Appendix K. Memo

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Subject: Underwater Acoustic Modeling of Drilling Activities During Pile Installation for New England Wind

K.1. Introduction

Park City Wind (the Proponent) is planning on the use of drilling to aid in foundation installation for the New England Wind Project. The Proponent has assessed the potential for impacts to marine fauna (marine mammals, sea turtles, and fish) from drilling activities during pile installation, and found impacts to fish to be unlikely, but impacts to marine mammals and sea turtles a possibility.

It is unclear whether the sound emitted by marine drilling activities is likely to impact the behavior of fish. McCauley (1998) determined that any effects to fish from sounds produced by marine drilling activity would likely be temporary behavioral changes within a few hundred meters of the source. For instance, measured source levels during drilling operations reached 120 dB at 3–5 km, which may have caused fish avoidance (McCauley 1998). The available literature suggests that continuous sound produced by drilling operations may mask acoustic signals of fish that convey important environmental information (McCauley 1994, Popper et al. 2014). Recordings of planktivorous fish choruses showed that the fish were still active during drilling operations off the coast of the Timor Sea; however, it is likely that partial masking of their calls would have occurred (McCauley 1998).

There are no data to support a clear link between anthropogenic sound and permanent injury or mortality in fish, particularly with non-impulsive sound sources (Popper and Hawkins 2019). Continuous sound has been linked to temporary threshold shift (TTS) in some species of fish; however, exposure times to these sounds were at least 12 hours (Amoser and Ladich 2003, Smith et al. 2006). The sounds emitted by marine drilling operations for wind farm construction are expected to be short-term and intermittent. It is therefore unlikely that the acoustic characteristics of this source will cause prolonged acoustic masking to fish, and the risk of impact from this activity is expected to be low.

Potential impacts to marine mammals and sea turtles from underwater sound exposure produced by drilling operations could include changes in behavior and auditory injury (permanent threshold shift [PTS]) at distances close to the sound source. This Memo provides a quantitative assessment of these potential impacts from drilling activity during pile installation for New England Wind.

K.2. Methods

K.2.1. Modeled Locations

Sound fields from drilling activities were modeled at three representative locations in the Lease Area (M1, M2, and J1) as depicted in Figure 1 and Table 1. These modeling locations were selected as they represent the range of water depths in the Lease Area. Acoustic modeling assumed that drilling activity could occur for a full 24 hours during any given day. Although it is not expected that drilling would be required up to 24 hours, all modeling results in this report reflect this duration and is assumed to be most conservative.

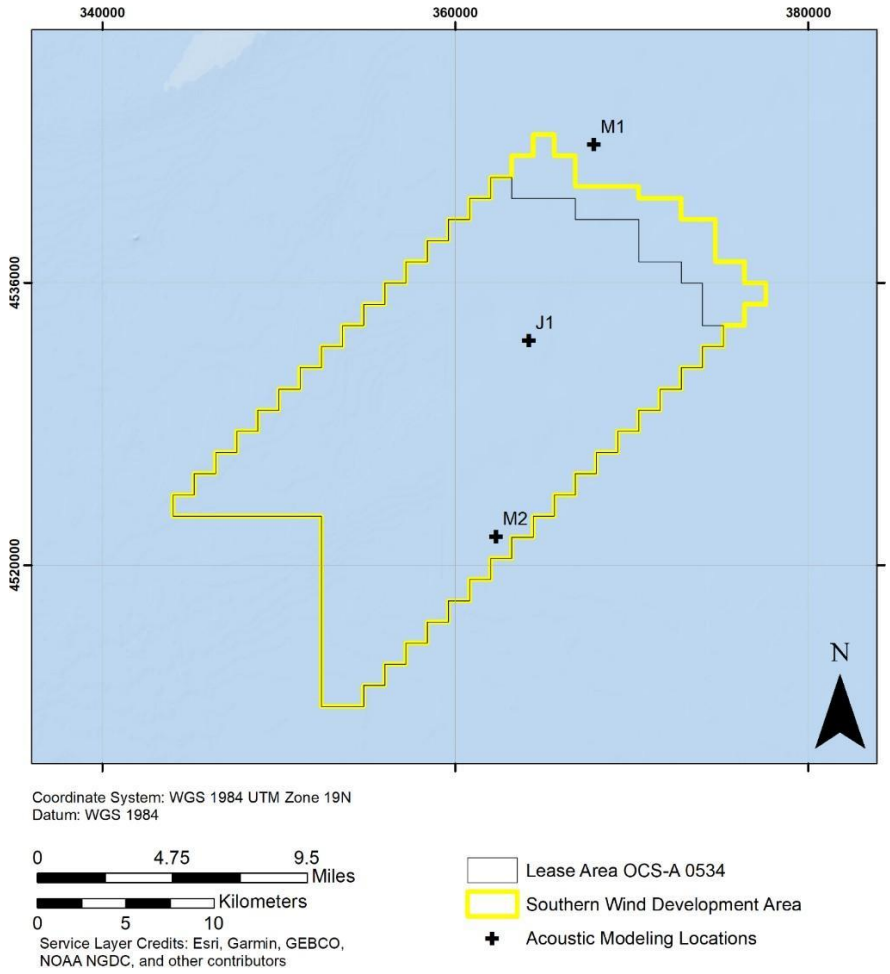

Figure 1. Drilling acoustic modeling locations relative to the Lease Area OCS-A 0534 and the Southern Wind Development Area (SWDA).

Table 1. Propagation modeling sampling locations used for drilling activity.

Modeling location[1, 2]	Latitude	Longitude	Depth (m)
M1	41.035501217	−70.571798180	44
M2	40.834461320	−70.632933892	52
J1	40.934831948	−70.613405411	53

[1] These drilling acoustic modeling locations correspond to the locations that were also used for modeling of impact pile driving. M1 and M2 represent monopile locations and J1 represents a jacket foundation location.

