-FE-36	380	1	20	29	29	35	33	26	9	0
NSA-FE-37	395	1	20	29	29	35	33	26	9	0
NSA-FE-38	420	1	20	29	29	35	33	26	8	0
NSA-FE-39	430	1	20	28	29	34	33	26	8	0
NSA-FE-40	410	1	20	29	29	35	33	26	9	0
NSA-FE-41	390	2	21	29	29	35	34	27	10	0
NSA-FE-42	350	2	21	30	30	36	34	28	12	0
NSA-FE-43	360	2	21	30	30	36	35	28	12	0
NSA-FE-44	315	3	22	31	31	37	36	29	15	0
NSA-FE-45	300	4	22	32	32	38	36	30	16	0
NSA-FE-46	310	4	22	32	32	38	36	30	16	0
NSA-FE-47	340	3	22	31	31	37	35	29	14	0
NSA-FE-48	370	3	21	31	31	36	35	28	13	0
NSA-FE-49	400	2	21	30	30	36	34	28	11	0
NSA-FE-50	360	3	22	31	31	37	35	29	13	0
NSA-FE-51	340	3	22	31	31	37	35	29	15	0

Location	Distance (meters)	Modeling Results (dbA L_{eq}) per Octave Band (Hz)								
		31.5	63	125	250	500	1,000	2,000	4,000	8,000
Noise Limit		**70**	**69**	**64**	**59**	**53**	**47**	**42**	**38**	**35**
NSA-FE-52	290	4	22	32	32	38	36	30	16	0
NSA-FE-53	260	5	23	33	33	39	38	32	19	0
NSA-FE-54	240	5	24	34	33	39	38	32	20	0
NSA-FE-55	230	5	24	34	34	39	38	32	19	0
NSA-FE-56	250	5	23	34	34	39	38	32	19	0
NSA-FE-57	230	5	23	33	33	39	37	32	19	0
NSA-FE-58	345	2	21	30	30	36	34	28	12	0
NSA-FE-59	490	0	19	27	28	33	31	24	5	0

