The latest revision date of Appendix L to the Empire Offshore Wind COP is July 2023. This appendix was not revised as part of the November 2023 submittal; therefore, the date on the Appendix L cover sheet remains as July 2023.

Empire Offshore Wind: Empire Wind Project (EW 1 and EW 2)
Construction and Operations Plan

APPENDIX L

In-Air Acoustic Assessment

Prepared for
equinor

TETRA TECH

JULY 2023

TABLE OF CONTENTS

L.1 Introduction ... L-1
L.1.1 Acoustic Concepts and Terminology ... L-3
L.2 Regulatory Criteria ... L-5
L.2.1 Federal Noise Requirements ... L-5
L.2.2 New York State Noise Requirements ... L-5
L.2.3 Local Noise Requirements ... L-6
L.3 Existing Ambient Conditions ... L-10
L.4 Acoustic Modeling Methodology ... L-15
L.5 Acoustic Modeling Scenarios ... L-15
L.5.1 Construction Acoustic Assessment ... L-16
L.5.2 Operational Acoustic Assessment ... L-44
L.6 Conclusions ... L-61
L.7 References ... L-62

TABLES

Table L-1 Sound Pressure Levels of Typical In-Air Noise Sources and Acoustic Environments......... L-4
Table L-2 New York City Noise Code Section 24-232 Octave Band Limits (dB) L-6
Table L-3 New York City Zoning Resolution Sections 42-213 & 214 Octave Band Limits (dB) L-7
Table L-4 Town of Hempstead Transient Noise Limits (dB)... L-7
Table L-5 Town of Hempstead Steady Noise Limits (dB) L-8
Table L-6 Permissible Continuous Sound Levels by Receiving Property Category, in dBA L-9
Table L-7 Baseline Noise Measurement Results L-13
Table L-8 Acoustic Model Setup Parameters L-15
Table L-9 General Construction Noise Levels (dBA) L-17
Table L-10 EW 1 Pile Driving Noise Levels (dBA) L-18
Table L-11 EW 2 Pile Driving Noise Levels (dBA) L-19
Table L-12 Sound Levels (dBA) during Vibratory Pile Driving at Nearshore Cofferdam..................... L-21
Table L-13 HDD and Direct Pipe Equipment Sound Pressure Source Levels, dBA at 3 ft L-27
Table L-14 HDD/Direct Pipe Candidate Noise Control Strategies.. L-28
Table L-15 Sound Levels (dBA) during HDD and Direct Pipe Construction... L-29
Table L-16 Sound Ratings of Substation Components.. L-50
Table L-17 All Onshore Substations: Predicted Nighttime L_{90} Sound Levels (dBA) at the Closest Noise Sensitive Areas L-55
Table L-18 EW 1 Onshore Substation: Tonal L_{90} Sound Levels (dB) at the Closest Noise Sensitive Areas.. L-57
Table L-19 EW 2 Onshore Substation A + Hampton Road Substation: Tonal L_{90} Sound Levels (dB) at the Closest Noise Sensitive Areas L-59
Table L-20 EW 2 Onshore Substation C: Tonal L_{90} Sound Levels (dB) at the Closest Noise Sensitive Areas.. L-60

FIGURES

Figure L-1 Lease Area and Submarine Export Cable Routes.. L-2
Figure L-2 EW 1 Ambient Sound Measurement Locations L-11
Figure L-3 EW 2 Ambient Sound Measurement Locations L-12
Figure L-4 EW 1 Vibratory Pile Driving Sound Contour Isopleth L-22
Figure L-5 EW 2 Landfall A and EW 2 Landfall B Vibratory Pile Driving Sound Contour Isopleth... L-23
Figure L-6 EW 2 Landfall C Vibratory Pile Driving Sound Contour Isopleth L-24
Figure L-7 EW 2 Landfall C (Approach C3) Vibratory Pile Driving Sound Contour Isopleth L-25
Figure L-8 EW 2 Landfall E Vibratory Pile Driving Sound Contour Isopleth L-26
Figure L-9 EW 1 HDD Contour Isopleth.. L-32
Figure L-10 EW 2 Landfall A HDD Contour Isopleth... L-33
Figure L-11 EW 2 Landfall B HDD Contour Isopleth... L-34
Figure L-12 EW 2 Landfall C HDD Contour Isopleth... L-35

Figure L-13 EW 2 Reynolds Channel Crossing – Location 1 HDD Contour Isopleth L-36
Figure L-14 EW 2 Reynolds Channel Crossing - Location 2 HDD Contour Isopleth L-37
Figure L-15 EW 2 Reynolds Channel Crossing - Location 3 HDD Contour Isopleth L-38
Figure L-16 EW 2 Reynolds Channel Crossing - Location 4 HDD Contour Isopleth L-39
Figure L-17 EW 2 Barnums Channel - HDD Contour Isopleth L-40
Figure L-18 EW 2 Onshore Substation A + Hampton Road Substation - HDD Contour Isopleth L-41
Figure L-19 Impact Pile Driving Received Sound Levels (In-Air) L-43
Figure L-20 EW 1 Onshore Substation – Conceptual Layout L-46
Figure L-21 EW 2 Onshore Substation A + Hampton Road Substation – Conceptual Layout L-47
Figure L-22 EW 2 Onshore Substation C – Conceptual Layout L-48
Figure L-23 EW 1 Onshore Substation Operational Sound Levels L-52
Figure L-24 EW 2 Onshore Substation A + Hampton Road Substation Operational Sound Levels (dBA) L-53
Figure L-25 EW 2 Onshore Substation C Operational Sound Levels (dBA) L-54

ACRONYMS AND ABBREVIATIONS

ANSI	American National Standards Institute
dB	decibel
dBA	A-weighted decibel
dBL	linear decibel
COP	Construction and Operations Plan
EPA	U.S. Environmental Protection Agency
Empire	Empire Offshore Wind LLC
EW	Empire Wind
ft	foot
HDD	horizontal directional drilling
Hz	Hertz
IMO	International Maritime Organization
ISO	International Organza ton for Standardization
km	kilometer
L_{10}	noise level exceeded 90 percent of the time (quietest 10 percent of any time period)
L_{50}	noise level exceeded 50 percent of the time
L_{90}	noise level exceeded 10 percent of the time (a measurement of intrusive noises)
L_{dn}	day-night sound level
Lease Area	designated Renewable Energy Lease Area OCS-A 0512
L_{eq}	equivalent sound level
L_P	sound pressure level
L_W	sound power level
m	meter
mi	mile
NEMA	National Electrical Manufacturers Association
nm	nautical mile
NSA	noise sensitive area
NYC	New York City
NYSDEC	New York State Department of Environmental Conservation
O&M	Operations and Maintenance
OSHA	Occupational Health and Safety Act
Ord. No.	ordinance number
PDE	Project Design Envelope
POI	Point of Interconnection
Project	The offshore wind project for OCS A-0512 proposed by Empire Offshore Wind LLC consisting of Empire Wind 1 (EW 1) and Empire Wind 2 (EW 2)
Project Area	The area associated with the build out of the Lease Area, submarine export cable routes, and onshore Project facility locations, including the onshore export and interconnection cables, the onshore substations, and the O&M Base

W	watt
USDOT	U.S. Department of Transportation

L.1 INTRODUCTION

Empire Offshore Wind LLC (Empire) proposes to construct and operate an offshore wind facility located in the designated Renewable Energy Lease Area OCS-A 0512 (Lease Area). The Lease Area covers approximately 79,350 acres (32,112 hectares) and is located approximately 14 statute miles (mi) (12 nautical miles [nm], 22 kilometers [km]) south of Long Island, New York and 19.5 mi (16.9 nm, 31.4 km) east of Long Branch, New Jersey (**Figure L-1**).

Empire proposes to develop the Lease Area in two wind farms, known as Empire Wind 1 (EW 1) and Empire Wind 2 (EW 2) (collectively referred to hereafter as the Project). Both EW 1 and EW 2 are covered in this Construction and Operations Plan (COP). EW 1 and EW 2 will be electrically isolated and independent from each other. Each wind farm will connect via offshore substations to separate Points of Interconnection (POIs) at onshore locations by way of export cable routes and onshore substations. In this respect, the Project includes two onshore locations in New York where the renewable electricity generated will be transmitted to the electric grid.

The offshore infrastructure will consist of wind turbines, foundations, offshore substations, interarray and submarine export cables, and scour protection. Onshore infrastructure will be constructed at the export cable landfall locations. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Empire expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Empire will comply with in using the facilities.

This In-Air Acoustic Assessment has been completed to present 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 M**) has been prepared to address the sound impacts associated with the Lease Area's 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. If needed, practical measures were proposed to minimize adverse effects associated with construction and operation of the Project. Mitigation measures are presented to show the feasibility of the Project to meet the specific noise requirements. Final design may incorporate different mitigation measures in order to achieve the same objective as demonstrated in this analysis.

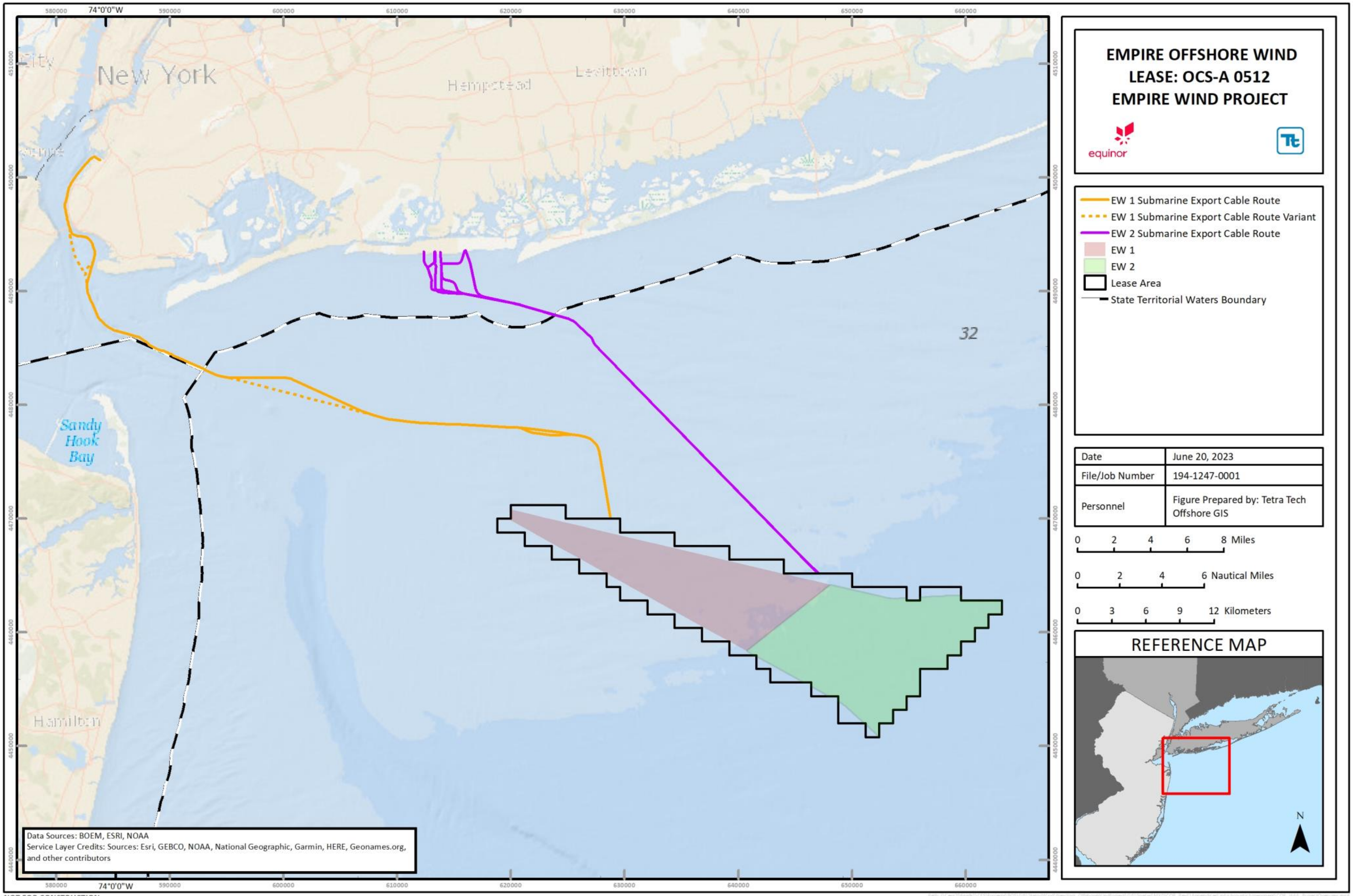

Figure L-1 Lease Area and Submarine Export Cable Routes

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

- Construction of the Operations and Maintenance (O&M) Base[1];
- Construction and operations of the onshore substations;
- Specialized construction activities including:
  - Horizontal directional drilling (HDD) and/or Direct Pipe installation associated with installation of the onshore export and interconnection cables;
  - Vibratory pile driving of bulkhead/relieving platform and cofferdams;
  - Impact pile driving of "goal posts" at EW 2 landfall HDD exit points; and
  - Impact pile driving of wind turbine, offshore substation, cable bridge, and onshore substation foundations;
- Vessel activity, including installation of the submarine export cables in the nearshore environment and O&M vessels;
- Use of helicopters to transport crew and equipment;
- Construction and operation of up to 147 wind turbines, 2 offshore substations, and the associated interarray 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 will be completed, as needed, once the final Project components are selected.

L.1.1 Acoustic Concepts and Terminology

This section outlines some of the relevant concepts in acoustics 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. By definition, sound power is the rate at which acoustical energy is radiated outward and is expressed in units of watts (W). Sound energy propagates through a medium where it is sensed and then interpreted by a receiver. A sound pressure level (L_P) 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

[1] While the O&M Base will serve both EW 1 and EW 2, the base will be located at South Brooklyn Marine Terminal, (SBMT) adjacent to the EW 1 onshore substation, and will therefore be included within the EW 1 Onshore Study Area for the purposes of this analysis.

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 (American National Standards Institute [ANSI] S1.42-2001, 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 (dBL) 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 L-1**.

Table L-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 (50 feet [ft]; 15.2 meters [m])	140	Threshold of pain
50-horsepower siren (100 ft; 30.5 m)	130	
Loud rock concert near stage Jet takeoff (200 ft; 61 m)	120	Uncomfortably loud
Float plane takeoff (100 ft; 30.5 m)	110	
Jet takeoff (2,000 ft; 609.6 m)	100	Very loud
Heavy truck or motorcycle (25 ft; 7.6 m)	90	
Garbage disposal Food blender (2 ft; 0.6 m) Pneumatic drill (50 ft; 15.2 m)	80	Loud
Vacuum cleaner (10 ft; 3 m)	70	Moderate
Passenger car at 65 mi per hour (25 ft; 7.6 m)	65	
Large store air-conditioning unit (20 ft; 6.1 m)	60	
Light auto traffic (100 ft; 30.5 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 (15 ft; 4.6 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: United State Environmental Protection Agency (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. Conversely, the L_{10} 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.

L.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.

L.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 the Occupational Health and Safety Act of 1970 (OSHA). 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 OSHA approved hearing protection devices and to 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.

L.2.2 New York State Noise Requirements

The New York State Department of Environmental Conservation (NYSDEC) guidelines are defined in the publication "Assessing and Mitigating Noise Impacts" (2001). This document states that L_P increases from 0 to 3 dBA should have no appreciable effect on receivers; increases of 3 to 6 dBA may have the potential for adverse impact only in cases where the most sensitive of receptors are present; and increases of more than 6 dBA may require a closer analysis of impact potential depending on existing sound levels and character of surrounding land use. The NYSDEC guidance states that the 6 dBA increase is to be used as a general guideline. Although not explicitly stated in the policy, the 6 dBA increase has been applied to the minimum measured L_{eq} or alternatively the time averaged L_{90} sound level for the licensing of other projects in New York State. There are other guidelines that should also be considered. For example, in settings with low ambient sound levels, NYSDEC guidance has deemed an absolute limit of 40 dBA as adequately protective.

The NYSDEC policy further states that the United States Environmental Protection Agency (EPA) "Protective Noise Levels" guidance found that an annual day-night sound level (L_{dn}) of 55 dBA was sufficient to protect the public health and welfare, and in most cases, did not create an annoyance. A 55 dBA L_{dn} would be equivalent to a daytime sound level of 55 dBA L_{eq}, and a nighttime sound level of 45 dBA L_{eq}, or a continuous level of approximately 49 dBA L_{eq}. In terms of absolute threshold values, the introduction of any new sound source should not raise ambient levels above 65 dBA L_{eq} in non-industrial settings to protect against speech disturbance or above approximately 79 dBA L_{eq} for industrial environments for associated noise-related health and safety reasons. In most cases, NYSDEC recommends that projects exceeding either of these threshold levels or resulting in an increase of 10 dBA consider avoidance and mitigation measures.

L.2.3 Local Noise Requirements

The EW 1 onshore substation, O&M Base, and export cable landfall will be located in the borough of Brooklyn in New York City, Kings County, New York. The EW 2 onshore substation and export cable landfall are located in Nassau County, New York, within the City of Long Beach and/or the Town of Hempstead, including the incorporated Village of Island Park, unincorporated Oceanside, and unincorporated Lido Beach. There are local noise requirements for all proposed onshore substation locations and those requirements are described further in subsequent discussion. These restrictions will be followed unless work outside of these timeframes is authorized by the appropriate regulatory authority.

L.2.3.1 New York City

Title 24, Chapter 2 of the New York City Administrative Code regulates sound by the existing land use of receiving property, not its zoning designation. There are two separate regulations that apply to the Project operation: (1) absolute octave band limits at residential and commercial property, and (2) incremental limits for all off-site locations. These provisions do not apply to construction noise; however, construction is limited to Monday through Friday from 7:00 am to 6:00 pm, unless otherwise authorized. A noise mitigation plan must be completed for any construction activity before construction begins. Work may take place after hours and on weekends only with express authorization from the Departments of Buildings and Transportation. A noise mitigation plan must be in place before any authorization is granted.

The octave band limits in Administrative Code Section 24-232 are summarized in **Table L-2** and apply to residential/commercial property as measured inside a room with the windows open. The octave band limits are prescribed in linear or unweighted decibels. They are equivalent to broadband limits of 45 dBA for residential use and 49 dBA for commercial use.

Table L-2 New York City Noise Code Section 24-232 Octave Band Limits (dB)

Octave Band (Hz)	Limits for Residential Property Receiver	Limits for Commercial Property Receiver
31.5	70	74
63	61	64
125	53	56
250	46	50
500	40	45
1k	36	41
2k	34	39
4k	33	38
8k	32	37

The incremental limits in Administrative Code Section 24-218 prohibit an increase in the “ambient sound level” of 7 dBA or more during the nighttime hours of 10:00 p.m. to 7:00 a.m. at any receiving property. Ambient sound is defined in Section 24-203 of Administrative Code as the total sound level “at a location that exists” excluding “extraneous sounds”, which are defined as “intense, intermittent” sounds. Although the Noise Code assigns no sound metric to the term “ambient sound,” the standard convention in acoustical assessment is to represent this condition as the average (L_{eq}) sound level.

In addition to the City of New York Noise Code Regulations, the City also has a zoning regulation, established by the New York City Department of City Planning. Sections 42-213 and 214 of the City's Zoning Resolution set regulatory limits on octave band sound levels from operation of a facility "at any point on or beyond any lot line." The decibel limits for whole octave bands from 31 Hz to 16,000 Hz differ depending on manufacturing districts. The manufacturing district relevant to the project will be M3-1, as shown in **Table L-3**, given in linear or unweighted decibels.

Table L-3 New York City Zoning Resolution Sections 42-213 & 214 Octave Band Limits (dB)

Octave Band (Hz)	Limits for M3-1 District
31.5	80
63	80
125	75
250	70
500	64
1k	58
2k	53
4k	49
8k	46

L.2.3.2 Town of Hempstead

The EW 2 Onshore Substation A site, associated onshore HDDs, the cable bridge crossing Barnums Channel, landfall of three potential export cables at up to two locations to be installed by trenchless installation methods, and portions of the onshore export and interconnection cable routes, are all located in the Town of Hempstead, in unincorporated hamlets of Oceanside and Lido Beach, within Nassau County, New York. EW 2 Onshore Substation C, portions of the onshore export and interconnection cable routes, and the north side of the Reynolds Channel crossing are located in the Town of Hempstead, in the incorporated Village of Island Park (Section L.2.3.4). Portions of the onshore export and interconnection cable routes are also located in unincorporated Barnum Island, which is also in the Town of Hempstead.