K.2.2. Evaluation Criteria

Injury to the hearing apparatus of marine mammals may result from a fatiguing stimulus measured in terms of the sound exposure level (SEL), which considers the sound level and duration of the exposure signal. A permanent threshold shift (PTS) in hearing may be considered injurious, but there are no published data on the sound levels that cause PTS in marine mammals. There are, however, data that indicate the received sound levels at which temporary threshold shift (TTS) occurs, and PTS onset can be extrapolated from TTS onset level and an assumed growth function (Southall et al. 2007). In 2018, the National Oceanographic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) issued a Technical Guidance document (NMFS 2018) that incorporated the best available science to estimate PTS onset thresholds in marine mammals from sound energy, SEL, accumulated over 24 hours.

NMFS (2018) also provided guidance on using weighting functions to adjust the received sound levels according to the hearing sensitivity of the animals. Acoustic criteria and weighting function application are divided into functional hearing groups (low-, mid-, and high-frequency cetaceans and phocid pinnipeds) that species are assigned to base on their respective hearing frequency ranges. Table 2 shows hearing group frequency ranges that are used to define the auditory weighting function, and Table 3 shows the hearing group thresholds.

After numerous studies on marine mammal behavioral responses to sound exposure there is still no consensus in the scientific community regarding the appropriate metric for assessing behavioral reactions. NMFS currently uses behavioral response thresholds of 120 dB re 1 µPa for continuous sounds for all marine mammal species (NMFS 2018) based on observations of mysticetes (Malme et al. 1983, 1984, Richardson et al. 1986, 1990).

Injury and behavioral thresholds for sea turtles were developed for use by the US Navy (Finneran et al. 2017) based on exposure studies (e.g., McCauley et al. 2000). The behavioral threshold recommended in the GARFO acoustic tool (GARFO 2020) is an SPL of 175 dB re 1 µPa (McCauley et al. 2000, Finneran et al. 2017).

Marine mammals and sea turtles were considered static receivers. Acoustic distances where sound levels could exceed marine mammal (NMFS 2018) and sea turtle (Finneran et al. 2017) thresholds were determined using a maximum-over-depth approach.

Table 2. Marine mammal hearing groups and frequency ranges (Sills et al. 2014, NMFS 2018).

Faunal group	Generalized hearing range [a]
Low-frequency (LF) cetaceans (mysticetes or baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (odontocetes: delphinids, beaked whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (other odontocetes)	275 Hz to 160 kHz
Phocid pinnipeds in water (PPW)	50 Hz to 86 kHz

[a] The generalized hearing range is for all species within a group. Individual hearing will vary.

Table 3. Summary of permanent threshold shift onset acoustic thresholds for marine mammals exposed to continuous sound sources (NMFS 2018).

Faunal group	Frequency-weighted $L_{E,24hr}$ (dB re 1 µPa^2·s)
Low-frequency (LF) cetaceans	199
Mid-frequency (MF) cetaceans	198
High-frequency (HF) cetaceans	173
Phocid pinnipeds in water (PPW)	201
Sea turtles	220

K.2.3. Source and Propagation Modeling

The Proponent is not aware of acoustic measurements of very large rotational drills specifically for this purpose, but comprehensive measurements of large seabed drills are available from projects in the Alaskan Chukchi and Beaufort Seas. In particular, measurements were made during use of mudline cellar drilling with a 6 m diameter bit (Austin et al. 2018). The mudline cellar is a circular area centered on an oil or gas well on the seabed for the purpose of placing well heads and blow-out preventers below the seafloor elevation. Mudline cellars are important in shallow arctic waters, where deep ice keels can destroy equipment that sits above the seafloor grade. Austin et al. (2018) measured sound pressure level (SPL) for three mobile drilling units at 1000 m and estimated their broadband source levels. Here, the average source level of these mobile drilling units is used as representative source spectrum of broadband drilling activity.

The mudline cellar drilling in the Chukchi Sea was measured at a site with a 46 m water depth, which is similar to the average depth of the New England Wind area. Seabed sediment geoacoustic properties differ: the Chukchi Sea drilling site had softer surface sediments with a 14.5 m thick top layer of a constant sound speed of 1630 m/s and a density of 1.45 g/cm^3, overlying more consolidated sediments with a sound speed of 2384 m/s and a density of 2.32 g/cm^3. By comparison, New England Wind surficial sediments are expected to be predominantly sand, based on samples from nearby study sites. Table 5 shows the sediment layer geoacoustic property profile based on the sediment type derived from measurements of geoacoustic parameters and determined empirical relationships between them (Ainslie 2010). Overall, the Chukchi Sea surface sediments have a slightly lower sound speed and lower density than the New England Wind site, with similar sound speeds at depth. Overall, the acoustic reflectivity at lower frequencies is expected to be similar between these sites. The ocean sound speed profiles at both the Chukchi and New England Wind sites are slightly downward refracting in summer (which is when the measurements were taken for Austin et al. (2018)).

A separate modeling study that included mudline cellar drilling was performed to predict noise footprints of that operation in the Chukchi Sea (Quijano et al. 2019). This modeling study found the 120 dB re µPa SPL threshold occurred at a distance of 16 km, which included noise from several vessels near the drill site on dynamic positioning.

We assumed that pile installation drilling produces similar sound levels as mudline cellar drilling, and, as a conservative measure, we averaged the three representative source levels estimated by Austin et al. (2018) for the 10–32,000 Hz band.' The average source level shown below have a broadband level of 191.6 dB re 1 µPa^2·s m^2.