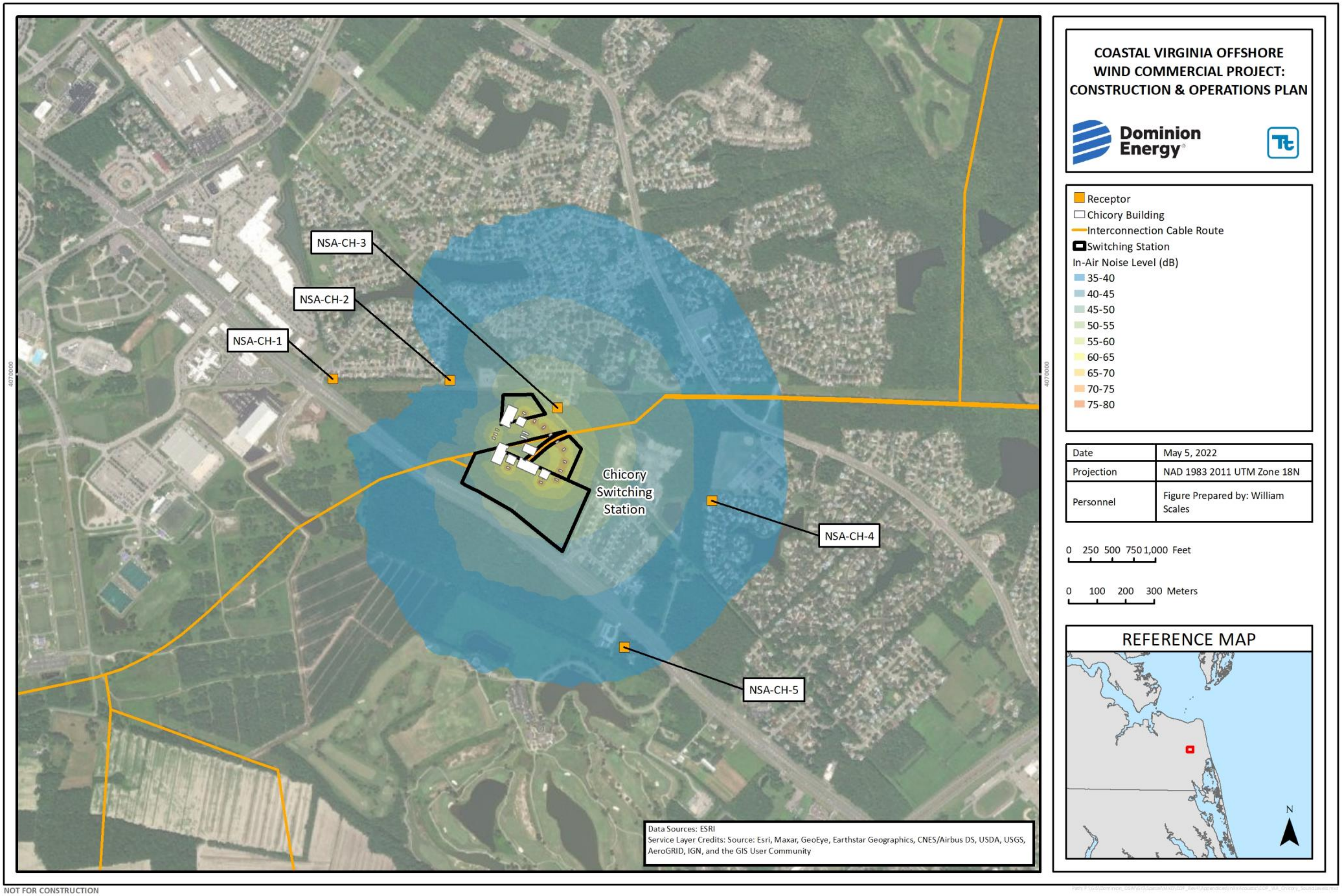

Figure Y-16. Chicory Switching Station Operational Sound Levels

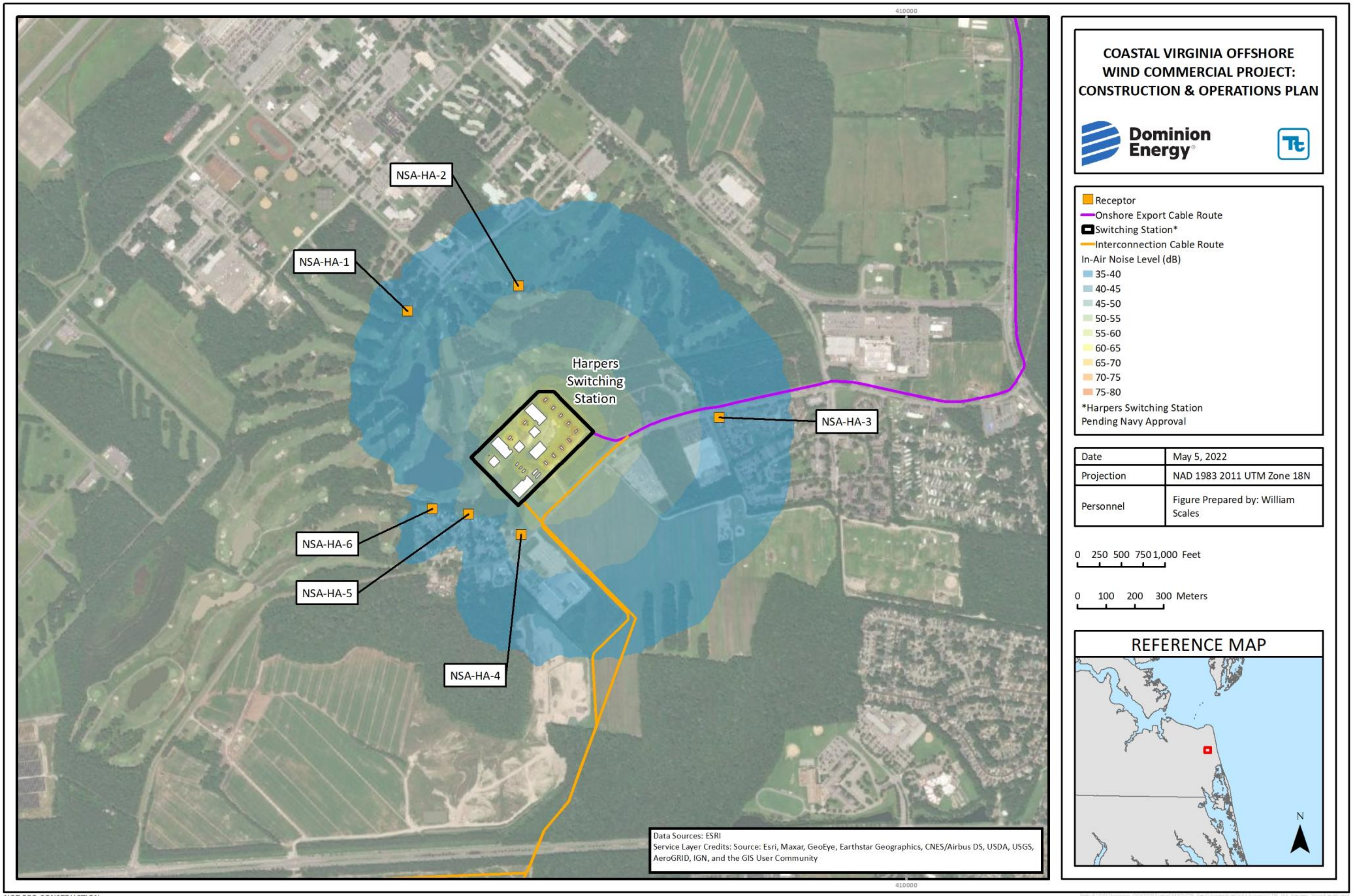

Figure Y-17. Harpers Switching Station Operational Sound Levels

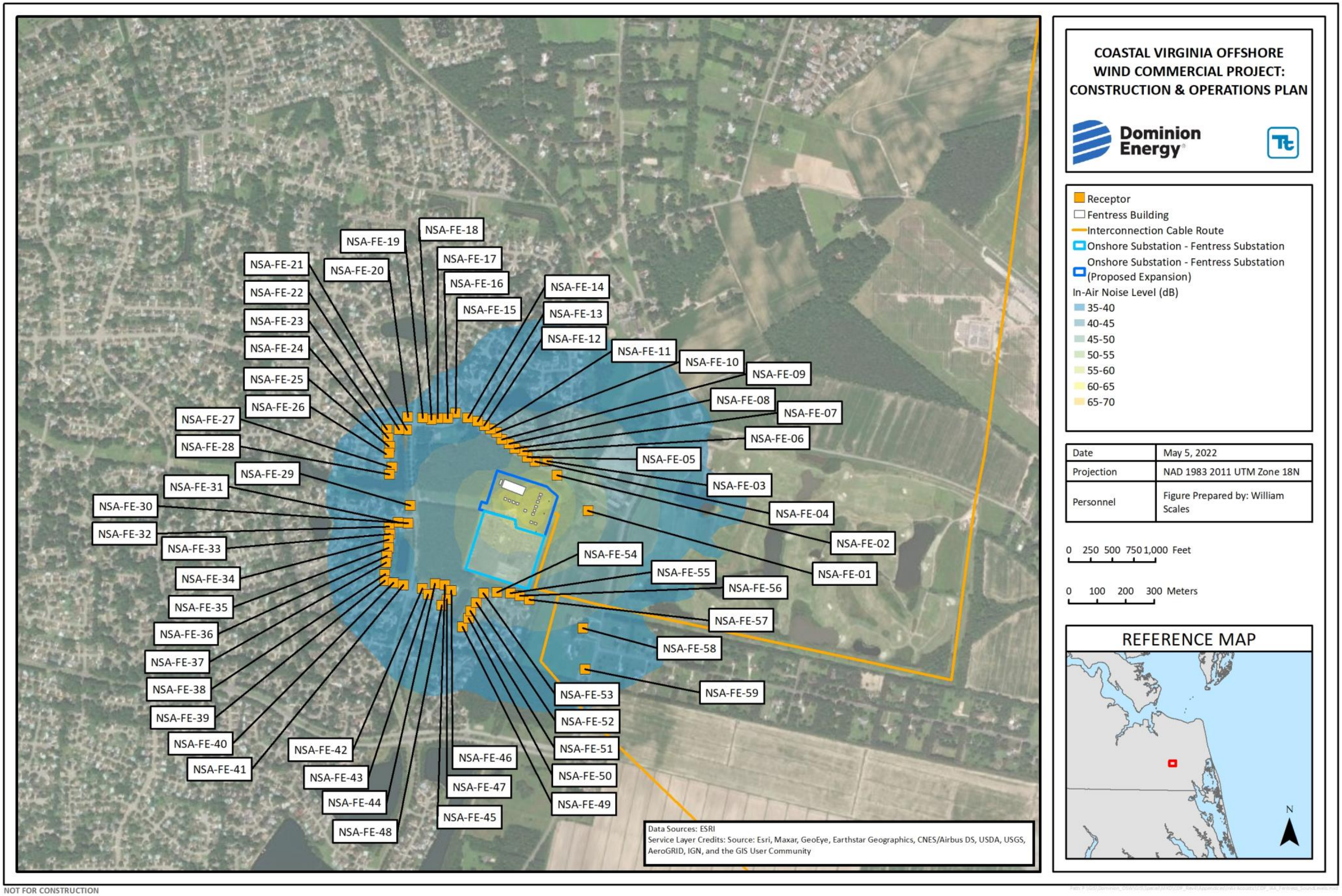

Figure Y-18. Onshore Substation Operational Sound Levels

Y.5.2.3 Sound Signals

Sound signals (i.e., foghorns) may be installed on select WTGs along the outer perimeter of the Lease Area. Due to the large amount of distance between the origin of the sound signals to the nearshore environment, the sound level there will be below the threshold of human perception.

Requirements detailed in 33 Code of Federal Regulations Part 67 call for a foghorn to be installed at least 10 ft (3 m) but not more than 150 ft (46 m) above mean high water and have a sound signal audible to 0.5 nm (0.9 km). 33 Code of Federal Regulations Part 67 also requires the foghorn to emit a tone of 119.8 dB at a frequency of 822 Hz occurring for a period of 2 seconds during a 20 second cycle (18 seconds silence). Sound levels were evaluated assuming installation of foghorns on the WTGs closest to the shoreline. Results show that under standard downwind propagation conditions, the received sound levels generated by the foghorn are expected to attenuate to a less than perceivable level onshore.

Y.6 CONCLUSIONS

In-air acoustic modeling was conducted for the Project in order to assess the potential noise impacts associated with construction and operation activities. The modeling analysis was conducted using the parameters and methodology described in Sections Y.4 and Y.5 of this report. Results are displayed in the form of sound contour plots, with Project-generated sound levels shown as color-coded isopleths in 5 dBA increments. The resultant sound contour plots are independent of the existing acoustic environment (i.e., the plots and tabulated results represent Project-generated sound levels only).