The Town of Hempstead regulates sound through its ordinance (Chapter 144, Ord. No. 25 amended in its entirety 11-1-1983 by L.L. No. 99-1983, effective 11-7-1983). Generally, construction is limited to the hours of 7:00 am to 6:00 pm on weekdays.

The Town prescribes limits by octave band frequency for transient (**Table L-4**) and steady-state sound sources (**Table L-5**) given in linear or unweighted decibels. During daytime hours (7:00 am to 7:00 pm) the limits in **Table L-4** would apply to a transient noise having a duration of more than 12 seconds. During nighttime hours, the limits in **Table L-4** would apply to a transient noise having a duration of more than six seconds.

Table L-4 Town of Hempstead Transient Noise Limits (dB)

Octave Band Center Frequency (Hz)	Octave Band Sound Pressure Level (dB)
63	92
125	87
250	79
500	72
1,000	66

Octave Band Center Frequency (Hz)	Octave Band Sound Pressure Level (dB)
2,000	60
4,000	54
8,000	52

Table L-5 Town of Hempstead Steady Noise Limits (dB)

Octave Band Center Frequency (Hz)	Octave Band Sound Pressure Level (dB)
63	72
125	67
250	59
500	52
1,000	46
2,000	40
4,000	34
8,000	32

L.2.3.3 City of Long Beach

Three potential export cable landfalls, to be installed by trenchless installation methods, portions of the onshore export cable route, as well as the south side of the Reynold Channel HDDs, are located in the City of Long Beach in Nassau County, New York. The City of Long Beach regulates sound through the City of Long Beach Noise Control Ordinance. Chapter 16, Section 16-6 lists the following as a violation of the Ordinance and are applicable to the Project:

- No person shall operate or permit to be operated any tools or equipment used in construction, drilling, excavations or demolition work, between the hours of 8:00 p.m. and 8:00 a.m. the following day or any time on Sunday or legal holidays prior to noon, except the provisions of this section shall not apply to emergency work.

- No person shall cause or permit the operation of any device, vehicle, construction equipment or lawn maintenance equipment, including but not limited to any diesel engine, internal combustion engine or turbine engine, without a properly functioning muffler, in good working order and in constant operation regardless of sound level produced.

- Any excessive or unusually loud sound which either annoys, disturbs, injures or endangers the comfort, repose, health, peace or safety of a reasonable person of normal sensibilities.

In addition to those specific prohibitions set forth in Ordinance Section 16-6, the following general prohibitions regarding continuous sound levels shall apply in determining unreasonable noise:

- No person shall make, cause, allow, or permit the operation of any source of sound on a particular category of property or any public space or right-of-way in such a manner as to create a sound level that exceeds the particular continuous A-weighted decibel limits set forth in **Table L-6** below when measured at or within the real property line of the receiving property except as provided in subsections (B) and (C).

- When measuring sound within a dwelling unit of a multi-dwelling-unit building, all exterior doors and windows shall be closed and measurements shall be taken in the center of the room.

- When measuring on Ocean Beach Park sound shall be measured at the center of the boardwalk at a point directly perpendicular to the source.

Table L-6 Permissible Continuous Sound Levels by Receiving Property Category, in dBA

Sound Source Property Category	Another Dwelling Within a Multi Dwelling Unit Building (7am - 10pm)	Another Dwelling Within a Multi Dwelling Unit Building (10pm-7am)	Residential (7am-10pm)	Residential (10pm-7am)	Commercial or Public Service or Community Service Facility (All times)	Industrial or Public Service Industrial Facility (All times)	Ocean Beach Park or Parks (6am-11pm)
Any location within a multi-dwelling unit building	50	45	65	50	70	75	65
Residential (or public spaces or rights-of-way)			65	50	70	75	65
Commercial or public service or community service facility			65	50	70	75	65
Industrial or public service industrial facility			65	50	70	75	65

Section 16-8 of the Ordinance describes general prohibitions regarding impulsive sound levels:

- No person shall make, cause, allow or permit the operation of any impulsive source of sound within any and all property in the city which has a peak sound pressure level in excess of eighty (80) dBA. If an impulsive sound is the result of the normal operation of an industrial or commercial facility and occurs more frequently than four (4) times in any hour the levels set forth in Table 16-1 shall apply.

Regardless of the decibel limits, the provisions of this Ordinance shall not apply to noise from construction activity provided all motorized equipment used in such activity is equipped, where applicable, with functioning mufflers, except as provided in Ordinance Section 16-6.

L.2.3.4 Village of Island Park

The EW 2 Onshore Substation C, portions of the onshore export and interconnection cable routes, and the north side of the Reynolds Channel HDDs will be located within the Village of Island Park, as will the Reynolds Channel bulkhead upgrade and marina removal and the crossing of Barnums Channel, whether accomplished by cable bridge, open cut, or trenchless method. The following noise restrictions are found within Chapter 349 of The Village of Island Park Codes:

- No person, with the intent to cause public inconvenience, annoyance or alarm, or recklessly creating a risk thereof, shall cause, suffer, allow or permit to be made, unreasonable noise.

- The erection, including excavation, demolition, alteration or repair, of any building other than between 7:00 a.m. and 9:00 p.m., except in case of a public safety emergency.

- The sounding of any horn or signaling device of an automobile, motorcycle or other vehicle for any unnecessary or unreasonable period of time.

- No person or persons, firm, association, corporation or contractor shall do, perform, cause, suffer or permit the operation of any mower or power lawn mower, machine or power tools or any other power equipment to commence operation earlier than 8:00 a.m. or later than 9:00 p.m. on Monday through Saturday or earlier than 9:00 a.m. and later than 9:00 p.m. on Sunday. All other noise generated from musical instruments or events will be allowed until 11:00 p.m.

- No person or persons, firm, association, corporation or contractor shall do, perform, cause, suffer or permit the operation of any mower or power lawn mower, machine or power tools or any other power equipment to commence operation earlier than 8:00 a.m. or later than 9:00 p.m. on Monday through Saturday or earlier than 9:00 a.m. and later than 9:00 p.m. on Sunday. All other noise generated from musical instruments or events will be allowed until 11:00 p.m.

L.3 EXISTING AMBIENT CONDITIONS

To characterize existing ambient conditions at the proposed onshore substation and export cable landfall sites, baseline sound measurements were conducted with an operator present for a minimum of 30 minutes during daytime and nighttime periods in accordance to 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 12:00 AM and 4:00 AM when ambient conditions are typically quietest (i.e., more conservative).

Baseline ambient measurement locations were pre-selected to be representative of the surrounding community and other potential noise sensitive areas (NSAs) near the proposed onshore substations, HDDs, and where export cable landfall will occur. The measurements were conducted at 5 ft (1.5 m) above grade and a minimum of 25 ft (7.5 m) from any dwelling or structure, generally at publicly accessible sidewalk locations. The measurement locations are shown on **Figure L-2** and **Figure L-3**, 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 trains and planes was observed during both daytime and nighttime. 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 clear, roadways were dry, and winds were minimal; these conditions are considered suitable for acoustic measurements. **Table L-7** summarizes the measured sound levels for each of the time periods as well as location addresses. Sound-level monitoring shows existing nighttime L_{90} levels are in the range of 33 to 65 dBA. A quiet suburban area would typically have nighttime levels in the range of 35 to 45 L_{90} dBA (ANSI 2013). Measured ambient sound levels exhibited typical diurnal patterns, with higher ambient sound levels during the daytime ranging from 45 to 66 L_{90} dBA.

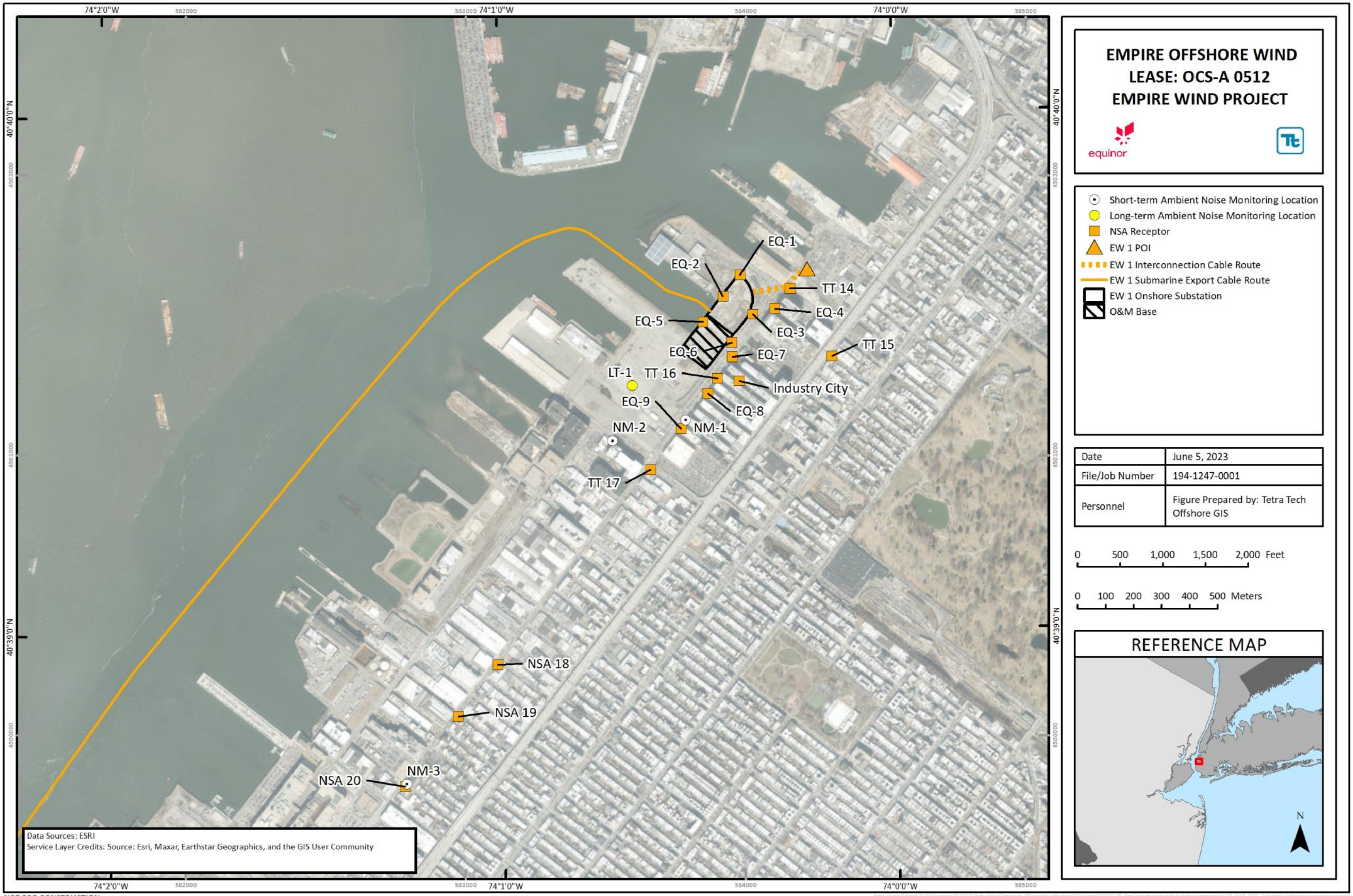

Figure L-2 EW 1 Ambient Sound Measurement Locations

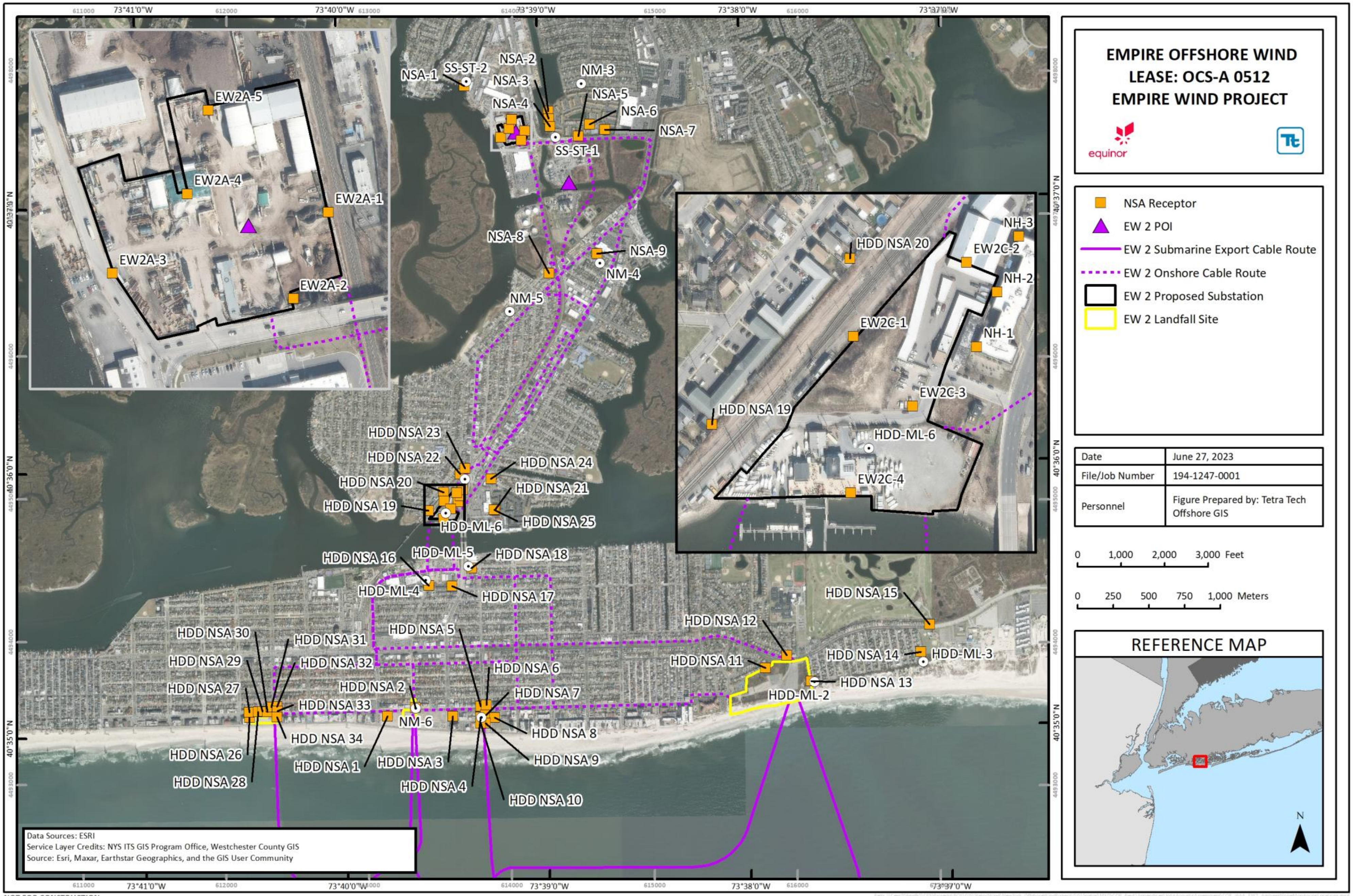

Figure L-3 EW 2 Ambient Sound Measurement Locations

Table L-7 Baseline Noise Measurement Results

Site	Monitoring Location	Location	Time Period	Sound Level Metrics (dBA)			
				L_{10}	L_{50}	L_{90}	L_{eq}
EW 1 Export Cable Landfall, Onshore Substation, and O&M Base	NM-1	630 2nd Avenue	Day	72	67	66	69
			Night	58	55	53	63
EW 1 Export Cable Landfall, Onshore Substation, and O&M Base	NM-2	100 39th Street	Day	67	56	46	65
			Night	69	66	65	67
EW 2 Onshore Substation A	NM-3	136 Harris Drive	Day	57	49	48	55
			Night	52	46	44	49
EW 2 Onshore Substation A	NM-4	1 Georgia Avenue	Day	59	55	51	56
			Night	54	49	47	51
EW 2 Onshore Substation A	NM-5	154 Waterford Road	Day	51	47	45	48
			Night	50	48	47	50
EW 2 Export Cable Landfall	NM-6	125 East Broadway	Day	59	53	51	59
			Night	50	47	46	49
EW 2 Onshore Cable Route HDD	HDD-ML-1	65 Lincoln Boulevard	Day	58	50	47	58
			Night	44	43	42	47
EW 2 Onshore Cable Route HDD	HDD-ML-2	1 Ocean Boulevard	Day	54	45	44	52
			Night	44	43	42	44
EW 2 Onshore Cable Route HDD	HDD-ML-3	78 Prescott Street	Day	51	45	43	50
			Night	52	44	41	49
EW 2 Onshore Cable Route HDD	HDD-ML-4	109 East Pine Street	Day	56	49	47	56
			Night	48	45	44	51
EW 2 Onshore Cable Route HDD	HDD-ML-5	270 East State Street	Day	65	61	55	63
			Night	60	53	52	56
EW 2 Onshore Substation C	HDD-ML-6	15 Railroad Place	Day	59	55	51	56
			Night	54	46	40	52
EW 2 Onshore Substation C	HDD-ML-7	90 Long Beach Road	Day	56	52	49	53
			Night	53	47	41	49

Site	Monitoring Location	Location	Time Period	Sound Level Metrics (dBA)			
				L_{10}	L_{50}	L_{90}	L_{eq}
EW 2 Onshore Substation A	SS-ST-1	4001 Daly Boulevard	Day	75	70	60	72
			Night	69	50	45	64
EW 2 Onshore Substation A	SS-ST-2	561 Bothner Street	Day	60	52	50	57
			Night	47	38	36	50

L.4 ACOUSTIC MODELING METHODOLOGY

The acoustical modeling for the Project was conducted with the Cadna-A® sound model from DataKustik GmbH (Version 2020 MR1) (DataKusik 2020). The outdoor sound propagation model is based on the International Organization for Standardization (ISO) 9613, Part 1: "Calculation of the absorption of sound by the atmosphere," (1993) and Part 2: "General method of calculation," (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-ft (30-m) interval between height points for the Project Area. The sound model propagation calculation parameters are summarized in **Table L-8**.

Table L-8 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 (1.5 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 mi/hour) (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 HDD 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.

L.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.

L.5.1 Construction Acoustic Assessment

Two types of pile driving may be required during Project construction, impact and vibratory pile driving. Impact pile driving may be used to install the wind turbine and offshore substation foundations and onshore substation foundations, while vibratory pile driving may be required to construct the temporary cofferdams to support export cable landfall, as well as bulkhead cofferdams along shoreline, where applicable. In addition, a cable bridge will be constructed, which requires the installation of piles using impact pile driving. Specialized HDD construction may also be required during export cable landfall. Onshore export and interconnection cable, onshore substation, and O&M Base installation construction 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 Lease Area.

L.5.1.1 Construction of Onshore Project Components

The construction of the O&M Base, onshore substations, and the onshore export and interconnection cables 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. O&M Base, onshore substation, and onshore export and interconnection cable installation construction generally consists of site clearing and grading, excavation, foundation work, building erection, and finishing work which is anticipated to have a total duration of up to three years for EW 1 and up to three years for EW 2. Construction of the onshore export and interconnection cables involves site preparation, duct bank installation, restoration, cable installation, cable jointing, and final testing.

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 EPA has published data on the L_{eq} sound levels for typical construction phases (EPA 1971). Following the EPA method, sound levels were projected from the acoustic center of the construction footprint. This calculation conservatively assumes all equipment operating concurrently onsite for the specified construction phase and no sound attenuation for ground absorption or onsite shielding by the existing buildings or structures.