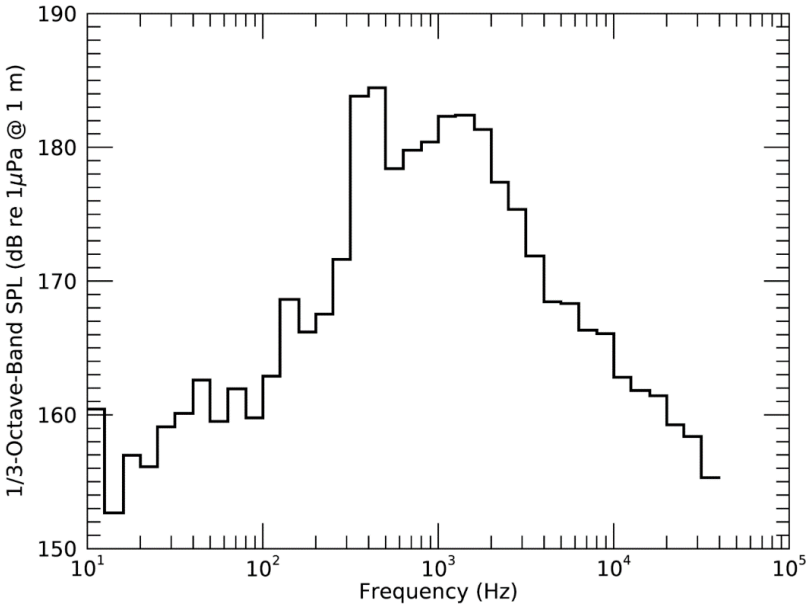

Figure 2. Decidecade band source levels averaged across three sources for drilling and excavation of mudline cellars (Austin et al. 2018).

JASCO's Marine Operations Noise Model (MONM) was used to predict SEL and SPL sound fields up to 1 kHz at a representative location near the proposed drilling sites considering the influence of bathymetry, seabed, water sound speed, and water attenuation. MONM uses a wide-angle parabolic equation solution to the acoustic wave equation (Collins 1993) based on a version of the US Naval Research Laboratory's Range-dependent Acoustic Model (RAM), which has been modified to account for a solid seabed (Zhang and Tindle 1995). From 1 to 25 kHz, the Bellhop ray tracing model (Porter and Liu 1994) was used to predict sound fields at the same representative location using from 2512 to 5012 geometric beams, increasing the beam coverage with frequency. The total sound energy transmission loss was computed at the center frequencies of decidecade bands as a function of range and depth from the source. Bellhop-MONM accounts for sound attenuation due to energy absorption through ion relaxation and viscosity of water in addition to acoustic attenuation due to reflection at the medium boundaries and internal layers (Fisher and Simmons 1977). The former type of sound attenuation is important for frequencies higher than 5 kHz and cannot be neglected without noticeably affecting the model results. The drill was represented as a point source in mid-water column at each site. The mid-water depth is a conservative representation of the noise source across the drill bit. The acoustic field in three dimensions was generated by modeling two-dimensional (2-D) vertical planes radially spaced at 2.5° in a 360° swath around the source (*N* x 2-D). Composite broadband received SEL were computed by summing the received decidecade band levels across frequency and taking the maximum-over-depth. Major modeling assumptions are listed in Table 4 and the estimated geoacoustic properties used for modeling are listed in Table 5.

Table 4. Major assumptions used in underwater acoustic modeling of relief drilling during piling.

Parameter	Value	Reference (if applicable)
JASCO Applied Sciences		
Drill	6 m drill bit, mudline cellar excavation	Austin et al. (2018)
New England Wind		
Bathymetry		US Coastal Relief Model, National Centers for Environmental Information NOAA (September 2010). (NGDC 2003)
Sound speed	Regionally and seasonally [a] averaged profiles	GDEM v-3.0 (NAVO 2003)
Geoacoustics	Elastic seabed properties based on client-supplied description of seabed layering	Ainslie (2010). See Table 5.

[a] Sound speed was converted to mean summer (June to August) profile.

Table 5. Estimated geoacoustic properties used for modeling, as a function of depth. Within an indicated depth range, the parameter varies linearly within the stated range.

Depth below seafloor (m)	Material	Density (g/cm³)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	Speed (m/s)	Attenuation (dB/λ)
0–5.0	Sand	2.086–2.093	1761–1767	0.88–0.879	300	3.65
5.0–10.0		2.093–2.099	1767–1774	0.879–0.877		
10.0–15		2.099–2.106	1774–1780	0.877–0.876		
15–65		2.106–2.172	1780–1842	0.876–0.861		
65–115		2.172–2.235	1842–1901	0.861–0.843		
115–240		2.235–2.382	1901–2034	0.843–0.790		
240–365		2.382–2.513	2034–2150	0.790–0.730		
365-615		2.513-2.719	2150-2342	0.730-0.616		
615-865		2.719-2.845	2342-2500	0.616-0.541		
>865		2.845	2500	0.541		

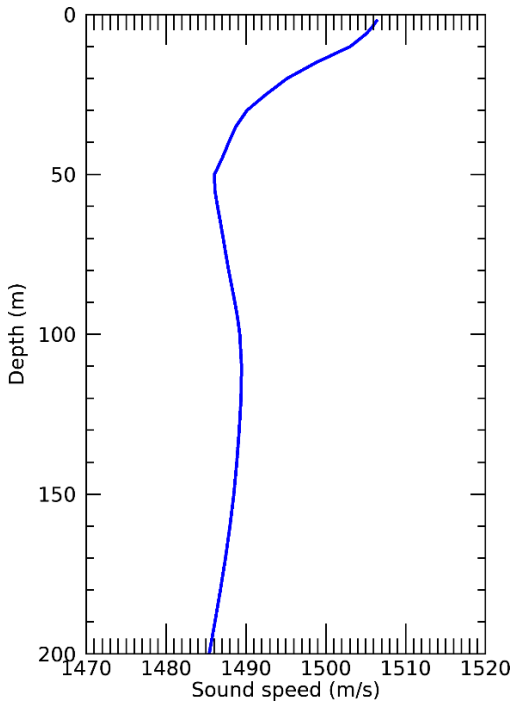

Figure 3. Mean Sound speed profile up to 200 m for the summer months for New England Wind. The mean profile used in the modeling was obtained by taking the average of all profiles for June through August.