Project construction noise was analyzed at varying distances from typical sources associated with site clearing, site grading and compaction, trenching and foundations, equipment pads, and equipment installation stages for Onshore Export Cable, Switching Station, Interconnection Cable, and Onshore Substation construction. Construction levels will primarily be limited to daytime hours. If required, noise mitigation strategies will be used to minimize offsite noise impacts to the extent practicable pending engagement with regulatory agencies and other stakeholders, as applicable.

Vibratory pile driving will be needed to construct nearshore cofferdams at the associated Offshore Trenchless Installation Punch-Out Location. Noise levels from the vibratory pile driving will reach 66 dBA at the nearest onshore receptor. These levels are deemed to be not significant due to it being a daytime-only event and the short-lasting duration of the activity.

In association with the vibratory pile driving, the Offshore Export Cables will require trenchless installation operations at the associated Cable Landing Location. The trenchless installation sound levels could reach 58 dBA during trenchless installation construction at the Cable Landing Location. In addition to the trenchless installation construction at the Cable Landing Location, there will be five sections along the Onshore Export Cable Route and Interconnection Cable Route that will require trenchless installation for crossings. Trenchless installation construction is expected to occur over a period of 18 to 24 months. The trenchless installation sound levels could reach 65 dBA at the nearest NSA. If any noise issues are identified, Dominion Energy will work with local authorities to mitigate as necessary.

Impact pile driving and vibratory pile driving will occur offshore during the construction stage to install the WTG and Offshore Substation Foundations; however, for the purposes of the Project in-air acoustic assessment, worst case noise impacts associated with impact pile driving were evaluated. The highest predicted received sound level at any onshore location during pile driving is less than 30 dBA, which is well below all applicable noise regulations. Given the extended distances between the coastal shoreline (approximately 24 nm [44 km]) no onshore impacts are expected.

Operational impacts for the Switching Station and Onshore Substation were evaluated based on equipment and associated sound power levels provided by Dominion Energy. Sound levels associated with the Chicory Switching Station and Harpers Switching Station will be in compliance with applicable noise regulations, with a maximum impact of 53 dBA and 43 dBA, respectively, at the nearest NSAs for each location. The Onshore Substation will be in compliance with applicable noise regulations, with a maximum impact of 50 dBA at the nearest NSAs to the Onshore Substation.

Operations associated with WTGs, Offshore Substations, and sound signals will not have an impact to the nearshore environment due to the large distance between the source of these sounds and the shoreline.

Y.7 REFERENCES

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