The results of these calculations are presented in **Table L-9** and show estimated construction sound levels in A-weighted decibels will vary depending on construction phase and distance, with the highest levels expected in proximity to the closest neighborhoods during the site excavation phase. These levels are similar to existing daytime sound levels experienced at these same locations. 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. Onshore substation and O&M Base construction will generally be limited to daytime periods. Construction could occur within 100 ft (30 m) of the closest neighborhoods. Reasonable efforts will be made to minimize the impact of noise resulting from construction activities. As such, the following noise mitigation measures will be implemented unless otherwise authorized by the appropriate regulatory authority:

- 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;
- Quieter-type adjustable backup alarms would be used for vehicles as feasible;
- Noisy equipment onsite will be located as far as possible from NSAs;

- If noise issues are identified, Empire will install moveable temporary noise barriers as close to the sound sources as possible, which have been shown to effectively reduce sound levels by 5 to 15 dBA; and
- A noise complaint hotline will be made available to help actively address all noise related issues.

Table L-9 General Construction Noise Levels (dBA)

Construction Phase	50 ft from Source (L_{eq})	250 ft from Source (L_{eq})	500 ft from Source (L_{eq})	1,000 ft from Source (L_{eq})
Clearing	84	70	65	58
Excavation	91	77	72	65
Foundations	78	64	59	52
Erection	85	71	66	59
Finishing	89	75	70	63

In addition to the above listed construction equipment, pile driving may be needed to install the foundation for the O&M Base and the onshore substations, specifically at the EW 1 Onshore Substation, EW 2 Onshore Substation A, and EW 2 Onshore Substation C. Impact pile driving is expected to support installation of onsite substation equipment structures, the installation of cable bridge piles, and the installation of nearshore goal posts. The nearshore goal posts were modeled at two representative locations. The western location represents the installation of goal posts associated with landfall E, landfall A, and landfall B, while the eastern location represents installation associated with landfall C. Vibratory pile driving is expected along the bulkheads adjacent to both the EW 1 onshore substation and O&M Base, and EW 2 Onshore Substation C.

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. Noise is generated from pile driving equipment 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).

Final design of the impact hammer and piles planned for installation is currently under development. Assuming the installation of steel piles with a diameter between 24 and 36 inches (61 to 91 cm), an average sound pressure level would correspond to 108 dBA at 50 feet (15 m), which is used as a modeling input for the construction acoustic analysis. For the purposes of the construction noise assessment, it is assumed that pile driving may be required to support the foundations of the Control Building, SVC Building, and GIS Building as well as the main transformer. Vibratory pile driving installation is estimated to produce sound levels of 78 dBA in air at a distance of approximately 400 ft (122 m) with a corresponding L_W of 127 dBA (USDOT 2012). The resulting sound levels from pile driving activities are shown in **Table L-10** for EW 1 and **Table L-11** for EW 2.

Table L-10 EW 1 Pile Driving Noise Levels (dBA)

Construction Phase	Received Sound Level (dBA)													
	NSA-14	NSA-15	NSA-16	NSA-17	EQ-1 a/	EQ-2 a/	EQ-3 a/	EQ-4	EQ-5 a/	EQ-6 a/	EQ-7	EQ-8	EQ-9	Industry City
Daytime Ambient Sound Level, L_{90} (dBA)	66	66	66	46	66	66	66	66	66	66	66	66	66	66
Pile Driving Location 1	92	84	86	78	100	96	96	94	90	90	88	84	81	86
Pile Driving Location 2	91	85	88	79	93	95	106	95	92	94	91	86	82	88
Pile Driving Location 3	89	85	89	80	92	96	99	92	94	96	93	87	83	89
Pile Driving Location 4	89	84	87	79	95	104	96	92	94	93	90	86	82	87
Pile Driving Location 5	90	84	87	79	97	102	96	92	92	92	89	85	82	87
Pile Driving Location 6	88	78	87	79	94	107	93	85	96	92	90	86	82	87
Pile Driving Location 7	86	82	90	81	90	94	91	88	120	93	92	88	84	88

Note:
a/ Substation boundary location

Table L-11 EW 2 Pile Driving Noise Levels (dBA)

Pile Driving	Location	Receptor	Distance (ft)	Modeling Results
Impact	Onshore Substation A + Hampton Road Substation Foundations	NSA-1	1,650	69
		NSA-2	750	75
		NSA-3	650	73
		NSA-4	600	72
		NSA-5	1,300	67
		NSA-6	1,550	67
		NSA-7	1,900	65
		NSA-8	3,300	61
		NSA-9	3,300	61
	Onshore Substation C Foundations	HDD-NSA 19	510	83
		HDD-NSA 20	155	93
		HDD-NSA 21	1,150	77
		HDD-NSA 22	170	81
		HDD-NSA 23	790	79
		HDD-NSA 24	1,115	78
		HDD-NSA 25	1,115	77
		NH-1 a/	250	86
		NH-2 a/	300	90
		NH-3 a/	400	87
	Cable Bridge Pile Location 1	NSA-1	3,114	60
		NSA-2	2,024	65
		NSA-3	1,870	65
		NSA-4	1,686	66
		NSA-5	1,700	71
		NSA-6	2,067	69
		NSA-7	2,185	64
		NSA-8	1,821	66
		NSA-9	1,706	66
	Cable Bridge Pile Location 2	NSA-1	2,959	61
		NSA-2	1,867	65
		NSA-3	1,673	66
		NSA-4	1,641	66
		NSA-5	1,558	72
		NSA-6	1,939	65
		NSA-7	2,080	64
		NSA-8	1,969	65
		NSA-9	1,887	65
	Cable Bridge Pile Location 3	NSA-1	4,610	55
		NSA-2	2,769	66

Pile Driving	Location	Receptor	Distance (ft)	Modeling Results
		NSA-3	2,625	62
		NSA-4	2,477	63
		NSA-5	1,870	70
		NSA-6	1,919	70
		NSA-7	1,690	71
		NSA-8	1,467	67
		NSA-9	2,510	73
	Cable Bridge Pile Location 4	NSA-1	4,593	55
		NSA-2	2,707	61
		NSA-3	2,585	62
		NSA-4	2,444	63
		NSA-5	1,805	66
		NSA-6	1,870	66
		NSA-7	1,595	67
		NSA-8	1,618	62
		NSA-9	2,658	67
	Goal Post Western Representative Location	Shore	1,654	76
	Goal Post Eastern Representative Location	Shore	1,805	74
Vibratory	Bulkhead at EW 2 Onshore Substation C Site	HDD-NSA 19	175	81
		HDD-NSA 20	680	69
		HDD-NSA 21	1,525	53
		HDD-NSA 22	1,245	63
		HDD-NSA 23	1,410	62
		HDD-NSA 24	1,690	54
		HDD-NSA 25	1,510	53
		NH-1 a/	775	60
		NH-2 a/	900	62
		NH-3 a/	1,000	62

Note:
a/ NH = Nursing Home

Pile driving activities may produce exceedances of Section 24-228 of the NYC Code, which allows for an increase of up to 15 dBA above the ambient sound level. Pile driving will be temporary and short-term, and pile driving activities are planned to occur during daytime hours. If necessary, subject to regulatory requirements and stakeholder engagement, Empire will install moveable temporary noise barriers as close to the sound sources as possible, which have been shown to effectively reduce sound levels by 5 to 15 dBA.

L.5.1.2 Vibratory Pile Driving at Nearshore Cofferdam for HDD Exit

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. The resulting received sound levels are presented in **Table L-12** and sound contour isopleths in **Figure L-4**, **Figure L-5**, **Figure L-6, Figure L-7,** and **Figure L-8**.

Table L-12 Sound Levels (dBA) during Vibratory Pile Driving at Nearshore Cofferdam

Site	Distance to Shore (ft)	Sound Level at Shore During Vibratory Piling (dBA)
EW 1	367	77
EW 2 Landfall A & EW 2 Landfall B	1,825	60
EW 2 Landfall C	1,500	62
EW 2 Landfall C (Approach C3)	1,450	64
EW 2 Landfall E	2,050	61

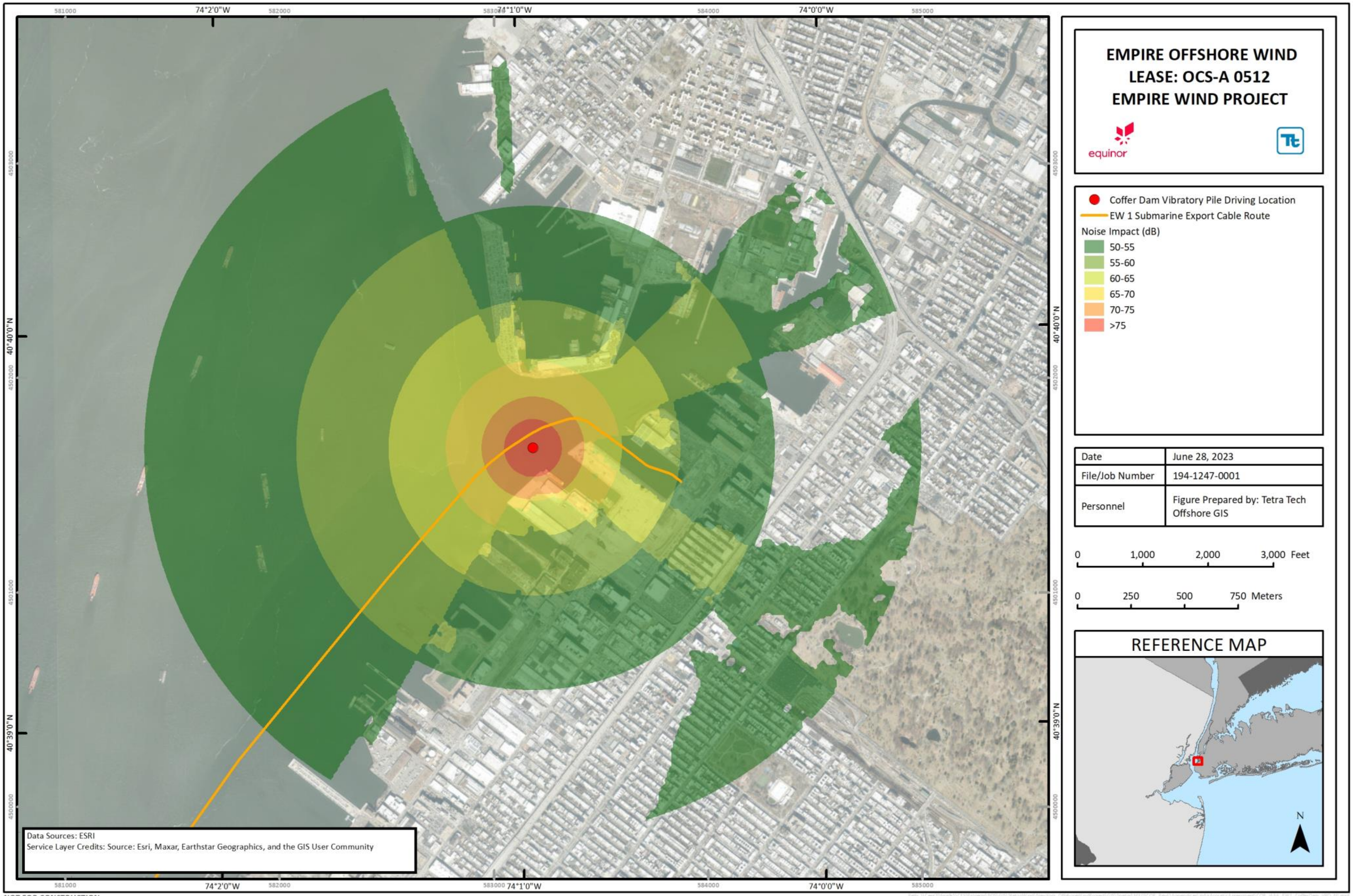

Figure L-4 EW 1 Vibratory Pile Driving Sound Contour Isopleth

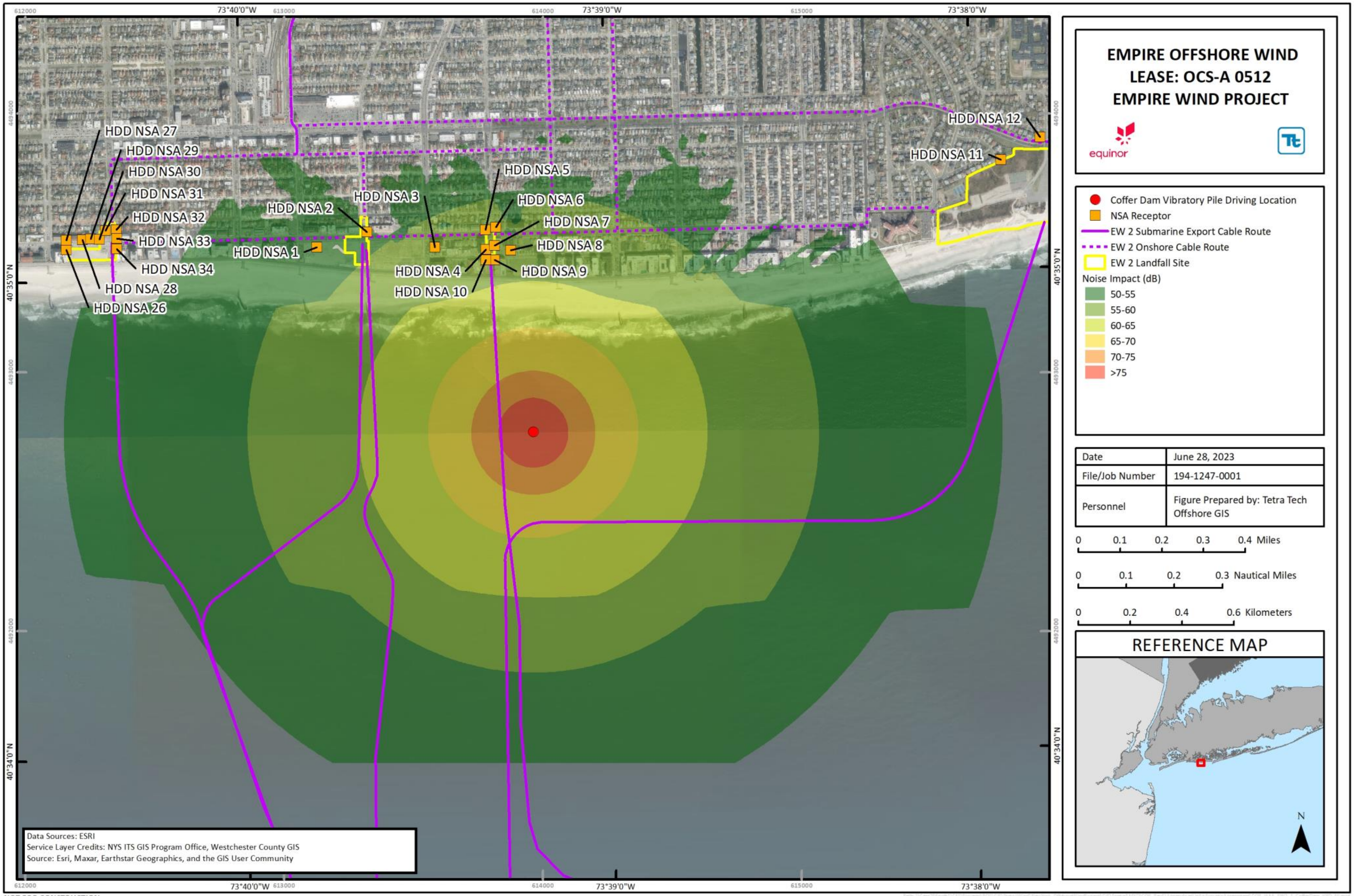

Figure L-5 EW 2 Landfall A and EW 2 Landfall B Vibratory Pile Driving Sound Contour Isopleth