K.2.4. Exposure Estimates for Marine Animals

Exposures were calculated for one day of drilling. Drilling was modeled at each of the three site locations (J1, M1, M2). Exposures were calculated for each of these locations individually and also for the maximum potential exposures using the maximum ensonified area for each threshold. Exposures were estimated using the monthly animal densities from May to December.

Density Calculations

Marine mammal densities in the potential impact area were estimated using the Marine Geospatial Ecology Laboratory (MGEL)/Duke University Habitat-based Marine Mammal Density Models for the US Atlantic (Roberts et al. 2016, 2022). Densities in the MGEL/Duke models are provided as the number of animals per 100 square kilometers (animals/100 km^2) and given for each 5 × 5 km cell in the US Atlantic for all species. Sea turtle densities were obtained from the US Navy Operating Area Density Estimate (NODE) database on the Strategic Environmental Research and Development Program Spatial Decision Support System (SERDP-SDSS) portal (DoN, 2012, 2017).

To calculate marine mammal densities for the potential drilling impact area, it was assumed that the surveys would occur in three areas of interest: J1, M1, and M2. The density perimeter was determined using the longest 10-dB attenuated 95th percentile acoustic range to the behavioral threshold ($R_{95\%}$) for all locations, rounded up to the nearest 5 km, and then applied around the entire lease area (i.e., 7.1 km rounded up to 10 km). Monthly densities were calculated for each species as the average of the densities from all MGEL/Duke model grid cells that overlap partially or completely with the area of interest. Cells entirely on land were not included, but cells that overlap only partially with land were included.

There are two cases in this study for which the MGEL/Duke models report densities for species guilds: seals and pilot whales. When calculating exposures for individual pilot whale and seal species, the guild densities provided by Roberts et al. (2016a, 2022) were scaled by the relative abundances of the two species in each guild, using the best available estimates of local abundance, to get species-specific density estimates for the project area. In estimating local abundances, all distribution data from the two pilot whale species and three seal species were downloaded from the Ocean Biodiversity Information System (OBIS) data repository (available at https://obis.org/). After reviewing the available datasets, it was deemed that data available in OBIS in Rhode Island and Massachusetts waters are the best available for the three seals species because of their overlap with the project area. For seals, OBIS reported 86 observations of gray seals, 129 observations of harbor seals, and 93 observations of harp seals. Therefore, the proportions of 0.28 (86/308), 0.42 (129/308), and 0.30 (93/308) were used to scale the seals guild densities for the three seal species, respectively. The best data available for pilot whales came from AMAPPS data in Rhode Island and Massachusetts waters. The proportions of 0.80 for long-finned and 0.20 for short-finned pilot whales were used (Palka et al 2021.)

The monthly densities were calculated for May to December. The resulting densities are included in Table 6 and Figure 4. Figure 4 shows the data cells included in the density average for distances to injury and behavior thresholds, respectively.

Table 6. Average monthly marine mammal density estimates for all modeled species in a 10-km perimeter around the Southern Wind Development Area (SWDA).

Species	Monthly density (animals/100 km²)												Annual mean	May to Dec mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Fin whale [a]	0.215	0.166	0.107	0.164	0.272	0.256	0.438	0.366	0.227	0.057	0.051	0.141	0.205	0.226
Minke whale	0.113	0.137	0.136	0.806	1.728	1.637	0.700	0.471	0.516	0.465	0.052	0.077	0.570	0.706
Humpback whale	0.031	0.023	0.043	0.149	0.294	0.307	0.172	0.120	0.167	0.236	0.190	0.030	0.147	0.189
North Atlantic right whale [a]	0.387	0.461	0.456	0.478	0.295	0.050	0.022	0.018	0.028	0.052	0.068	0.197	0.209	0.091
Sei whale [a]	0.039	0.021	0.044	0.112	0.192	0.052	0.013	0.011	0.019	0.036	0.079	0.065	0.057	0.058
Atlantic white-sided dolphin	2.049	1.230	0.850	1.313	3.322	3.003	1.392	0.730	1.654	2.431	1.791	2.440	1.850	2.095
Atlantic spotted dolphin	0.001	0.000	0.001	0.003	0.018	0.025	0.031	0.054	0.273	0.431	0.179	0.018	0.086	0.128
Common dolphin	7.130	2.455	1.884	3.258	6.254	13.905	10.533	14.446	25.703	22.676	11.103	10.774	10.844	14.424
Bottlenose dolphin, offshore	0.495	0.111	0.059	0.156	0.814	1.358	1.479	1.659	1.483	1.337	1.255	1.101	0.942	1.311
Risso's dolphin	0.043	0.004	0.002	0.018	0.096	0.048	0.068	0.128	0.158	0.087	0.120	0.179	0.079	0.111
Long-finned pilot whale [b]	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189
Short-finned pilot whale [b]	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047
Sperm whale [a]	0.031	0.011	0.013	0.003	0.014	0.028	0.038	0.107	0.070	0.057	0.031	0.020	0.035	0.046
Harbor porpoise	10.007	10.784	10.277	8.914	6.741	0.960	0.880	0.848	0.988	1.271	1.418	5.812	4.908	2.365
Gray seal [c]	5.395	5.603	4.176	3.203	4.716	0.806	0.088	0.094	0.226	0.500	1.768	4.534	2.592	1.591
Harbor seal [c]	8.093	8.404	6.265	4.804	7.074	1.209	0.132	0.140	0.339	0.750	2.652	6.802	3.889	2.387
Harp seal [c]	5.781	6.003	4.475	3.432	5.053	0.864	0.094	0.100	0.242	0.535	1.894	4.858	2.778	1.705

[a] Listed as Endangered under the ESA.
[b] Long- and short-finned pilot whale densities are the annual pilot whale guild density scaled by their relative abundances.
[c] Gray and harbor seal densities are the seals guild density scaled by their relative abundances. Gray seals are used as a surrogate for harp seals.