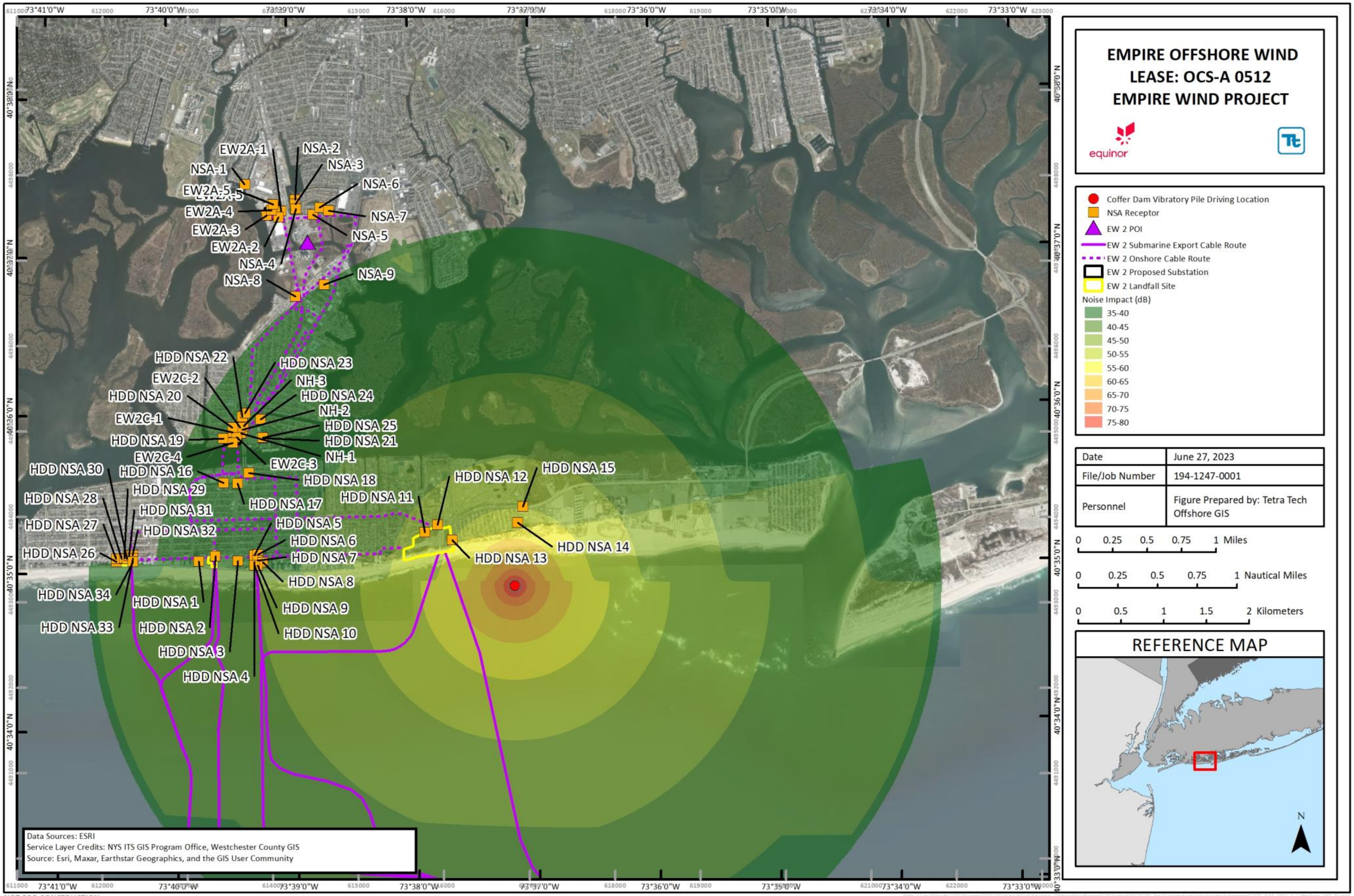

Figure L-6 EW 2 Landfall C Vibratory Pile Driving Sound Contour Isopleth

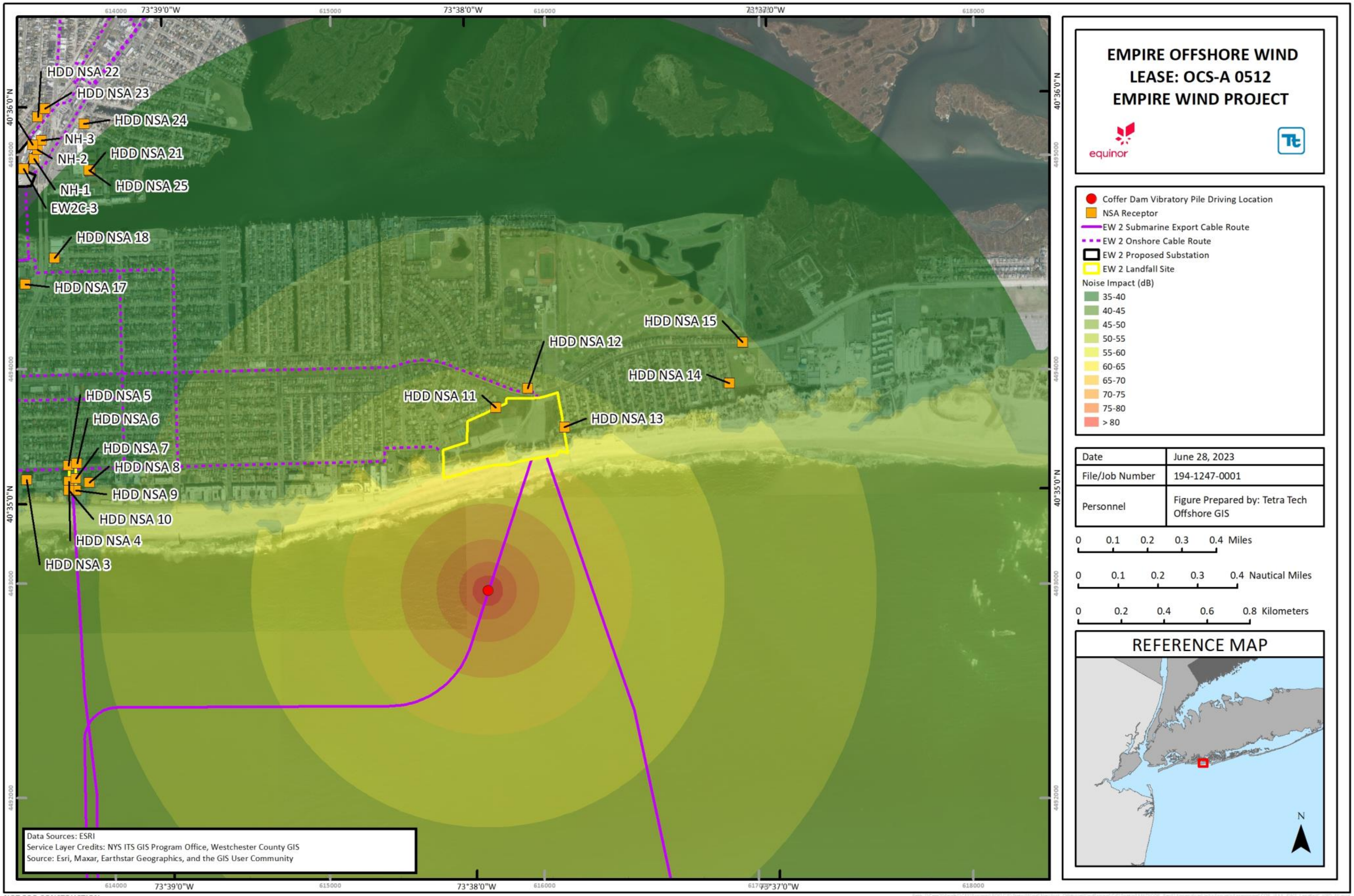

Figure L-7 EW 2 Landfall C (Approach C3) Vibratory Pile Driving Sound Contour Isopleth

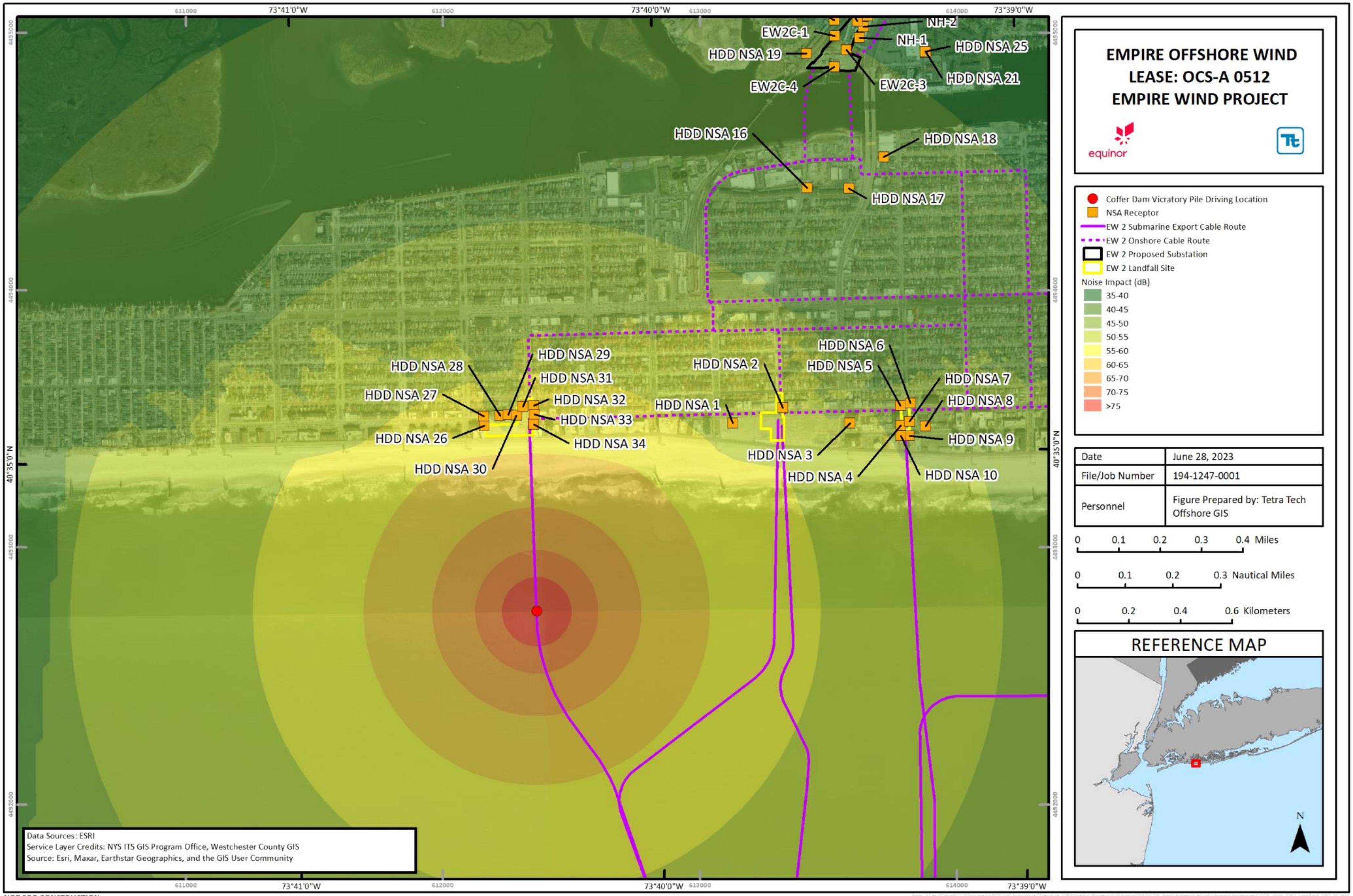

Figure L-8 EW 2 Landfall E Vibratory Pile Driving Sound Contour Isopleth

As shown in **Table L-12**, vibratory pile driving at the EW 1 cofferdam will result in a modeled sound pressure level of 77 dBA at the shore. The vibratory pile driving at the EW 2 Landfall A and EW 2 Landfall B cofferdam will result in a modeled sound pressure level of 60 dBA at the shore, while the EW 2 Landfall C and EW 2 Landfall D cofferdam will result in a modeled sound pressure level of 62 dBA, the EW 2 Landfall C (western variant) cofferdam will result in a modeled sound pressure level of 64 dBA, and the EW 2 Landfall E cofferdam will result in a modeled sound pressure level of 61 dBA at the shore. Considering this construction activity will last for a relatively short duration of time and will be limited to daytime periods, this construction activity 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.

While open-cut trench is the preferred export cable landfall installation method for EW 1, the use of HDD, and therefore, the installation of a cofferdam, is proposed as part of the Project Design Envelope (PDE).

L.5.1.3 HDD and Direct Pipe Construction at the Export Cable Landfall Work Area

Export cable landfall would be completed using open cut, HDD, or Direct Pipe installation techniques within the export cable landfall area for each site. The EW 1 export cable landfall is expected to use open cut techniques that will be similar to the construction noise levels in **Table L-9**; however, the use of HDD is proposed as part of the PDE. Use of HDD was analyzed at the EW 1 and use of HDD or Direct Pipe was analyzed at the EW 2 export cable landfalls, and found to potentially generate relatively high sound levels.

HDD and Direct Pipe construction equipment consists of drill 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 L-13** presents the HDD and Direct Pipe components included in the analysis and **Table L-14** provides candidate noise control mitigation strategies. Once the HDD/Direct Pipe and pull-back are complete, noise from the export cable landfall site will be limited to typical construction activities associated with equipment such as tracked graders, backhoes and pickup trucks. HDD and Direct Pipe construction activities will occur during daytime period unless a situation arises that would require operation to continue into the night or deemed acceptable from the appropriate regulatory authority. In the case of night operations, only the HDD/Direct Pipe rig and power unit will be used unless deemed acceptable from the appropriate regulatory authority.

Table L-13 HDD and Direct Pipe Equipment Sound Pressure Source Levels, dBA at 3 ft

Installation Technique	Equipment Component	Sound Level without Acoustical Treatment	Sound Level with Acoustical Treatment
HDD	HDD 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
	Total Sound Level	108	92
Direct Pipe	Separation Plant	90	80
	Power Plant	85	80
	Mud Pumps	90	80
	Pipe Thruster	85	80
	Pneumatic Hammer	140	115

Installation Technique	Equipment Component	Sound Level without Acoustical Treatment	Sound Level with Acoustical Treatment
	Side Boom	83	83
	Excavator	85	85
	Crane	85	85

Table L-14 HDD/Direct Pipe Candidate Noise Control Strategies

HDD 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 HDD Rig	A complete acoustical enclosure for the power unit equipped with a critical grade exhaust silencer. Partial enclosure or barrier for the HDD 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 L-15 summarizes the predicted sound levels at the closest NSAs, indicated as HDD-NSA#, assuming the HDD and Direct Pipe sources operate continually for daytime and nighttime construction scenarios. The resulting sound contour isopleths for HDD during nighttime operation are provided in **Figure L-9** through **Figure L-18**. These predictive results demonstrate that with application of the proposed noise mitigation strategies, resulting sound levels will not constitute a violation of local nuisance by-laws for the New York City or the Town of Hempstead's stationary source noise limits, nor result in a potential imminent hazard to public health or the environment.

Once the HDD/Direct Pipe and pull-back are complete, noise from the export cable landfall area will be limited to typical construction activities associated with equipment such as tracked graders, backhoes, and pickup trucks. HDD/Direct Pipe construction activities will occur during the daytime period unless a situation arises that would require operation to continue into the night or deemed acceptable from the appropriate regulatory authority. In the case of night operations, only the HDD drill rig and power unit will be used unless deemed acceptable from the appropriate regulatory authority. The pneumatic hammer associated with the Direct Pipe method will only operate during the daytime. If necessary, subject to regulatory requirements and stakeholder engagement, Empire will install moveable temporary noise barriers as close to the sound sources as possible, which have been shown to effectively reduce sound levels by 5 to 15 dBA.

Table L-15 Sound Levels (dBA) during HDD and Direct Pipe Construction

Site	Location	Distance (ft)	Sound Level at NSAs due to Drill Rig Only (Nighttime Operations)	Sound Level at NSAs due to all HDD/Direct Pipe Sources (Daytime Operations)
EW 1	NSA-14	1,906	49	52
	NSA-15	2,532	47	50
	NSA-16	1,291	53	56
	NSA-17	2,106	49	52
	EQ-1	1,354	53	56
	EQ-2	1,028	55	58
	EQ-3	1,392	52	55
	EQ-4	1,718	51	54
	EQ-5	752	58	61
	EQ-6	1,191	54	57
	EQ-7	1,291	53	56
	EQ-8	1,329	53	56
	EQ-9	1,605	51	54
	Industry City	1,517	53	55
EW 2 Landfall A (HDD)	HDD-NSA 1	620	57	60
	HDD-NSA 2	190	68	71
	HDD-NSA 3	850	54	57
EW 2 Landfall A (Direct Pipe)	HDD-NSA 1	620	59	84
	HDD-NSA 2	190	69	94
	HDD-NSA 3	850	56	81
EW 2 Landfall B (HDD)	HDD-NSA 4	16	86	89
	HDD-NSA 5	207	68	71
	HDD-NSA 6	246	66	69
	HDD-NSA 7	49	79	82
	HDD-NSA 8	256	67	70
	HDD-NSA 9	92	73	76
	HDD-NSA 10	92	74	77
EW 2 Landfall B (Direct Pipe)	HDD-NSA 4	16	84	109
	HDD-NSA 5	207	67	92
	HDD-NSA 6	246	66	91
	HDD-NSA 7	49	77	102
	HDD-NSA 8	256	66	91
	HDD-NSA 9	92	72	97
	HDD-NSA 10	92	73	98
EW 2 Landfall C (HDD)	HDD-NSA 11	748	57	60
	HDD-NSA 12	689	58	61

Site	Location	Distance (ft)	Sound Level at NSAs due to Drill Rig Only (Nighttime Operations)	Sound Level at NSAs due to all HDD/Direct Pipe Sources (Daytime Operations)
	HDD-NSA 13	377	63	66
EW 2 Landfall C (Direct Pipe)	HDD-NSA 11	705	58	83
	HDD-NSA 12	655	58	83
	HDD-NSA 13	425	62	87
EW 2 Landfall E (HDD)	HDD-NSA 26	500	59	61
	HDD-NSA 27	490	59	61
	HDD-NSA 28	290	63	66
	HDD-NSA 29	180	67	70
	HDD-NSA 30	80	73	76
	HDD-NSA 31	130	70	73
	HDD-NSA 32	150	69	72
	HDD-NSA 33	60	75	78
	HDD-NSA 34	70	74	77
EW 2 Landfall E (Direct Pipe)	HDD-NSA 26	500	60	85
	HDD-NSA 27	490	60	85
	HDD-NSA 28	290	61	89
	HDD-NSA 29	180	67	92
	HDD-NSA 30	80	73	98
	HDD-NSA 31	130	71	96
	HDD-NSA 32	150	70	95
	HDD-NSA 33	60	75	100
	HDD-NSA 34	70	74	99
EW 2 Reynolds Channel Crossing - Location 1	HDD-NSA 16	200	68	71
EW 2 Reynolds Channel Crossing - Location 2	HDD-NSA 17	568	59	62
	HDD-NSA 18	417	57	61
EW 2 Reynolds Channel Crossing – Location 3/EW 2 Onshore Substation C	HDD-NSA 19	584	60	63
	HDD-NSA 20	548	54	57
	HDD-NSA 21	902	53	56
	NH-1 a/	275	65	68
EW 2 Reynolds Channel Crossing - Location 4/EW 2 Onshore Substation C	NH-2 a/	400	63	66
	NH-3 a/	243	67	70
	HDD-NSA 22	59	77	80
	HDD-NSA 23	154	70	73
	HDD-NSA 24	607	59	62
	HDD-NSA 25	978	55	58

Site	Location	Distance (ft)	Sound Level at NSAs due to Drill Rig Only (Nighttime Operations)	Sound Level at NSAs due to all HDD/Direct Pipe Sources (Daytime Operations)
Barnums Channel (HDD)	NSA-1	3,576	37	40
	NSA-2	1,837	45	48
	NSA-3	1,700	45	48
	NSA-4	1,529	46	49
	NSA-5	1,014	51	54
	NSA-6	1,257	51	54
	NSA-7	1,161	52	55
	NSA-8	2,336	43	46
	NSA-9	1,647	46	49
EW 2 Onshore Substation A + Hampton Road Substation (HDD)	NSA-1	1,475	49	52
	NSA-2	900	51	54
	NSA-3	850	52	55
	NSA-4	825	51	54
	NSA-5	1,475	46	49
	NSA-6	1,750	45	48
	NSA-7	2,100	43	46
	NSA-8	3,275	40	43
	NSA-9	3,350	38	41