Table 7. Sea turtle density estimates for all modeled species in the Southern Wind Development Area (SWDA).

Common name	Density (animals/100 km^2 [38.6 mi^2])[a]			
	Spring	Summer	Fall	Winter
Green sea turtle[b]	0.015	0.015	0.015	0.015
Leatherback sea turtle	0.023	0.630[c]	0.873[c]	0.023
Loggerhead sea turtle	0.107	0.206[d]	0.633[d]	0.107
Kemp's ridley sea turtle	0.015	0.015	0.015	0.015

[a] Density estimates are extracted from SERDP-SDSS NODE database within a 10 km perimeter of the SWDA, unless otherwise noted.
[b] Kraus et al. (2016) did not observe any green sea turtles in the RI/MA WEA. Densities of Kemp's ridley sea turtles are used as a conservative estimate.
[c] Densities calculated as averaged seasonal densities from 2011 to 2015 (Kraus et al. 2016).
[d] Densities calculated as the averaged seasonal leatherback sea turtle densities scaled by the relative, seasonal sighting rates of loggerhead and leatherback sea turtles (Kraus et al. 2016).

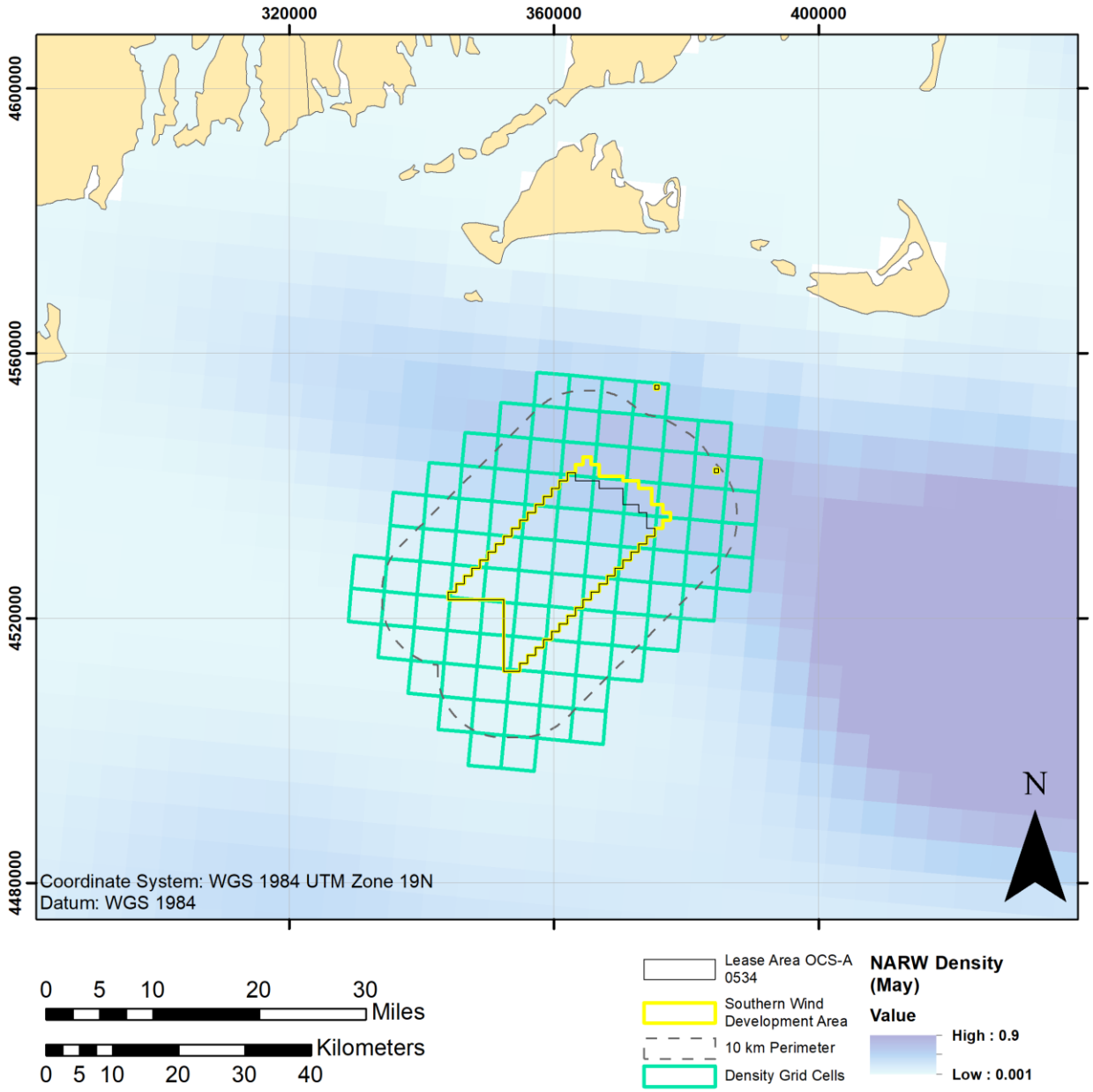

Figure 4. Marine mammal (e.g., NARW) density showing highlighted grid cells used to calculate monthly species density estimates within a 10 km perimeter around Lease Area OCS-A 0534 ((Roberts et al. 2016a, 2016b, 2017, 2018, 2021a, 2021b).

K.3. Results

K.3.1. Acoustic Ranges

Assuming up to 24 hours of drilling could occur during a 24-hour period, the frequency-weighted distances to potential injury for the marine mammal hearing groups are shown in Table 6 through Table 17 for the modeled locations. While we are not aware of any studies of noise attenuation systems (NAS) used with very large rotational drills, the Proponent expects to employ the same NAS during all drilling activity of WTG and ESP foundations as used during impact driving. Drilling produces sound of similar frequency content as impact pile driving, so the NAS performance, at sufficient distance to attenuate sound entering the water from the substrate, would be expected to have essentially the same performance for during drilling as impact pile driving. For this reason, results with attenuations of 10 dB and 12 dB during the summer are also included. The acoustic ranges to the marine mammal PTS injury are less than 100 m at the three sites for all hearing groups, except for low-frequency and high-frequency animals (FHWG 2008) whose predicted maximum $R_{95\%}$ acoustic ranges are ~300 m.

The acoustic ranges to the behavioral thresholds for marine mammal hearing groups sounds SPL 120 dB re 1 µPa threshold (NMFS 2018) and sea turtles SPL 175 dB re 1 µPa threshold, without frequency weighting, are shown in Table 18 through Table 20 for the modeled locations and attenuations (0 dB, 10 dB, 12 dB) during the summer. The maximum, unweighted, unattenuated, marine mammal behavioral acoustic ranges were found to extend to 20.73 km at J1, 21.65 km at M1, and 25.37 km at M2 location. Excluding 5% of the farthest points (R95%), the behavioral threshold ranges were 17.76 km at J1, 16.62 km at M1 and 19.67 at M2 location. The unweighted SPL levels at 750 m are 145.25 dB re 1 µPa, 146.33 dB re 1 µPa and 145.44 dB re 1 µPa for J1, M1, and M2, respectively during the summer. The corresponding unweighted cumulative SEL levels at 750m are 195.24 dB re 1 µPa2·s, 195.07 dB re 1 µPa2·s, and 194.10 dB re 1 µPa2·s for J1, M1, and M2, respectively during the summer, At all sites, the behavioral threshold ranges were approximately equidistant in all directions (Figure 1). Propagation extent and shoreline were determined using global bathymetry data (STRM15+ referenced vertically to the EGM96 geoid).

Table 8. Site J1 (Summer): Distances to PTS onset for marine mammal hearing groups (NMFS 2018) thresholds for continuous sounds generated by relief drilling during piling for attenuation 0 dB.

Hearing group	Frequency-weighted $L_{E,24hr}$ (dB re 1 µPa²·s)	Drilling		
		24hr		
		R_{max} (km)	$R_{95\%}$ (km)	Area (km²)
Low-frequency (LF) cetaceans	199	0.315	0.309	0.320
Mid-frequency (MF) cetaceans	198	-	-	-
High-frequency (HF) cetaceans	173	0.261	0.251	0.207
Phocid pinnipeds in water (PPW)	201	0.057	0.057	0.015
Sea turtles	220	-	-	-

Table 9. Site M1 (Summer): Distances to PTS onset for marine mammal hearing groups (NMFS 2018) thresholds for continuous sounds generated by relief drilling during piling for attenuation 0 dB.

Hearing group	Frequency-weighted $L_{E,24hr}$ (dB re 1 µPa²·s)	Drilling		
		24hr		
		R_{max} (km)	$R_{95\%}$ (km)	Area (km²)
Low-frequency (LF) cetaceans	199	0.317	0.312	0.318
Mid-frequency (MF) cetaceans	198	-	-	-
High-frequency (HF) cetaceans	173	0.276	0.273	0.243
Phocid pinnipeds in water (PPW)	201	0.067	0.067	0.015
Sea turtles	220	-	-	-

Table 10. Site M2 (Summer): Distances to PTS onset for marine mammal hearing groups (NMFS 2018) thresholds for continuous sounds generated by relief drilling during piling for attenuation 0 dB.

Hearing group	Frequency-weighted $L_{E,24hr}$ (dB re 1 µPa²·s)	Drilling		
		24hr		
		R_{max} (km)	$R_{95\%}$ (km)	Area (km²)
Low-frequency (LF) cetaceans	199	0.323	0.296	0.285
Mid-frequency (MF) cetaceans	198	-	-	-
High-frequency (HF) cetaceans	173	0.255	0.248	0.207
Phocid pinnipeds in water (PPW)	201	0.065	0.065	0.012
Sea turtles	220	-	-	-

Table 11. Site J1 (Summer): Distances to PTS onset for marine mammal hearing groups (NMFS 2018) thresholds for continuous sounds generated by relief drilling during piling for attenuation 10 dB.

Hearing group	Frequency-weighted $L_{E,24hr}$ (dB re 1 µPa²·s)	Drilling		
		24hr		
		R_{max} (km)	$R_{95\%}$ (km)	Area (km²)
Low-frequency (LF) cetaceans	199	0.057	0.057	0.015
Mid-frequency (MF) cetaceans	198	-	-	-
High-frequency (HF) cetaceans	173	0.057	0.057	0.015
Phocid pinnipeds in water (PPW)	201	-	-	-
Sea turtles	220	-	-	-

Table 12. Site M1 (Summer): Distances to PTS onset for marine mammal hearing groups (NMFS 2018) thresholds for continuous sounds generated by relief drilling during piling for attenuation 10 dB.

Hearing group	Frequency-weighted $L_{E,24hr}$ (dB re 1 µPa²·s)	Drilling		
		24hr		
		R_{max} (km)	$R_{95\%}$ (km)	Area (km²)
Low-frequency (LF) cetaceans	199	0.065	0.065	0.012
Mid-frequency (MF) cetaceans	198	-	-	-
High-frequency (HF) cetaceans	173	<0.05	<0.05	0.010
Phocid pinnipeds in water (PPW)	201	-	-	-
Sea turtles	220	-	-	-

Table 13. Site M2 (Summer): Distances to PTS onset for marine mammal hearing groups (NMFS 2018) thresholds for continuous sounds generated by relief drilling during piling for attenuation 10 dB.