Note:
a/ NH = Nursing Home

Figure L-9 EW 1 HDD Contour Isopleth

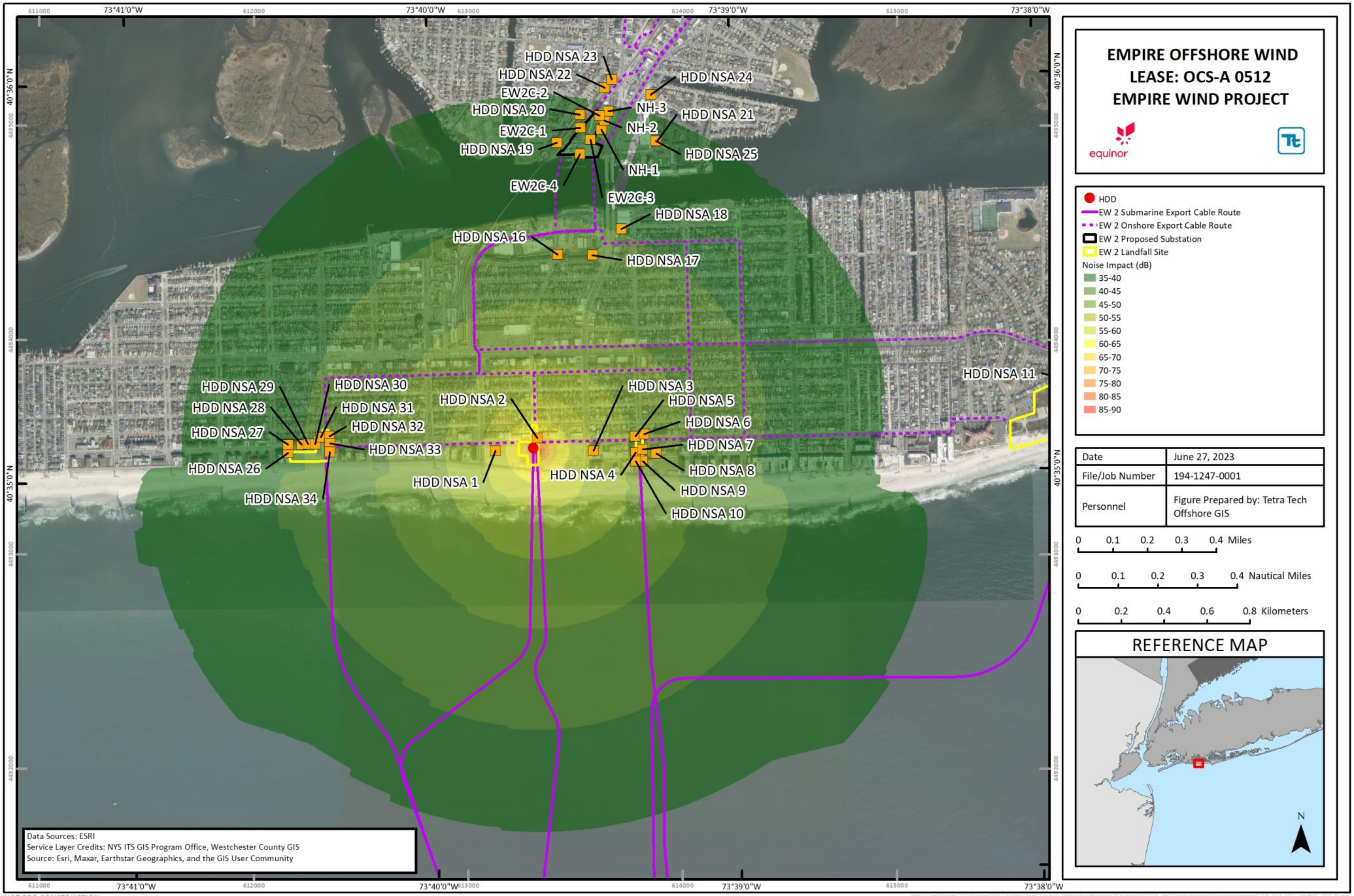

Figure L-10 EW 2 Landfall A HDD Contour Isopleth

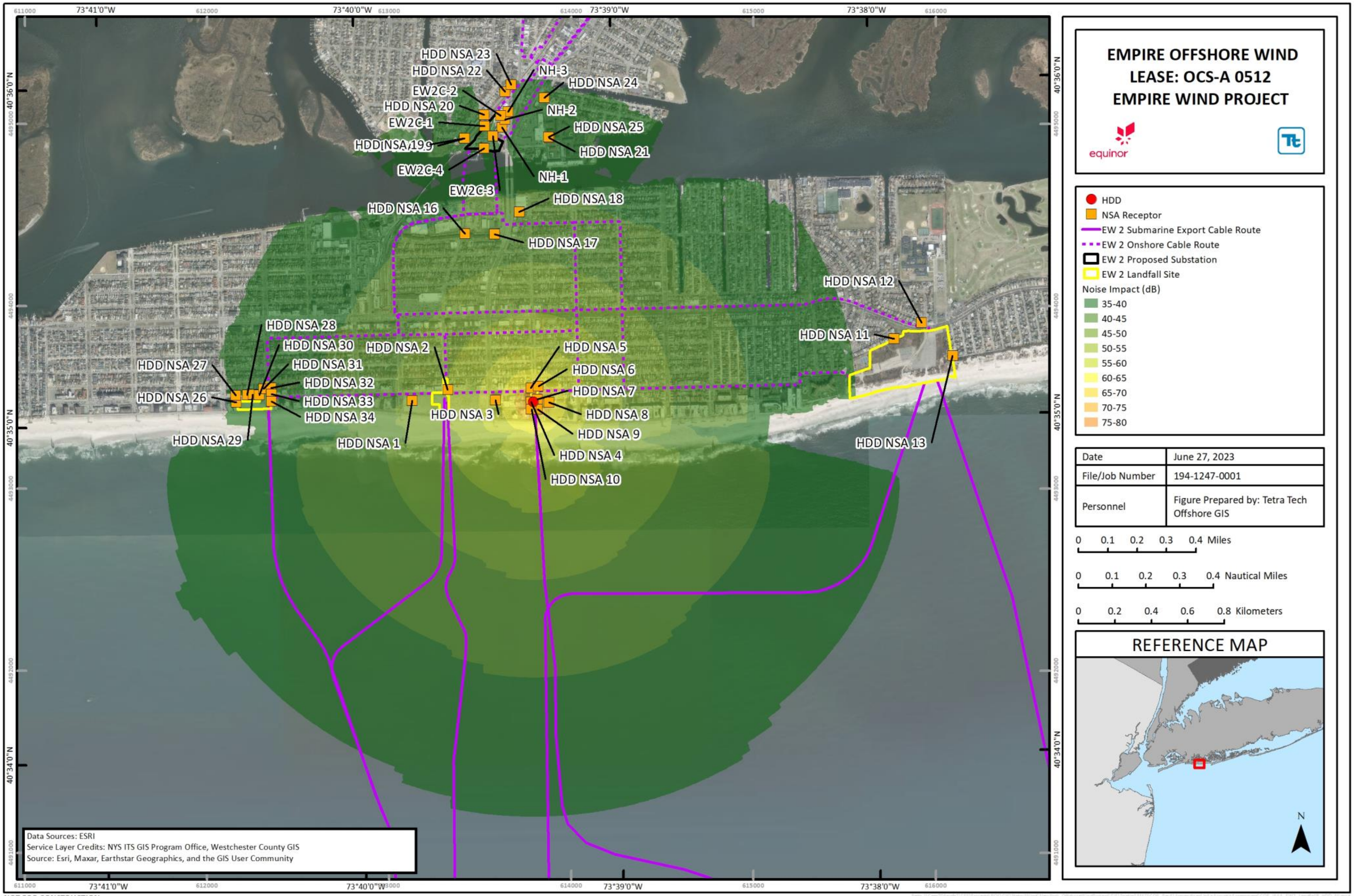

Figure L-11 EW 2 Landfall B HDD Contour Isopleth

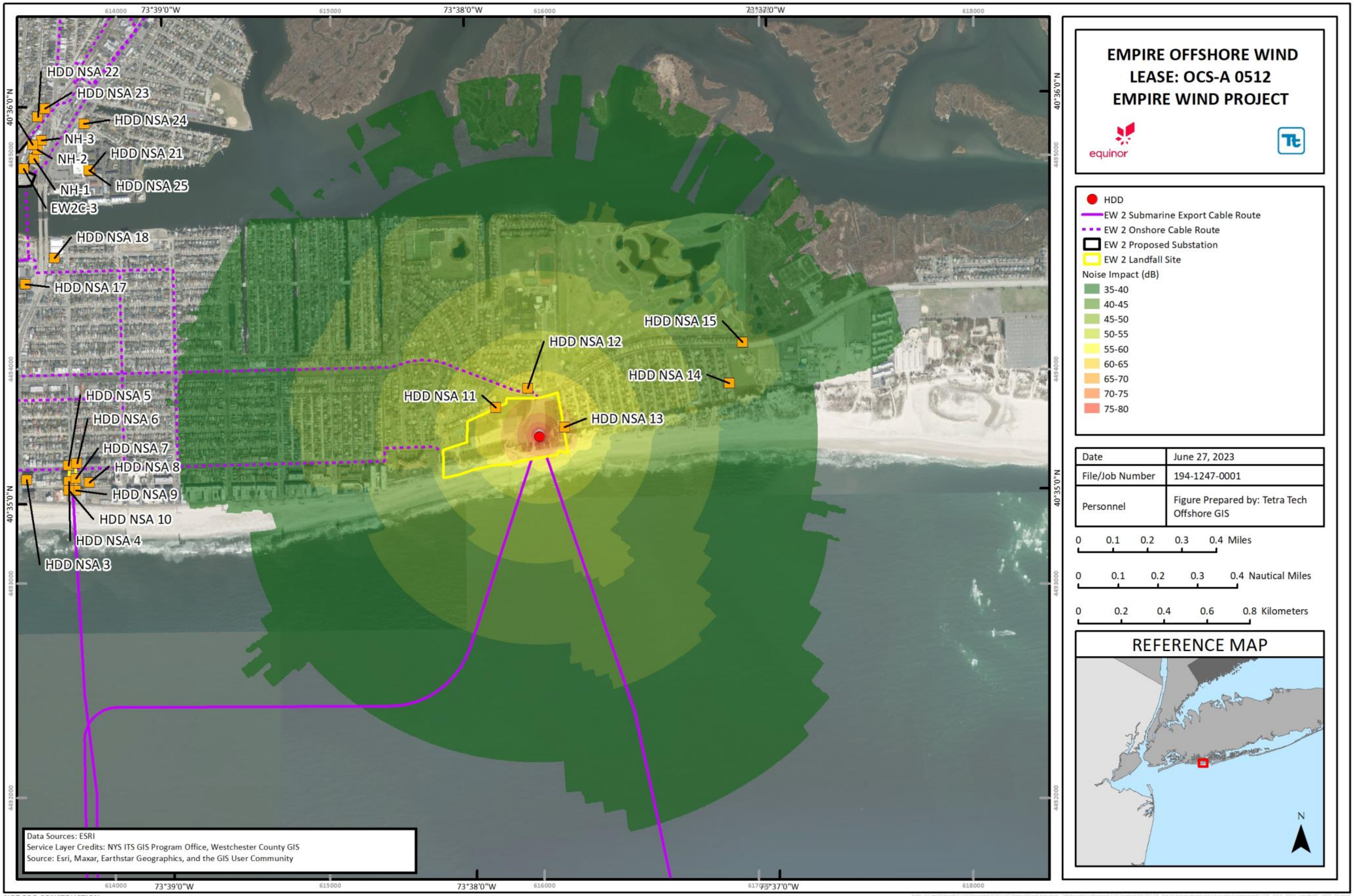

Figure L-12 EW 2 Landfall C HDD Contour Isopleth

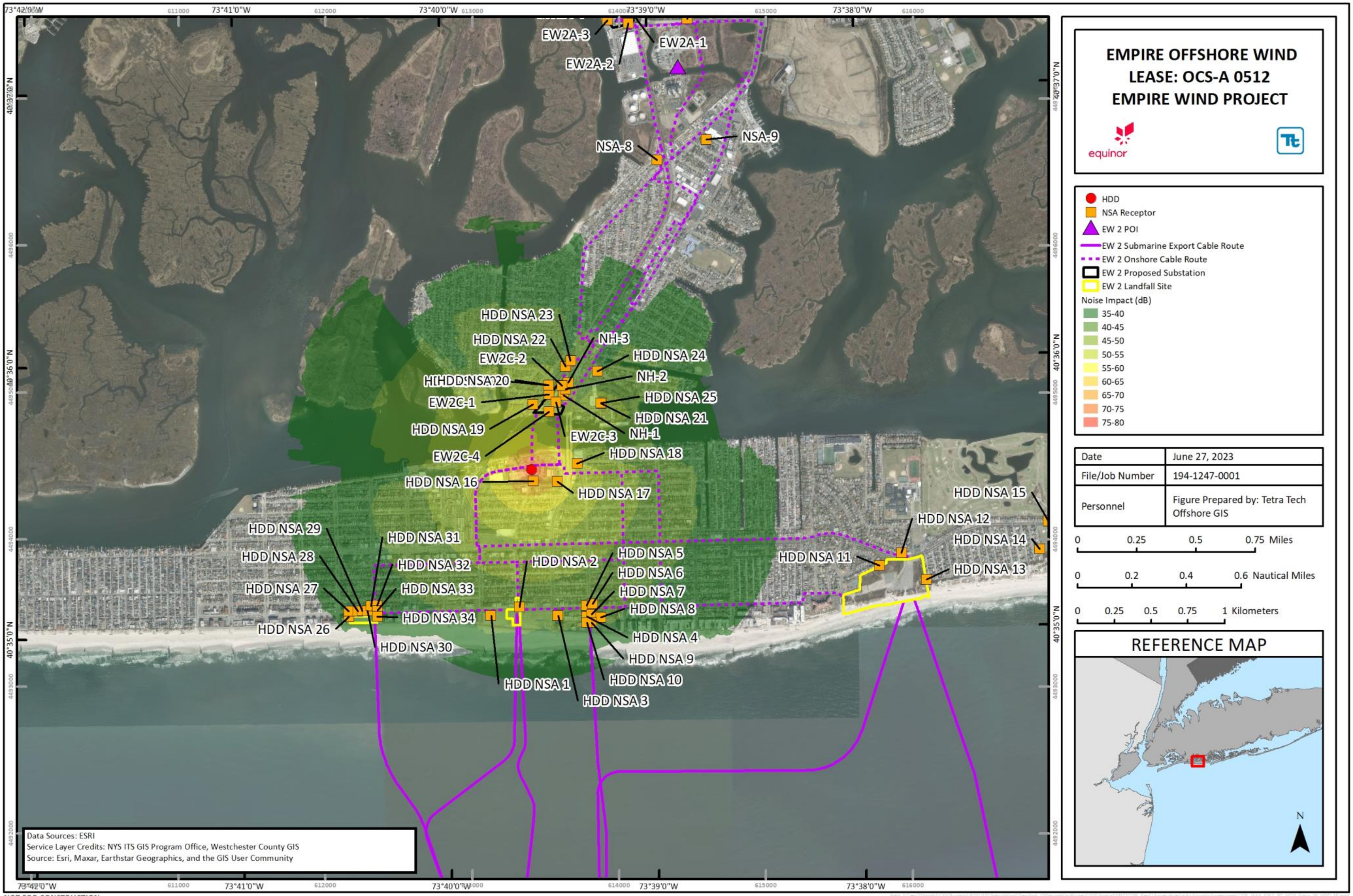

Figure L-13 EW 2 Reynolds Channel Crossing – Location 1 HDD Contour Isopleth

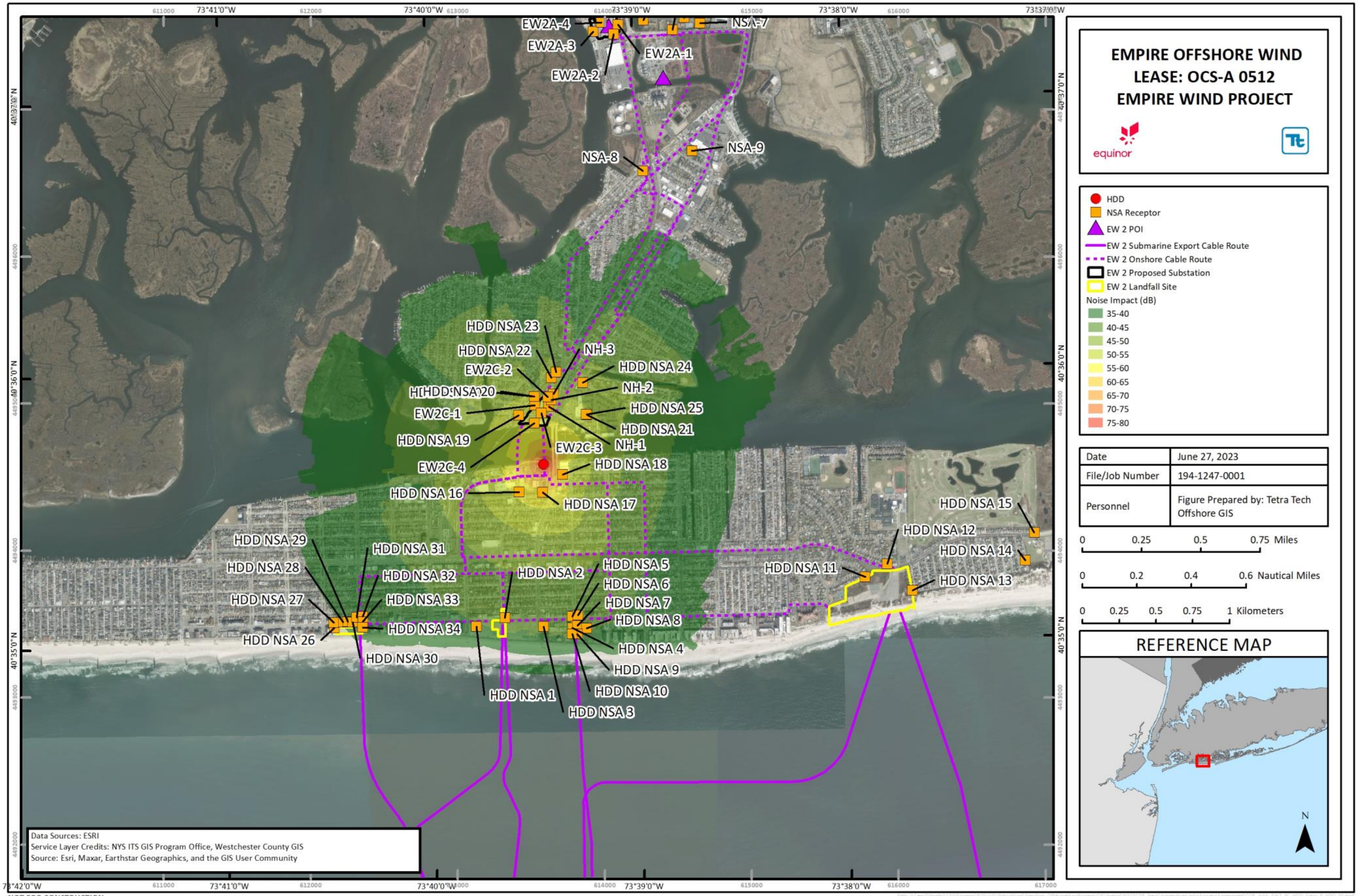

Figure L-14 EW 2 Reynolds Channel Crossing - Location 2 HDD Contour Isopleth

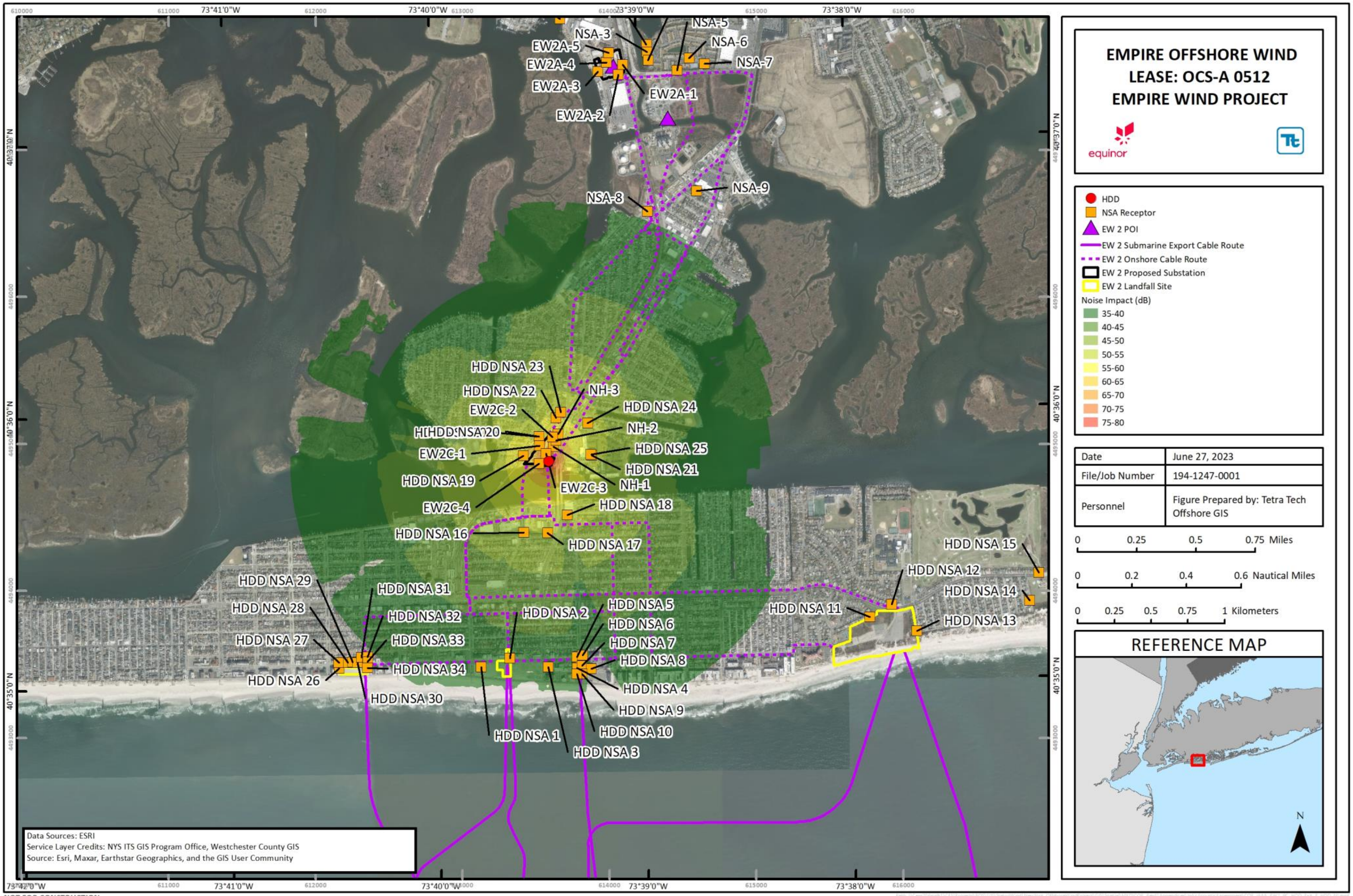

Figure L-15 EW 2 Reynolds Channel Crossing - Location 3 HDD Contour Isopleth

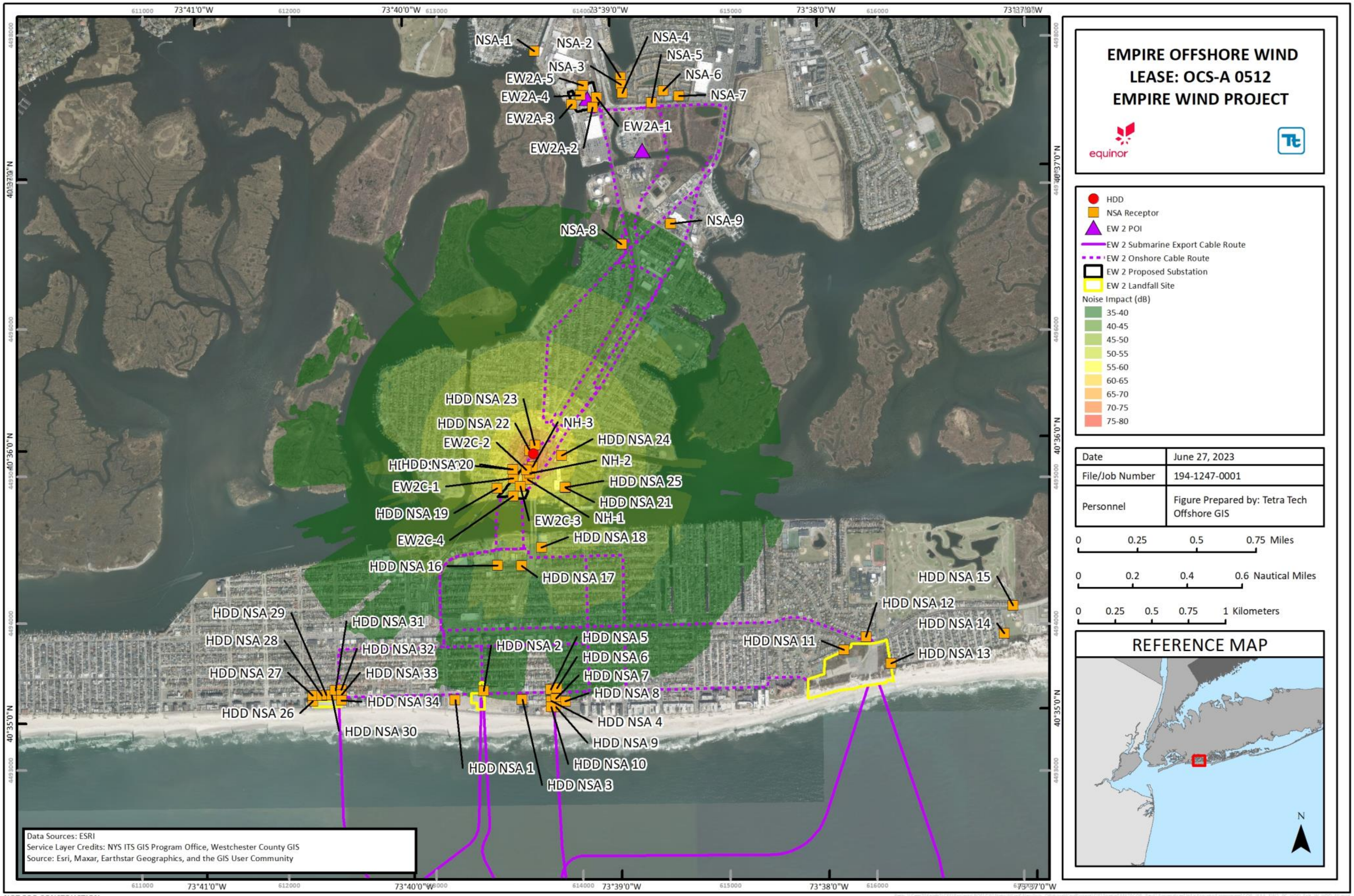

Figure L-16 EW 2 Reynolds Channel Crossing - Location 4 HDD Contour Isopleth

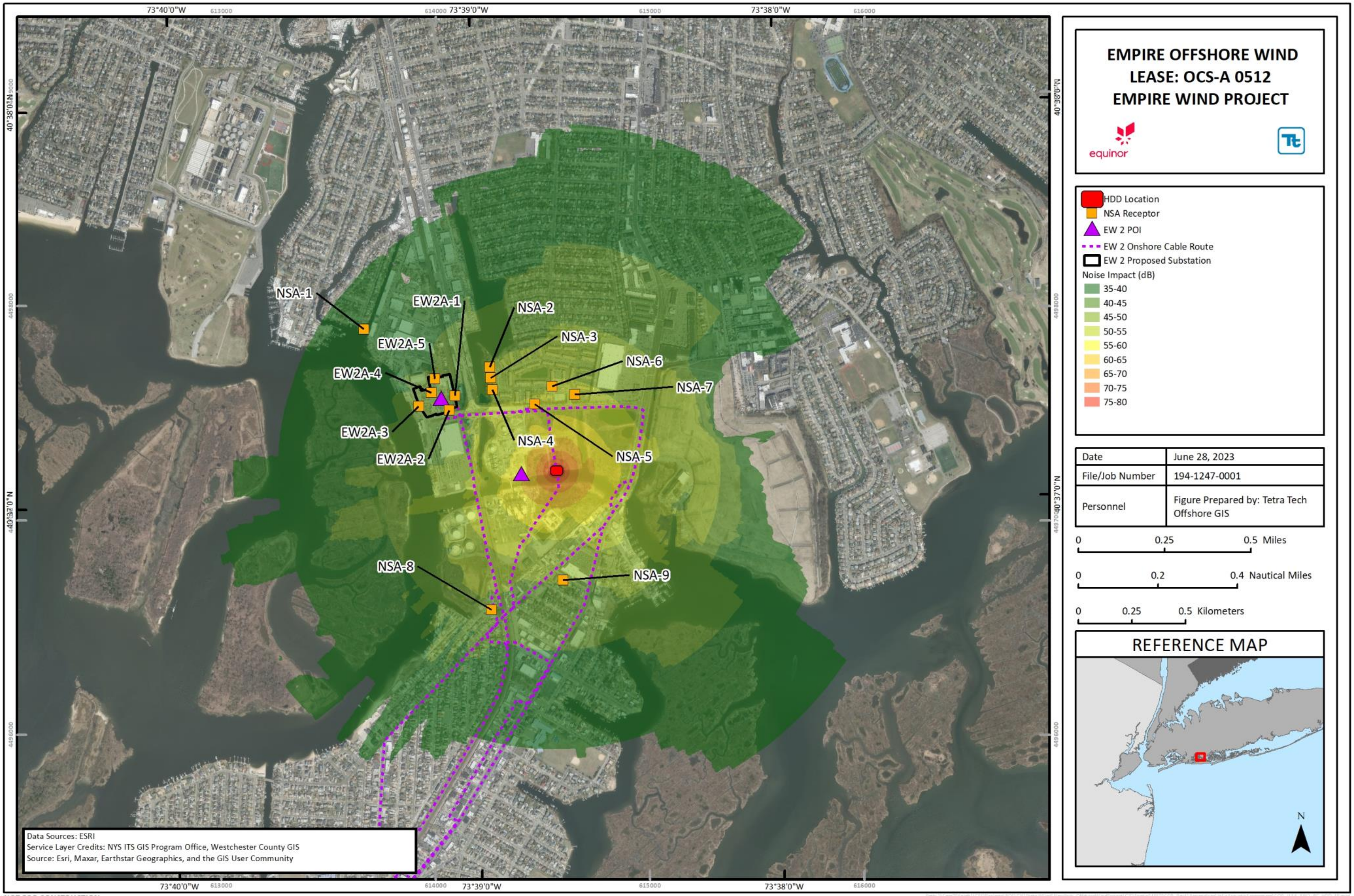

Figure L-17 EW 2 Barnums Channel - HDD Contour Isopleth

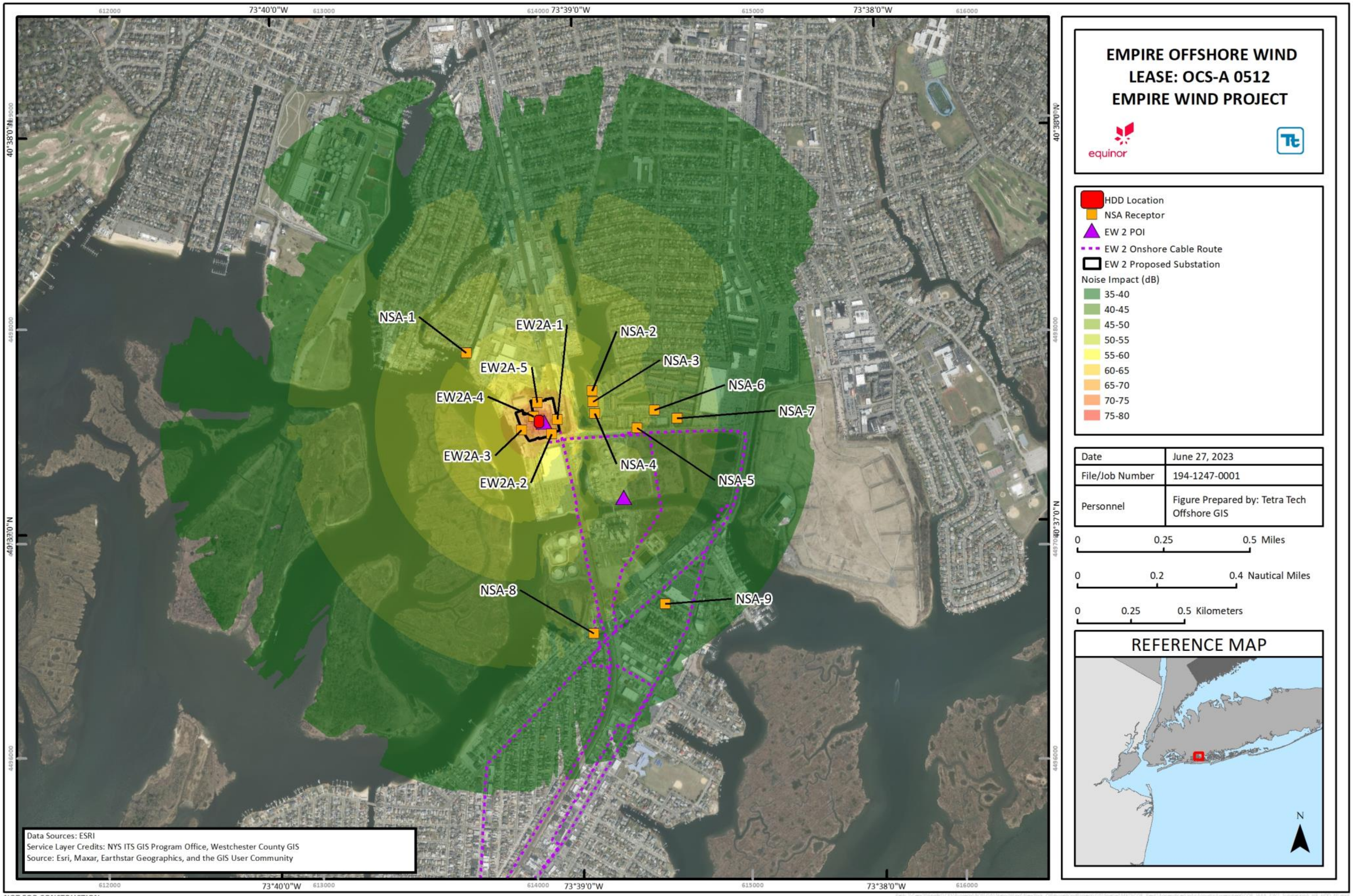

Figure L-18 EW 2 Onshore Substation A + Hampton Road Substation - HDD Contour Isopleth

L.5.1.4 Impact Pile Driving of Offshore Wind Turbine and Offshore Substation Foundations

Impact piling is performed using hammers which drive the pile 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 an increment into the ground.

Generating higher sound levels than vibratory pile driving, impact pile installation of the monopile wind turbine foundation is estimated to produce sound levels of 87 dBA in air at a distance of 400 ft (122 m) with a corresponding L_W at the source of 137 dBA (USDOT 2012). Acoustic modeling was conducted for noise produced from impact pile driving of the wind turbine monopile foundation at the shallowest and deepest representative location relative to the shoreline, as this is anticipated to represent the maximum design scenario for this activity. The separate Underwater Acoustic Assessment results can be found in **Appendix M**.

Received sound levels generated from impact pile driving during offshore foundation installation are shown in **Figure L-19**. 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 Project and coastal shorelines (approximately 14 and 17 mi [22 and 27 km]), no negative impacts are expected.

L.5.1.5 Support Vessels and Helicopters

Helicopters and vessels will transport crews and materials to the offshore Project Area during construction, and to a lesser extent during ongoing operations. 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 substation, submarine export and interarray cables and wind turbines, and their foundations will require a number of different types of construction vessels, including heavy lift vessels, cable installation and crew transport vessels. The vessels used nearshore work will have sound emissions similar to vessel 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 1981, 1975) 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, installation of the submarine export cables activities 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 submarine export cables will cause any significant impact in the communities along the shoreline. It also unlikely that helicopter noise will adversely impact onshore receptors as the helicopter flight path is predominantly offshore.

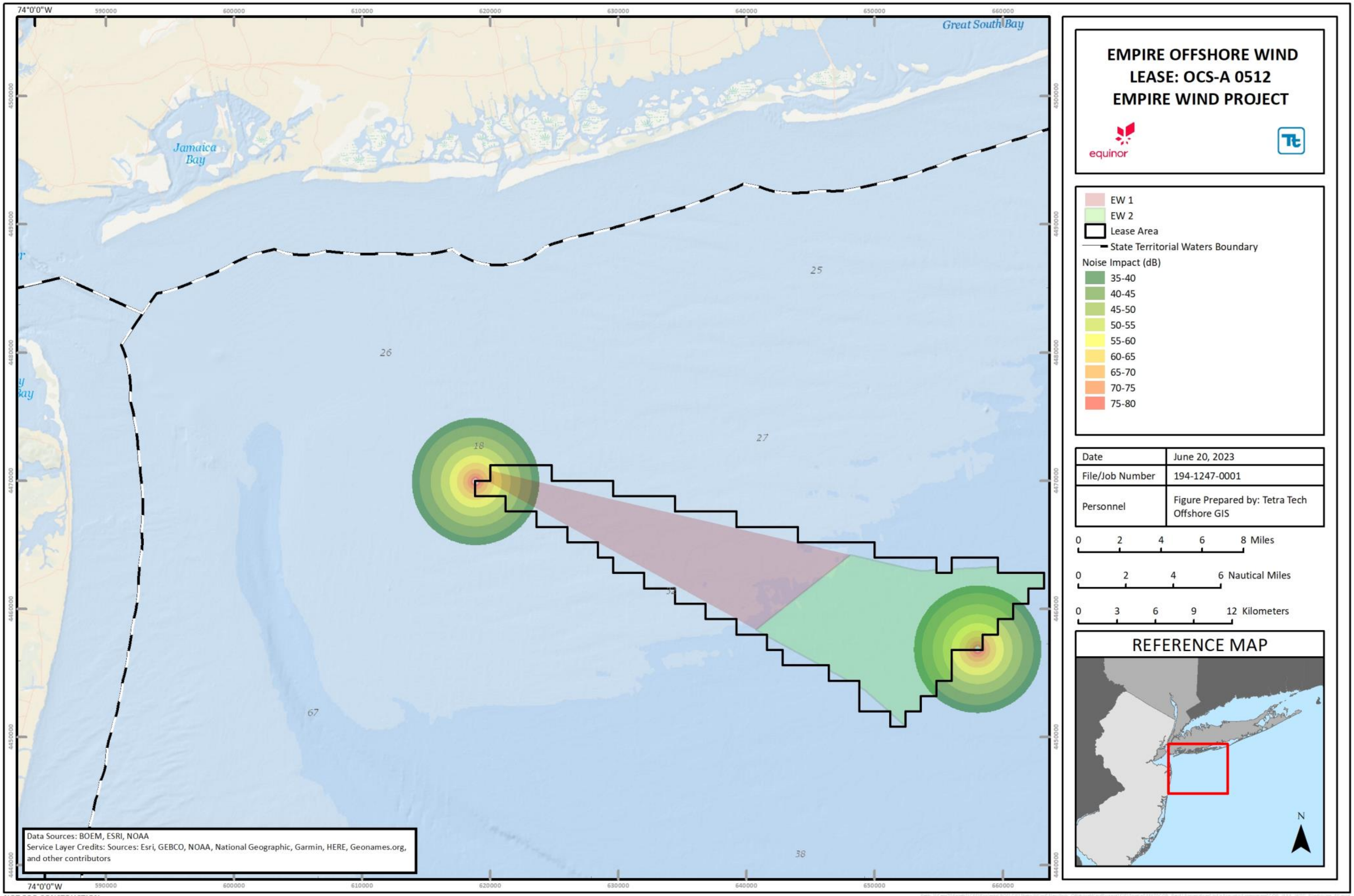

Figure L-19 Impact Pile Driving Received Sound Levels (In-Air)

L.5.2 Operational Acoustic Assessment

The operational component of the Project consists of wind turbines, two offshore substations, two onshore substations, and sound signals (i.e., foghorns). Of these sources, only the onshore substations and associated transformers and auxiliary equipment are regulated under applicable noise policy.

L.5.2.1 Offshore Wind Turbines and Substations