Hearing group	Frequency-weighted $L_{E,24hr}$ (dB re 1 µPa²·s)	Drilling		
		24hr		
		R_{max} (km)	$R_{95\%}$ (km)	Area (km²)
Low-frequency (LF) cetaceans	199	<0.05	<0.05	0.010
Mid-frequency (MF) cetaceans	198	-	-	-
High-frequency (HF) cetaceans	173	<0.05	<0.05	0.010
Phocid pinnipeds in water (PPW)	201	-	-	-
Sea turtles	220	-	-	-

Table 14. Site J1 (Summer): Distances to PTS onset for marine mammal hearing groups (NMFS 2018) thresholds for continuous sounds generated by relief drilling during piling for attenuation 12 dB.

Hearing group	Frequency-weighted $L_{E,24hr}$ (dB re 1 µPa²·s)	Drilling		
		24hr		
		R_{max} (km)	$R_{95\%}$ (km)	Area (km²)
Low-frequency (LF) cetaceans	199	<0.05	<0.05	<0.05
Mid-frequency (MF) cetaceans	198	-	-	-
High-frequency (HF) cetaceans	173	<0.05	<0.05	<0.05
Phocid pinnipeds in water (PPW)	201	-	-	-
Sea turtles	220	-	-	-

Table 15. Site M1 (Summer): Distances to PTS onset for marine mammal hearing groups (NMFS 2018) thresholds for continuous sounds generated by relief drilling during piling for attenuation 12 dB

Hearing group	Frequency-weighted $L_{E,24hr}$ (dB re 1 µPa²·s)	Drilling		
		24hr		
		R_{max} (km)	$R_{95\%}$ (km)	Area (km²)
Low-frequency (LF) cetaceans	199	<0.05	<0.05	0.005
Mid-frequency (MF) cetaceans	198	-	-	-
High-frequency (HF) cetaceans	173	<0.05	<0.05	0.005
Phocid pinnipeds in water (PPW)	201	-	-	-
Sea turtles	220	-	-	-

Table 16. Site M2 (Summer): Distances to PTS onset for marine mammal hearing groups (NMFS 2018) thresholds for continuous sounds generated by relief drilling during piling for attenuation 12 dB.

Hearing group	Frequency-weighted $L_{E,24hr}$ (dB re 1 µPa²·s)	Drilling		
		24hr		
		R_{max} (km)	$R_{95\%}$ (km)	Area (km²)
Low-frequency (LF) cetaceans	199	<0.05	<0.05	0.005
Mid-frequency (MF) cetaceans	198	-	-	-
High-frequency (HF) cetaceans	173	<0.05	<0.05	0.005
Phocid pinnipeds in water (PPW)	201	-	-	-
Sea turtles	220	-	-	-

Table 17. Site J1 (Summer): Distances to behavioral thresholds for marine mammal hearing groups (NMFS 2018) and sea turtles for continuous sounds generated by relief drilling during piling.

Hearing group	Unweighted L_P (dB re 1 µPa)	0 dB			10 dB			12 dB		
		R_{max} (km)	$R_{95\%}$ (km)	Area (km²)	R_{max} (km)	$R_{95\%}$ (km)	Area (km²)	R_{max} (km)	$R_{95\%}$ (km)	Area (km²)
Marine mammals	120	20.73	17.76	972.5	7.498	7.054	162.8	6.003	5.517	100.6
Fish	150	0.33	0.32	0.34	0.06	0.06	0.02	0.03	0.03	0.01
Sea turtles	175 [b]	-	-	-	-	-	-	-	-	-

[a] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[b] McCauley et al. (2000).

Table 18. Site M1 (Summer): Distances to behavioral thresholds for marine mammal hearing groups (NMFS 2018) and sea turtles for continuous sounds generated by relief drilling during piling.

Hearing group	Unweighted L_P (dB re 1 µPa)	0 dB			10 dB			12 dB		
		R_{max} (km)	$R_{95\%}$ (km)	Area (km²)	R_{max} (km)	$R_{95\%}$ (km)	Area (km²)	R_{max} (km)	$R_{95\%}$ (km)	Area (km²)
Marine mammals	120	21.65	16.62	877.2	7.830	6.853	151.1	6.089	5.435	94.62
Fish	150	0.35	0.33	0.36	0.07	0.07	0.02	0.05	0.05	0.01
Sea turtles	175 [b]	-	-	-	-	-	-	-	-	-

[a] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[b] McCauley et al. (2000).

Table 19. Site M2 (Summer): Distances to behavioral thresholds for marine mammal hearing groups (NMFS 2018) and sea turtles for continuous sounds generated by relief drilling during piling.

Hearing group	Unweighted L_P (dB re 1 µPa)	0 dB			10 dB			12 dB		
		R_{max} (km)	$R_{95\%}$ (km)	Area (km²)	R_{max} (km)	$R_{95\%}$ (km)	Area (km²)	R_{max} (km)	$R_{95\%}$ (km)	Area (km²)
Marine mammals	120	25.37	19.67	>1000	7.641	6.884	152.1	6.051	5.495	95.79
Fish	150	0.34	0.32	0.33	0.05	0.05	0.01	0.03	0.03	0.01
Sea turtles	175 [b]	-	-	-	-	-	-	-	-	-

[a] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[b] McCauley et al. (2000).

Table 20. Site J1 (Summer): Distances to fish and sea turtle injury thresholds for continuous sounds generated by drilling during piling.