The expected wind turbine 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 wind turbines 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. Mechanical sound is generated at the gearbox, generator, and cooling fan, and is radiated from the surfaces of the nacelle and machinery enclosure and by openings in the nacelle casing. Due to the improved design of wind turbine mechanical components and the use of improved noise damping materials within the nacelle, including elastomeric elements supporting the generator and gearbox, mechanical sound emissions have been minimized.

Wind farms, 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 [m/s] 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 due to wind generated sound in foliage or increased sound related to waves crashing on the shoreline. In practical terms, this means a nearby receptor may hear these other sound sources (i.e., foliage, ocean waves) rather than wind turbine sound.

Wind farm operations in the offshore environment is unique due to effects related to the sound reflective nature of the surrounding water and the impact of the shoreline on sound attenuation. As sound waves reach the coastline, a modification of the ground boundary occurs, and 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 3,281 ft (1,000 m), and then increasing with distance.

In addition, sound propagation from offshore wind turbine is different than propagation from land-based wind turbines. Sound propagation over water at large distances (generally above 6,562-9,843 ft [2,000-3,000 m]) involves a completely reflective surface and is dependent on 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 wind turbines.

Offshore receptors (boaters) may be subject to higher sound levels resulting from wind turbine operations depending on their distance relative to the wind turbines, but this effect will be well below relevant OSHA health and safety requirements, even in immediate proximity of the wind turbine and offshore substation locations.

L.5.2.2 Onshore Substations

Two potential onshore substation sites were evaluated, comprised of the EW 1 and EW 2 sites. **Figure L-20**, **Figure L-21**, and **Figure L-22** describe the onshore Project features at the onshore substation sites.

- EW 1: The EW 1 onshore substation site is located in Brooklyn, New York. The onshore substation site will be located on 2nd Avenue and bounded to the north by Gowanus Bay and industrial use, to the east and south by industrial and residential use, and to the west by Gowanus Bay[2].

- EW 2 Onshore Substation A + Hampton Road Substation: The EW 2 Onshore Substation A site is located in unincorporated Oceanside, in Nassau County, New York. The EW 2 Onshore Substation A is proposed to be located at the corner of Hampton Road and Daly Boulevard. The EW 2 Onshore Substation A site is bounded to the north by commercial and residential uses; to the east by residential uses; to the south by industrial use, and to the west by Hawlett Bay. The onshore features of the Hampton Road Substation were also included in this evaluation.

- EW 2 Onshore Substation C. The EW 2 Onshore Substation C is located within the Village of Island Park, the Town of Hempstead, Nassau County, New York. The EW 2 Onshore Substation C will be located on Long Beach Boulevard. The EW 2 Onshore Substation C site is bounded primarily by commercial land uses on all sides with an existing railroad also located to the west.

.

[2] Subsequent to initial efforts, Empire refined the design of the onshore substation based on preliminary assessments and engagement with state and municipal stakeholders; therefore, the acoustic modeling was completed utilizing a refined layout. As the onshore substation design is further refined, additional modeling may be completed, as necessary, to support state and local permitting.

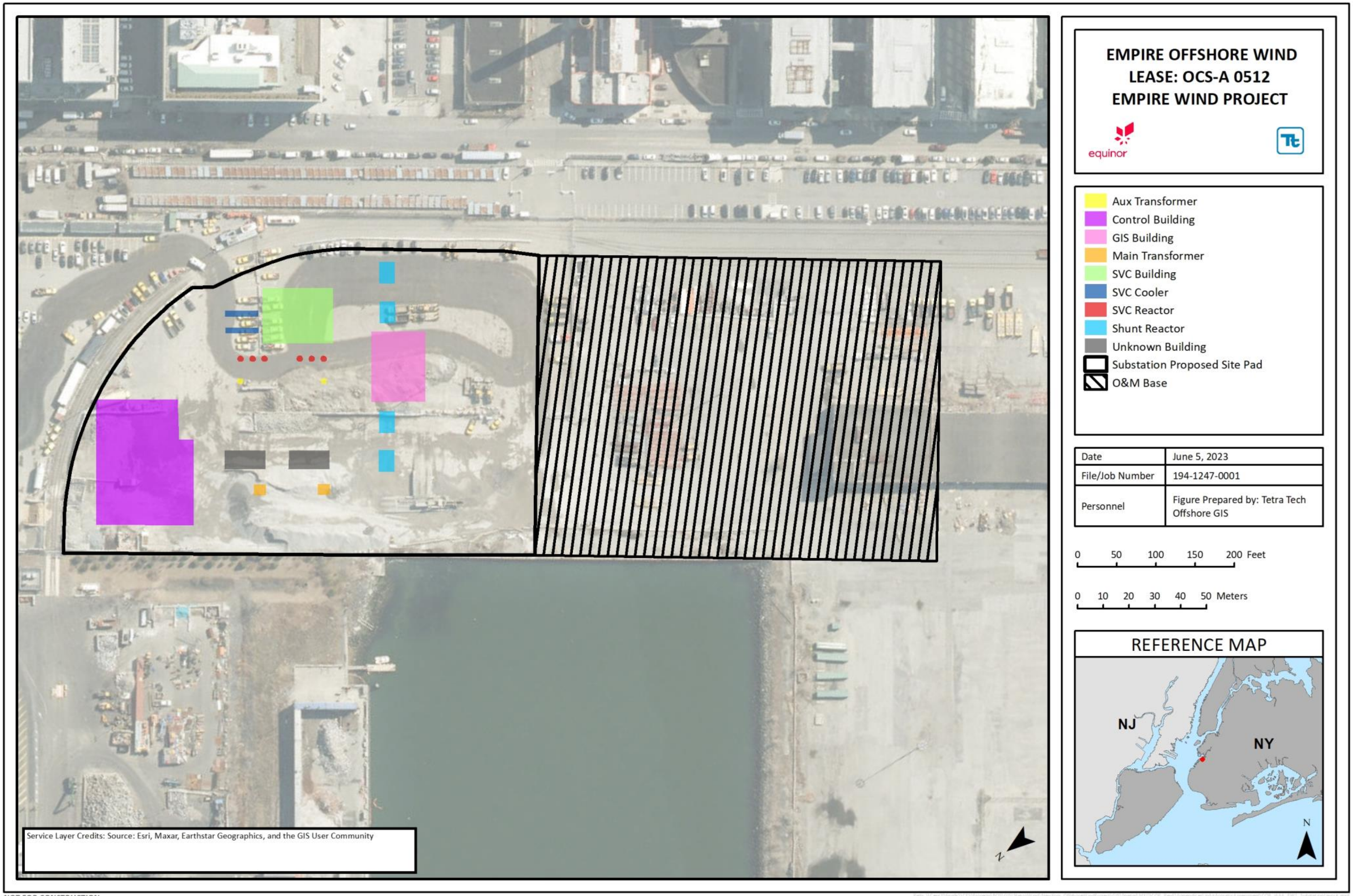

Figure L-20 EW 1 Onshore Substation – Conceptual Layout

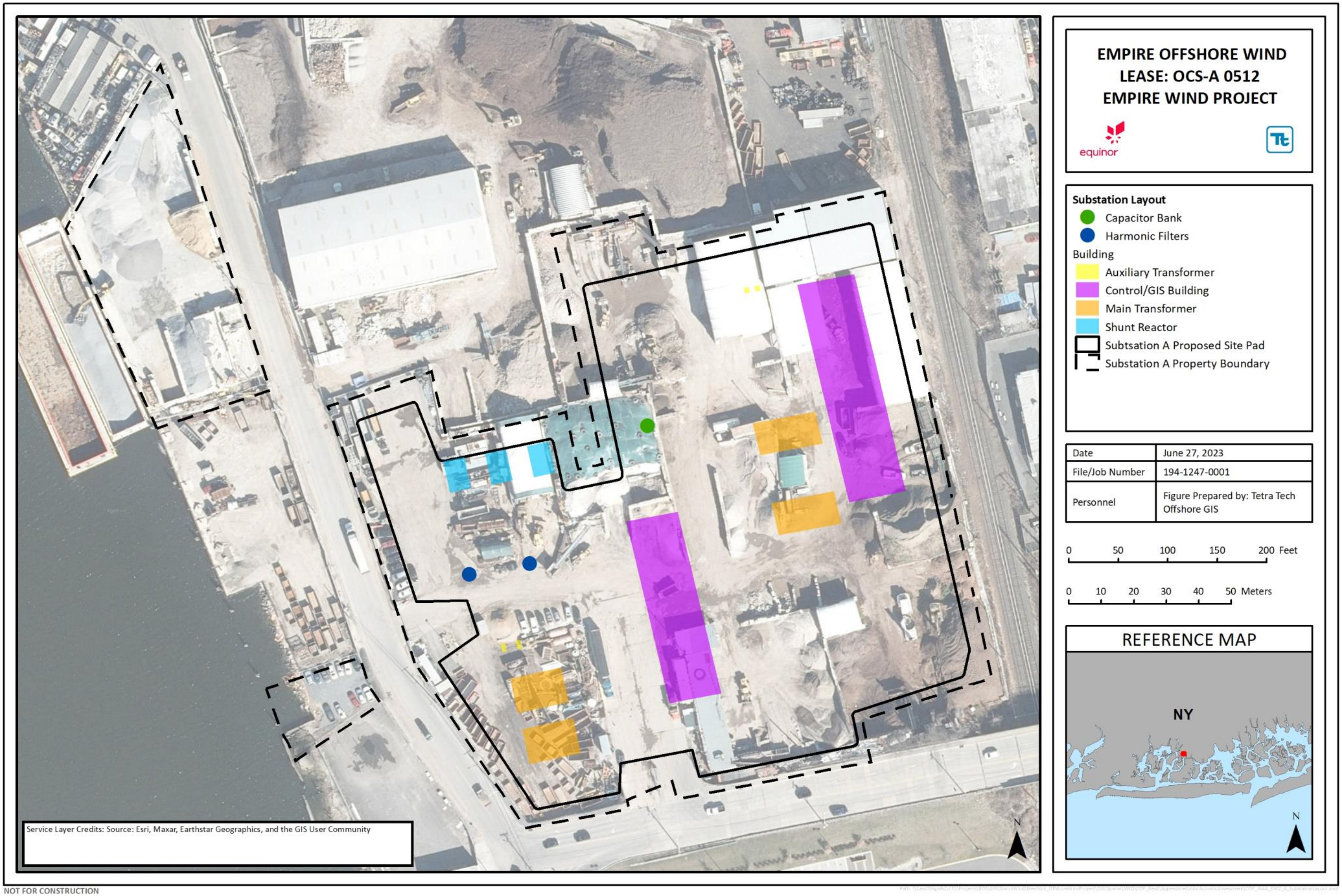

Figure L-21 EW 2 Onshore Substation A + Hampton Road Substation – Conceptual Layout

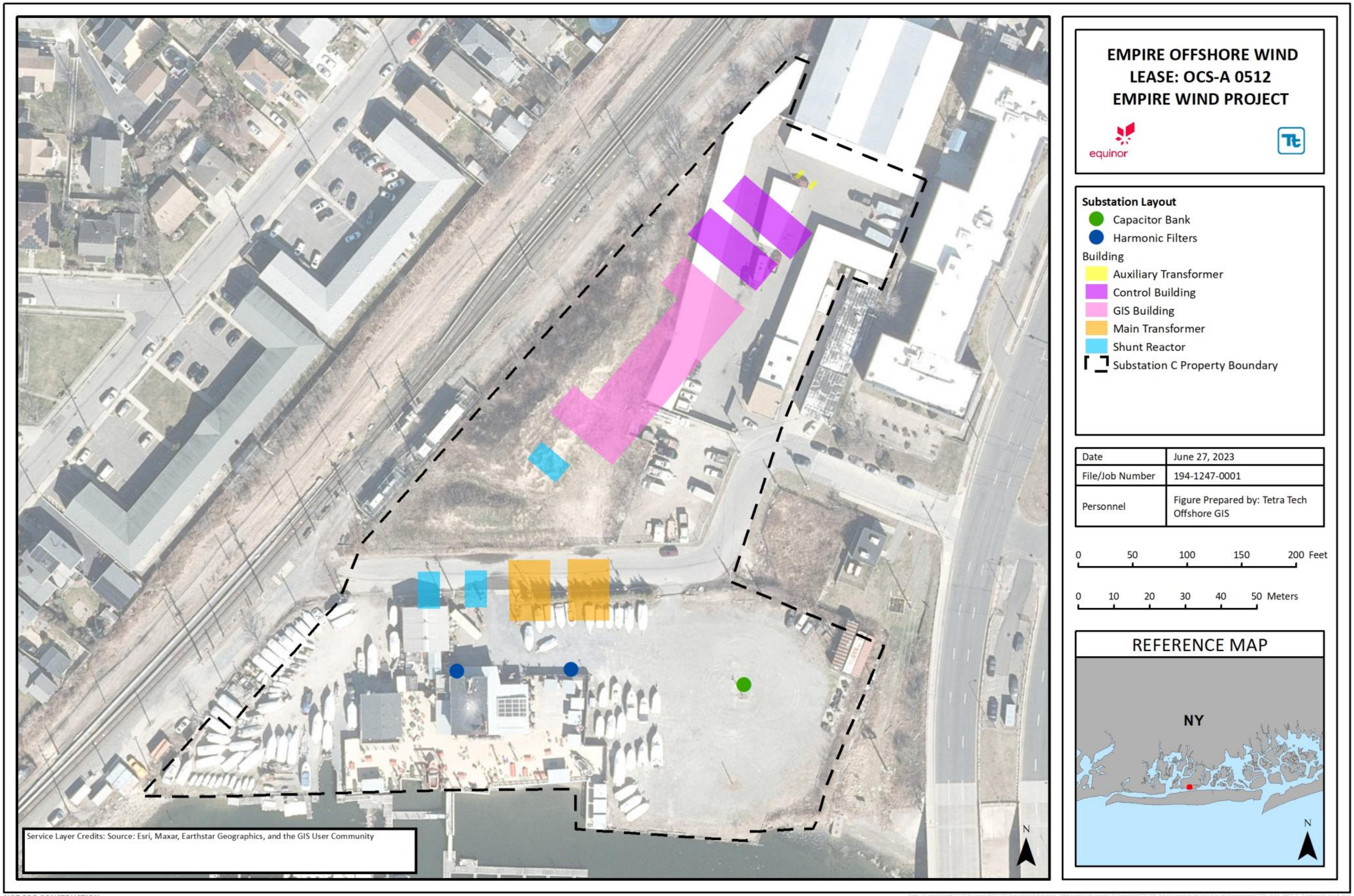

Figure L-22 EW 2 Onshore Substation C – Conceptual Layout

Electrical onshore substations have switching, protection and control equipment, as well as one or more transformers which can generate the 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, dominating in the intermediate frequency range between 100 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 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.

Transformers are designed and catalogued by kilovolt ampere or megavolt ampere ratings. Just as horsepower ratings designate the power capacity of an electric motor, a transformer's 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 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) and the 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 sound generated is primarily from vibrational forces resulting from magnetic "pull" effects at iron-air interfaces. Also, unlike transformers, operation of shunt reactors is typically intermittent, operating when voltage stabilization is needed during load variation. Both transformers and shunt reactors were included in the acoustic modeling analysis, as identified in the site plans. Circuit-breaker operations may also cause audible sound, particularly the operation of air-blast breakers, which is characterized as an impulsive sound event of very short duration and 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 engineering design is 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 based on measurements from similar equipment types. Sound modeling of onshore substation components are provided for the maximum design scenario for operations.

Empire provided a preliminary conceptual design for the EW 1 and EW 2 onshore substations, which included the site layout and number and sound power levels for the equipment (**Table L-16**). At each location, the onshore substation was modeled for maximum design scenario conditions, which included no sound screening walls and no roof for the filter building.

Table L-16 Sound Ratings of Substation Components

Project	Substation Component	Number	Sound Power Level
EW 1	450 MVA Main Transformers (Outdoor)	2	98 dBA
	150 MVAr Shunt Reactors (Outdoor)	2	95 dBA
	80 MVAr filter Shunt Reactors (Outdoor)	2	95 dBA
	80 MVAr Filter Capacitors (Indoor)	2	56 dBA
	SVC Converter (Indoor)	1	66 dBA
	SVC Reactors (Outdoor)	6	85 dBA
	SVC Coolers (Outdoor)	2	75 dBA
	Aux Transformers (Outdoor)	2	68 dBA
	Exhaust Fans (Outdoor)	6	64 dBA
	Air Handling Units (Outdoor)	6	74 dBA
EW 2 (Onshore Substation A + Hampton Road Substation)	Main Transformers (Outdoor)	4	98 dBA
	Shunt Reactors (Outdoor)	3	95 dBA
	Harmonic Filters (Outdoor)	3	95 dBA
	Capacitor Bank (Outdoor)	1	95 dBA
	Aux Transformers (Outdoor)	4	68 dBA
	Exhaust Fans (Outdoor)	12	64 dBA
	Air Handling Units (Outdoor)	12	74 dBA
EW 2 (Onshore Substation C)	Main Power Transformers	2	98 dBA
	Shunt Reactors	3	95 dBA
	AC Filter Shunt Reactors	2	95 dBA
	AC Filter Capacitors	1	95 dBA
	Auxiliary Transformers	2	68 dBA
	Exhaust Fans	8	64 dBA
	Air Handling Units	8	74 dBA

Received sound levels were evaluated at the closest NSAs to each site with resultant sound contour plots displaying operational sound levels in **Figure L-23**, **Figure L-24**, and **Figure L-25**. As shown in **Table L-17**, **Table L-18**, **Table L-19**, and **Table L-20**, compliance is demonstrated with the applicable noise policy for the EW 1 Onshore Substation, but not for the EW 2 Onshore Substation A and Hampton Road Substation or EW 2 Onshore Substation C.

Most of the applicable noise regulations consist of octave band frequency sound limits and not broadband sound limits. Compliance with those octave band sound limits is addressed by tables **Table L-18** through **Table L-20.** However, the New York City Code, which applies to the EW 1 onshore substation site, includes an incremental increase limit of 7 dBA at a receiving property relative to ambient nighttime sound levels. **Table L-18** demonstrates that the EW 1 onshore substation site will successfully demonstrate compliance with the 7-dBA incremental increase limit.

Table L-18 shows that the EW 1 onshore substation will be in compliance with New York City octave band noise limits for the M3 district and at residential receivers. Locations EQ-1, EQ-2, EQ-3, EQ-5, and EQ-6 are receptors at the onshore substation boundary and are shown to be in compliance with the M3 district limits.

Table L-19 shows that for EW 2 Onshore Substation A + Hampton Road Substation and EW 2 Onshore Substation C, there are exceedances of the Town of Hempstead's octave band frequency noise limits for steady state sound sources at the Project property boundary, as shown in **Table L-20**. Further review of the substation site layout, equipment and noise mitigation measures will be conducted to successfully demonstrate compliance with the applicable noise regulations.

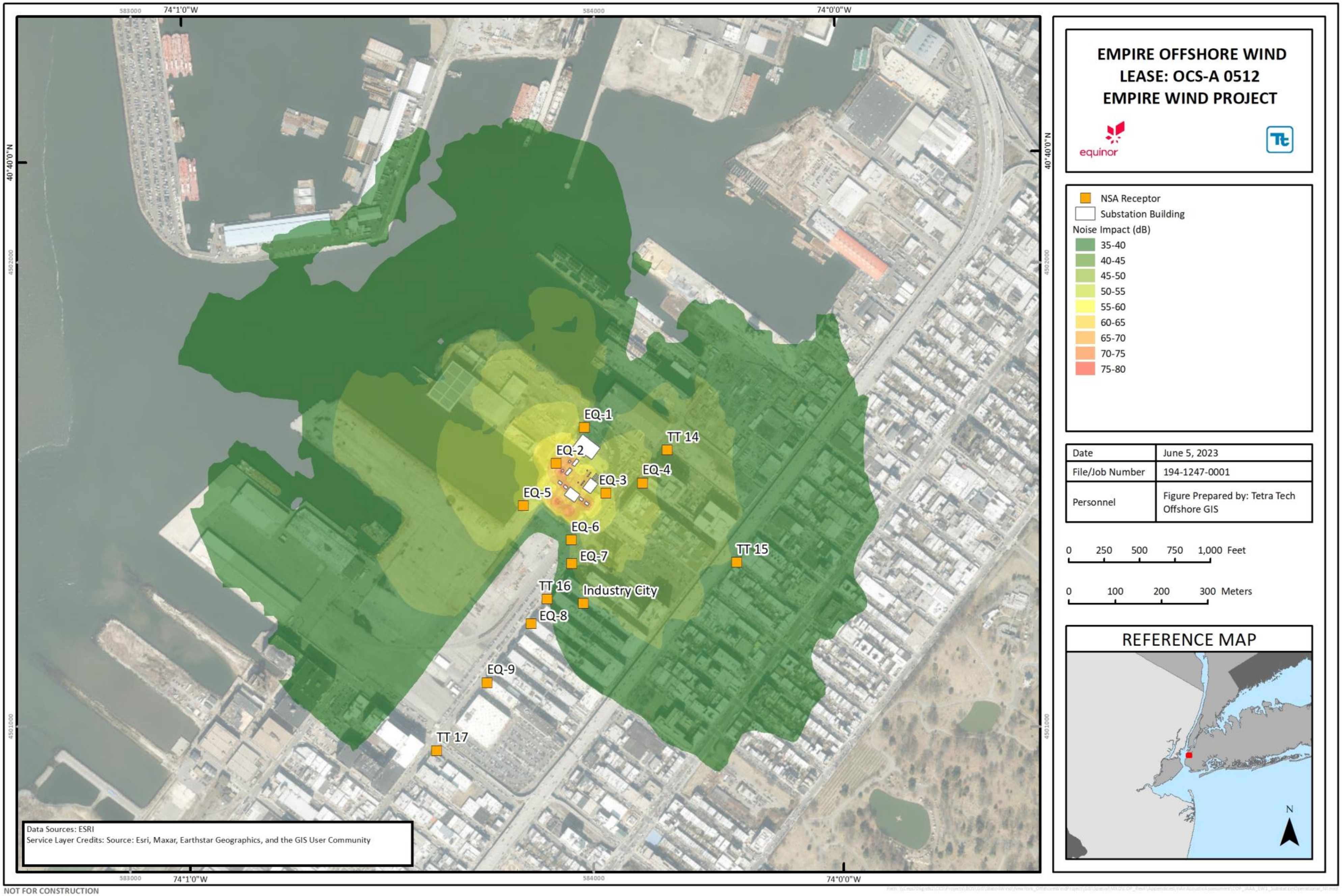

Figure L-23 EW 1 Onshore Substation Operational Sound Levels

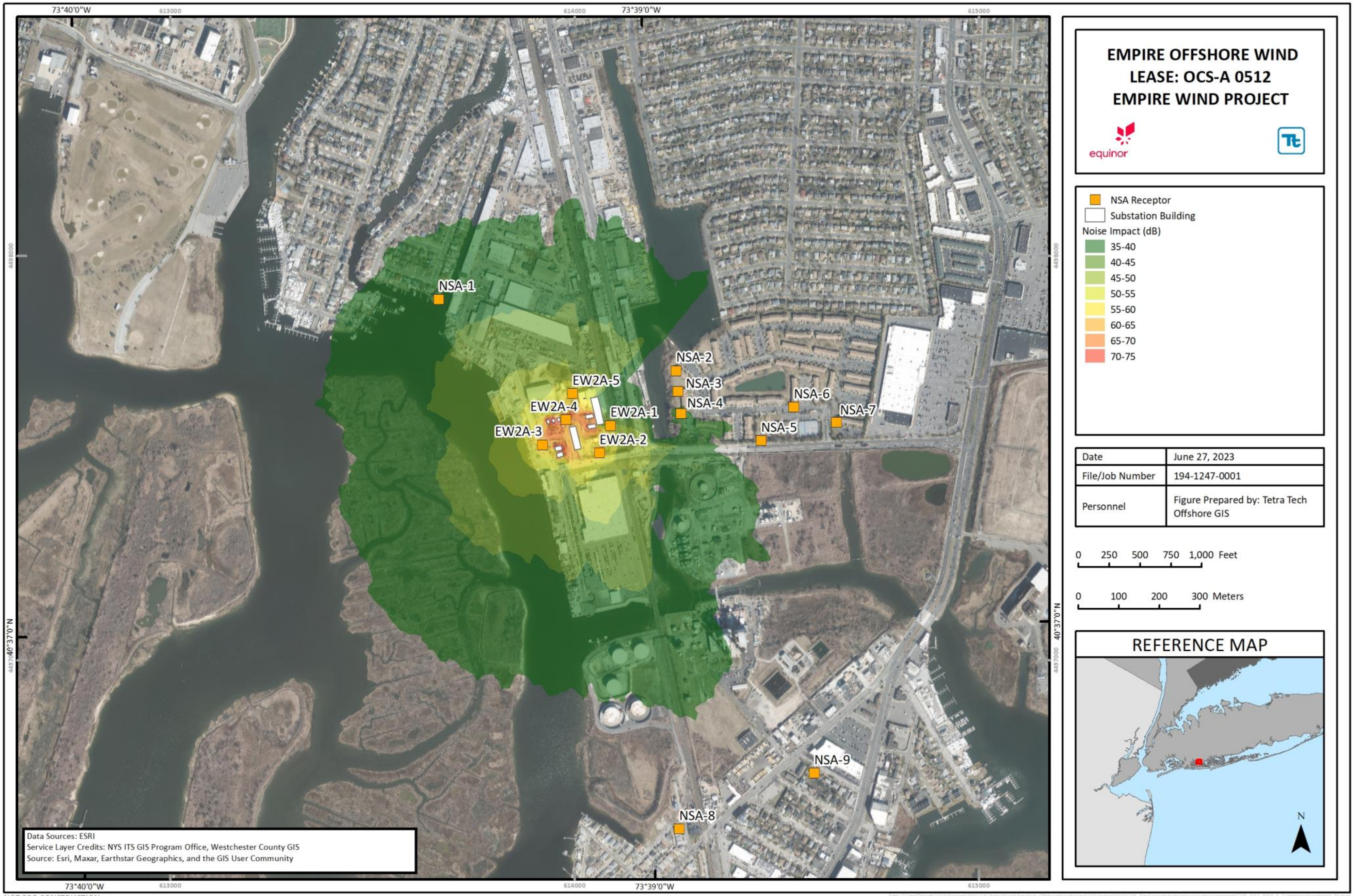

Figure L-24 EW 2 Onshore Substation A + Hampton Road Substation Operational Sound Levels (dBA)

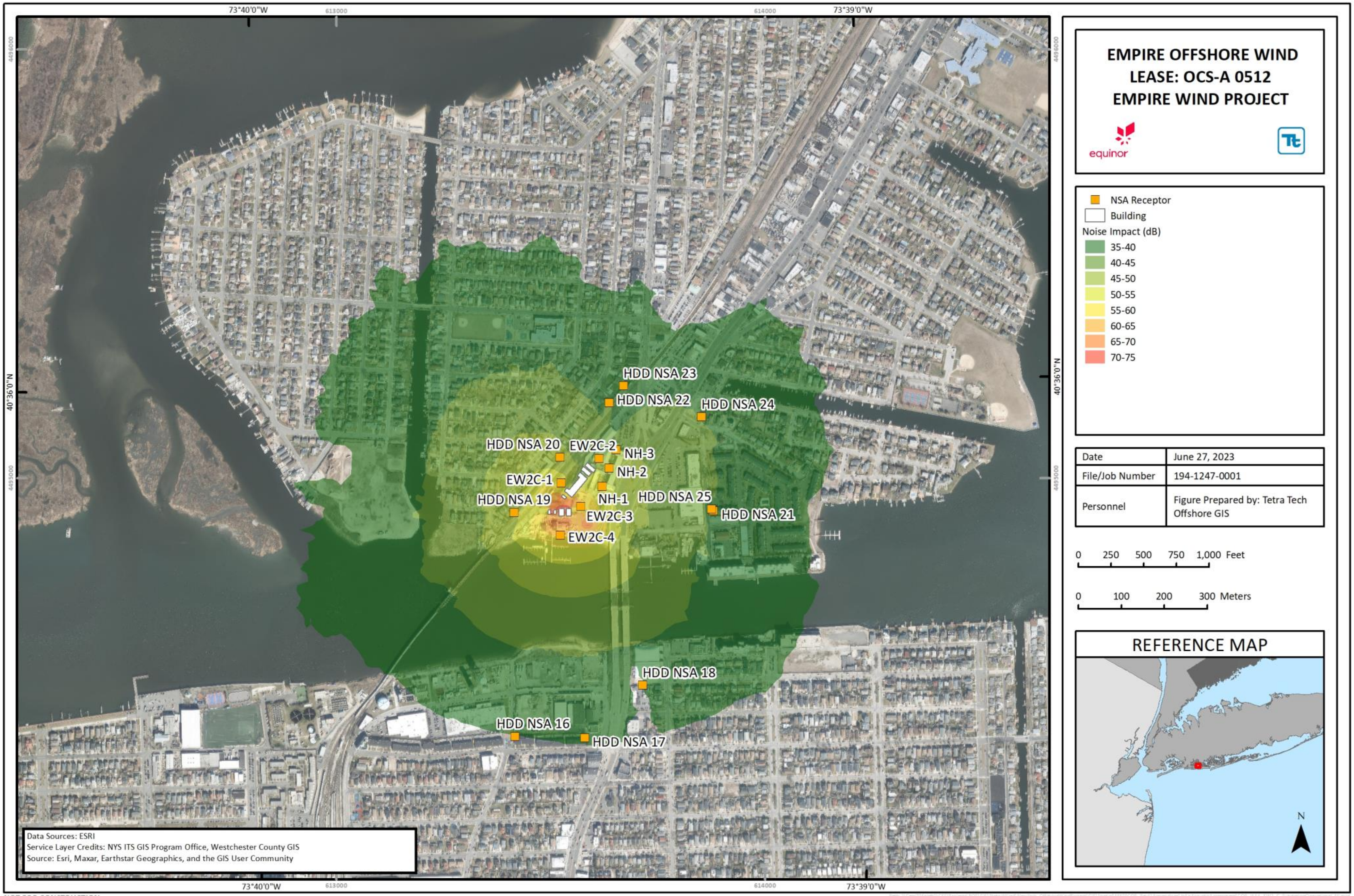

Figure L-25 EW 2 Onshore Substation C Operational Sound Levels (dBA)

Table L-17 All Onshore Substations: Predicted Nighttime L_{90} Sound Levels (dBA) at the Closest Noise Sensitive Areas

Site	Location	Distance (ft)	Nighttime Ambient Sound Level, L_{90}	Ambient Location from Table L-7	Modeling Results	Modeling Results Plus Existing Ambient	Increase Above Existing Ambient
EW 1	NSA-14	278	53	NM-1	44	53	0
	NSA-15	1,035	53	NM-1	40	53	0
	NSA-16	435	53	NM-1	34	53	0
	NSA-17	1,775	65	NM-2	25	65	0
	EQ-1 a/	0	53	NM-1	41	53	0
	EQ-2 a/	0	53	NM-1	64	64	11
	EQ-3 a/	0	53	NM-1	52	56	3
	EQ-4	137	53	NM-1	46	54	1
	EQ-5 a/	0	53	NM-1	51	55	2
	EQ-6 a/	0	53	NM-1	40	53	0
	EQ-7	162	53	NM-1	40	53	0
	EQ-8	628	53	NM-1	31	53	0
	EQ-9	1,160	53	NM-1	27	53	0
	Industry City	448	53	NM-1	39	53	0
EW 2 Onshore Substation A + Hampton Road Substation	NSA-1	372	44	NM-3	37	45	1
	NSA-2	184	44	NM-3	34	44	0
	NSA-3	177	44	NM-3	34	44	0
	NSA-4	172	44	NM-3	35	45	1
	NSA-5	355	44	NM-3	34	44	0
	NSA-6	450	44	NM-3	33	44	0
	NSA-7	549	44	NM-3	32	44	0
	NSA-8	1914	47	NM-5	29	47	0
	NSA-9	1887	47	NM-4	28	47	0
	EW2A-1 a/	0	45	SS-ST-1	48	50	5
	EW2A-2 a/	0	45	SS-ST-1	57	57	12
	EW2A-3 a/	0	45	SS-ST-1	60	60	15
	EW2A-4 a/	0	45	SS-ST-1	64	64	19
	EW2A-5 a/	0	45	SS-ST-1	55	55	10
EW 2 Onshore Substation C	HDD-NSA 19	120	40	HDD-ML-6	49	50	10
	HDD-NSA 20	140	41	HDD-ML-7	47	48	7
	HDD-NSA 21	850	41	HDD-ML-7	40	43	2

Site	Location	Distance (ft)	Nighttime Ambient Sound Level, L_{90}	Ambient Location from Table L-7	Modeling Results	Modeling Results Plus Existing Ambient	Increase Above Existing Ambient
	HDD-NSA 22	360	41	HDD-ML-7	40	44	3
	HDD-NSA 23	525	41	HDD-ML-7	39	43	2
	HDD-NSA 24	790	41	HDD-ML-7	40	43	2
	HDD-NSA 25	850	40	HDD-ML-6	40	43	3
	NH-1 b/	62	40	HDD-ML-6	51	51	11
	NH-2 b/	16	40	HDD-ML-6	48	49	9
	NH-3 b/	110	40	HDD-ML-6	45	46	6
	EW2C-1 a/	0	40	HDD-ML-6	53	53	13
	EW2C-2 a/	0	40	HDD-ML-6	46	47	7
	EW2C-3 a/	0	40	HDD-ML-6	60	60	20
	EW2C-4 a/	0	40	HDD-ML-6	60	60	20

Notes:
a/ Onshore substation boundary location
b/ NH = Nursing Home

Table L-18 EW 1 Onshore Substation: Tonal L_{90} Sound Levels (dB) at the Closest Noise Sensitive Areas

Maximum Permitted Sound Pressure Level (in dB)			EW 1 Octave Band Sound Pressure Level (dB)										
Octave Band (cycles per second)	District M3	Limits for Residential Property Receiver	NSA-14	NSA-15	NSA-16	NSA-17	EQ-1 a/	EQ-2 a/	EQ-3 a/	EQ-4	EQ-5 a/	EQ-6 a/	EQ-7
20 to 75	80	70	49	45	41	35	51	67	56	51	54	47	46
75 to 150	75	61	50	46	41	35	50	69	58	52	56	46	46
150 to 300	70	53	45	41	35	27	43	64	52	47	51	40	41
300 to 600	64	46	44	40	34	24	40	64	52	46	50	39	40
600 to 1,200	58	40	37	33	27	15	31	58	46	39	44	33	34
1,200 to 2,400	53	36	30	25	20	5	24	53	40	34	38	27	28
2,400 to 4,800	49	34	21	12	10	0	15	47	34	26	31	19	19
Above 4,800	46	33	0	0	0	0	2	38	23	8	14	5	1
		Average (dBA)	44	40	34	25	41	64	52	46	51	40	40

Note:
a/ Onshore substation boundary location

Table L-18 EW 1 Onshore Substation: Tonal L_{90} Sound Levels (dB) at the Closest Noise Sensitive Areas (Continued)

Maximum Permitted Sound Pressure Level (in dB)			EW 1 Octave Band Sound Pressure Level (dB)							
Octave Band (cycles per second)	District M3	Limits for Residential Property Receiver	EQ-8	EQ-9	Industry City	NSA-18	NSA-19	NSA-20	NSA-21	NSA-22
20 to 75	80	70	40	37	44	37	37	39	35	33
75 to 150	75	61	39	36	45	41	40	44	41	39
150 to 300	70	53	32	28	40	42	40	45	42	40
300 to 600	64	46	31	26	39	36	34	40	36	34
600 to 1,200	58	40	24	18	33	35	32	39	35	33
1,200 to 2,400	53	36	17	9	26	28	25	32	27	25
2,400 to 4,800	49	34	5	0	16	21	18	24	17	14
Above 4,800	46	33	0	0	0	6	5	9	0	0
		Average (dBA)	31	27	39	35	32	39	35	33

Table L-19 EW 2 Onshore Substation A + Hampton Road Substation: Tonal L_{90} Sound Levels (dB) at the Closest Noise Sensitive Areas

Octave Band Center Frequency (Hz)	Octave Band Sound Pressure Level (dB) Limit	Octave Band Sound Pressure Level (dB)													
		NSA-1	NSA-2	NSA-3	NSA-4	NSA-5	NSA-6	NSA-7	NSA-8	NSA-9	EW2 A-1 a/	EW2 A-2 a/	EW2 A-3 a/	EW2 A-4 a/	EW2 A-5 a/
63	72	46	45	46	47	44	43	42	39	39	55	61	63	68	59
125	67	43	43	43	44	41	40	39	35	35	55	63	65	69	61
250	59	36	34	34	36	34	33	32	29	28	48	57	60	64	55
500	52	37	32	33	34	33	32	31	28	28	47	57	59	64	55
1,000	46	32	26	26	28	27	26	25	22	22	41	51	53	58	49
2,000	40	24	17	17	20	19	17	16	11	11	35	45	48	53	43
4,000	34	9	3	4	6	1	0	0	0	0	27	38	42	47	36
8,000	32	0	0	0	0	0	0	0	0	0	15	24	31	37	24
	Average (dBA)	37	34	34	35	34	33	32	29	28	48	57	60	64	55

Note:
a/ Onshore substation boundary location

Table L-20 EW 2 Onshore Substation C: Tonal L_{90} Sound Levels (dB) at the Closest Noise Sensitive Areas

Octave Band Center Frequency (Hz)	Octave Band Sound Pressure Level (dB) Limit	Octave Band Sound Pressure Level (dB)													
		HDD-NSA 19	HDD-NSA 20	HDD-NSA 21	HDD-NSA 22	HDD-NSA 23	HDD-NSA 24	HDD-NSA 25	NH-1 a/	NH-2 a/	NH-3 a/	EW2C-1 b/	EW2C-2 b/	EW2C-3 b/	EW2C-4 b/
63	72	55	54	48	48	47	47	48	57	54	51	58	51	63	63
125	67	55	53	46	47	46	46	46	57	54	51	59	51	65	65
250	59	48	45	38	39	38	39	38	50	47	44	53	46	60	60
500	52	48	46	39	39	38	39	39	50	48	44	53	45	59	60
1,000	46	44	41	34	34	33	34	34	45	42	39	47	39	53	54
2,000	40	38	36	27	27	26	27	27	40	36	33	41	33	48	49
4,000	34	30	28	15	16	12	13	15	32	28	23	34	27	41	43
8,000	32	14	9	0	0	0	0	0	16	9	2	21	17	30	32
	Average (dBA)	49	47	40	40	39	40	40	51	48	45	53	46	60	60

Notes:
a/ NH = Nursing Home
b/ Onshore substation boundary location

L.5.2.3 Sound Signals

Sound signals (i.e., fog horns) will be installed on select wind turbines along the outer perimeter of the Lease Area. Due to the large separation of distances of the sound signals to the nearshore environment, the sound level will be below the threshold of perception.

Requirements as detailed in 33 Code of Federal Regulations § 67, which calls for a foghorn to be installed less than 150 ft (46 m) above mean sea level with a sound signal audible to 0.5 nm (0.9 km). 33 Code of Federal Regulations § 67 also requires the foghorn emit a tone of 119.8 dB at a frequency of 822 Hz that will sound for a period of two seconds during a 20 second cycle (18 seconds silence). Using CadnaA, sound levels were modeled at the closest wind turbine to the shoreline. Results show that under standard downwind propagation conditions received sound levels generated by the foghorn are expected to attenuate to a less than perceivable level onshore.

L.6 CONCLUSIONS

In-air acoustic modeling was conducted for the Project in order to assess the potential noise impacts associated with construction and operations activities. The modeling analysis was conducted using the parameters and methodology described in Sections 4 and 5 of this report. Results are displayed in the form of sound contour plots with Project-generated sound levels 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 clearing, excavation, foundation, erection, and finishing phases for onshore export and interconnection cable, onshore substation, and O&M Base construction. Construction noise will primarily be limited to daytime hours. If required, noise mitigation will be used to minimize offsite noise impacts to the extent practicable pending engagement with regulatory agencies and other stakeholders, as applicable.

Pile driving activities were analyzed for the EW 1 and EW 2 onshore substations, as well as the substation bulkhead. Pile driving activities will occur during daytime hours, but the modeling results show that there may be exceedances of section 24-228 of the NYC Code, which allows for an increase of up to 15 dBA above the ambient sound level. Pile driving will be temporary and short-term and the Applicant will minimize offsite impacts to the extent practicable using potential mitigating technologies. Examples of potential technologies are temporary nose barriers, pile cap/cushion, trenching, and/or nose shrouds installed in proximity to pile driving.

Vibratory pile driving for construction of nearshore cofferdams has been analyzed at the EW 1 and EW 2 export cable landfall locations. Noise levels from the vibratory pile driving will reach 77 dBA at the EW 1 shore, and 64 dBA at the worst-case EW 2 shore. 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 export cables will require HDD operations at the associated export cable landfalls. HDD will also be needed in association with the EW 2 onshore export and interconnection cables. The HDD nighttime levels could reach 58 dBA at the EW 1 location, and 86 dBA at the worst-case EW 2 location. If any noise issues are identified, moveable temporary noise barriers can be erected with placement as close to the sound sources as possible, which have been shown to effectively reduce sound levels by 5 to 15 dBA.

Impact pile driving will also occur during the construction phase to install the wind turbines and offshore substation foundations. The highest predicted received sound level at any onshore location during offshore pile driving is less than 30 dBA, which is well below all applicable noise regulations. Given the extended distances between the coastal shoreline, approximately 14 mi (22 km), no impacts are expected.

Onshore substation operational impacts were evaluated at the EW 1 and EW 2 sites. Sound levels associated with the onshore substations will be in compliance with each location's applicable noise regulations with the exception of EW 2 Onshore Substation A + Hampton Road Substation and EW 2 Onshore Substation C. Further review of design and acoustic analysis will be conducted to successfully demonstrate compliance at all NSAs.

L.7 REFERENCES

ANSI (American National Standards Institute). 2006. ANSI/ASA Standard S1.4-2006: American National Standard Specification for Sound Level Meters.

ANSI. 2013. 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. 2016. S1.42-2001 (R2016) Design Response of Weighting Networks For Acoustical Measurements.

DataKustik GmbH. 2017. Computer-Aided Noise Abatement Model CadnaA, Version 2019 MR1 [64 Bit] build 163.4824. Munich, Germany, 2018.

EPA (U.S. Environmental Protection Agency). 1971. Noise from Construction Equipment and Operations, Building Equipment and Home Appliances, NTID-200.1, 1971.

ISO (International Organization for Standardization). 1993. ISO 9613-1, Acoustics—Sound attenuation during propagation outdoors, Part 1: Calculation of the absorption of sound by the atmosphere.

ISO. 1996. ISO 9613-2, Acoustics—Attenuation of sound during propagation outdoors Part 2: General method of calculation.

IMO (International Maritime Organization). 1975. Resolution A.343 (IX), Recommendations on methods of measuring noise levels at listening ports.

IMO. 1981. Resolution A.486 (XII). Code on Noise Levels on Board Ships: Code on Noise Levels on Board Ships and Recommendations on Methods of Measuring Noise Levels at Listening Posts.

Johansson, L. 2003. Sound propagation around offshore wind turbines - Long range parabolic equation calculations for Baltic Sea conditions. Stockholm: KTH Department of Civil and Architectural Engineering Division of Building Technology. NEMA (National Electrical Manufacturers Association). 1993. NEMA Standards Publication No. TR 1-1993 (R2000) Transformers, Regulators and Reactors.

NYSDEC (New York Department of Environmental Conservation). 2001. Assessing and Mitigating Noise Impacts.

USDOT (U.S. Department of Transportation). 2012. "High-Speed Ground Transportation Noise and Vibration Impact Assessment". September 2012.