Faunal group	Metric	Threshold (dB)	Attenuation								
			0 dB			10 dB			12 dB		
			R_{max} (km)	$R_{95\%}$ (km)	Area (km^2)	R_{max} (km)	$R_{95\%}$ (km)	Area (km^2)	R_{max} (km)	$R_{95\%}$ (km)	Area (km^2)
Sea turtles	L_E	220	-	-	-	-	-	-	-	-	-
Fish without swim bladder	L_E	216	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E	203	0.18	0.17	0.10	0.03	0.03	0.01	-	-	-
Fish with swim bladder involved in hearing	L_E	203	0.18	0.17	0.10	0.03	0.03	0.01	-	-	-
Fish greater than or equal to 2 g	L_E	187	2.89	2.78	25.57	0.56	0.53	0.94	0.35	0.34	0.38
Fish less than 2 g	L_E	183	4.81	4.59	69.72	1.08	1.04	3.58	0.97	0.94	2.91

L_{pk} = unweighted peak sound pressure (dB re 1 µPa); L_E = unweighted sound exposure level (dB re 1 µPa^2·s); L_p = unweighted sound pressure level (dB re 1 µPa).

Table 21. Site M1 (Summer): Distances to fish and sea turtle injury thresholds for continuous sounds generated by drilling during piling.

Faunal group	Metric	Threshold (dB)	Attenuation								
			0 dB			10 dB			12 dB		
			R_{max} (km)	$R_{95\%}$ (km)	Area (km²)	R_{max} (km)	$R_{95\%}$ (km)	Area (km²)	R_{max} (km)	$R_{95\%}$ (km)	Area (km²)
Sea turtles	L_E	220	-	-	-	-	-	-	-	-	-
Fish without swim bladder	L_E	216	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E	203	0.19	0.19	0.11	0.03	0.03	0.01	-	-	-
Fish with swim bladder involved in hearing	L_E	203	0.19	0.19	0.11	0.03	0.03	0.01	-	-	-
Fish greater than or equal to 2 g	L_E	187	3.16	3.03	24.51	0.76	0.74	1.27	0.36	0.35	0.40
Fish less than 2 g	L_E	183	4.89	4.60	65.12	1.45	0.98	3.18	0.88	0.86	2.42

L_{pk} = unweighted peak sound pressure (dB re 1 µPa); L_E = unweighted sound exposure level (dB re 1 µPa^2·s); L_p = unweighted sound pressure level (dB re 1 µPa).

Table 22. Site M2 (Summer): Distances to fish and sea turtle injury thresholds for continuous sounds generated by drilling during piling.

Faunal group	Metric	Threshold (dB)	Attenuation								
			0 dB			10 dB			12 dB		
			R_{max} (km)	$R_{95\%}$ (km)	Area (km²)	R_{max} (km)	$R_{95\%}$ (km)	Area (km²)	R_{max} (km)	$R_{95\%}$ (km)	Area (km²)
Sea turtles	L_E	220	-	-	-	-	-	-	-	-	-
Fish without swim bladder	L_E	216	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E	203	0.18	0.17	0.09	0.02	0.02	<0.005	-	-	-
Fish with swim bladder involved in hearing	L_E	203	0.18	0.17	0.09	0.02	0.02	<0.005	-	-	-
Fish greater than or equal to 2 g	L_E	187	3.08	2.85	24.86	0.53	0.48	0.77	0.37	0.34	0.38
Fish less than 2 g	L_E	183	5.09	4.56	63.42	1.11	1.05	3.58	1.01	0.95	2.67

L_{pk} = unweighted peak sound pressure (dB re 1 µPa); L_E = unweighted sound exposure level (dB re 1 µPa^2·s); L_p = unweighted sound pressure level (dB re 1 µPa).

Table 23. Site J1 (Summer): Distances to behavioral thresholds for fish and sea turtles for continuous sounds generated by relief drilling during piling.

Hearing group	Unweighted L_P (dB re 1 µPa)	R_{max} (m)	$R_{95\%}$ (m)	Area (km²)	R_{max} (m)	$R_{95\%}$ (m)	Area (km²)	R_{max} (m)	$R_{95\%}$ (m)	Area (km²)
		0 dB			10 dB			12 dB		
Fish	150 [a]	0.33	0.32	0.34	0.06	0.06	0.02	0.03	0.03	0.01
Sea turtles	175 [b]	-	-	-	-	-	-	-	-	-

[a] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[b] McCauley et al. (2000).

Table 24. Site M1 (Summer): Distances to behavioral thresholds for fish and sea turtles for continuous sounds generated by relief drilling during piling.

Hearing group	Unweighted L_P (dB re 1 µPa)	R_{max} (m)	$R_{95\%}$ (m)	Area (km²)	R_{max} (m)	$R_{95\%}$ (m)	Area (km²)	R_{max} (m)	$R_{95\%}$ (m)	Area (km²)
		0 dB			10 dB			12 dB		
Fish	150 [a]	0.35	0.33	0.36	0.07	0.07	0.02	0.05	0.05	0.01
Sea turtles	175 [b]	-	-	-	-	-	-	-	-	-

[a] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[b] McCauley et al. (2000).

Table 25. Site M2 (Summer): Distances to behavioral thresholds for fish and sea turtles for continuous sounds generated by relief drilling during piling.

Hearing group	Unweighted L_P (dB re 1 µPa)	R_{max} (m)	$R_{95\%}$ (m)	Area (km²)	R_{max} (m)	$R_{95\%}$ (m)	Area (km²)	R_{max} (m)	$R_{95\%}$ (m)	Area (km²)
		0 dB			10 dB			12 dB		
Fish	150 [a]	0.34	0.32	0.33	0.05	0.05	0.01	0.03	0.03	0.01
Sea turtles	175 [b]	-	-	-	-	-	-	-	-	-

[a] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[b] McCauley et al. (2000).

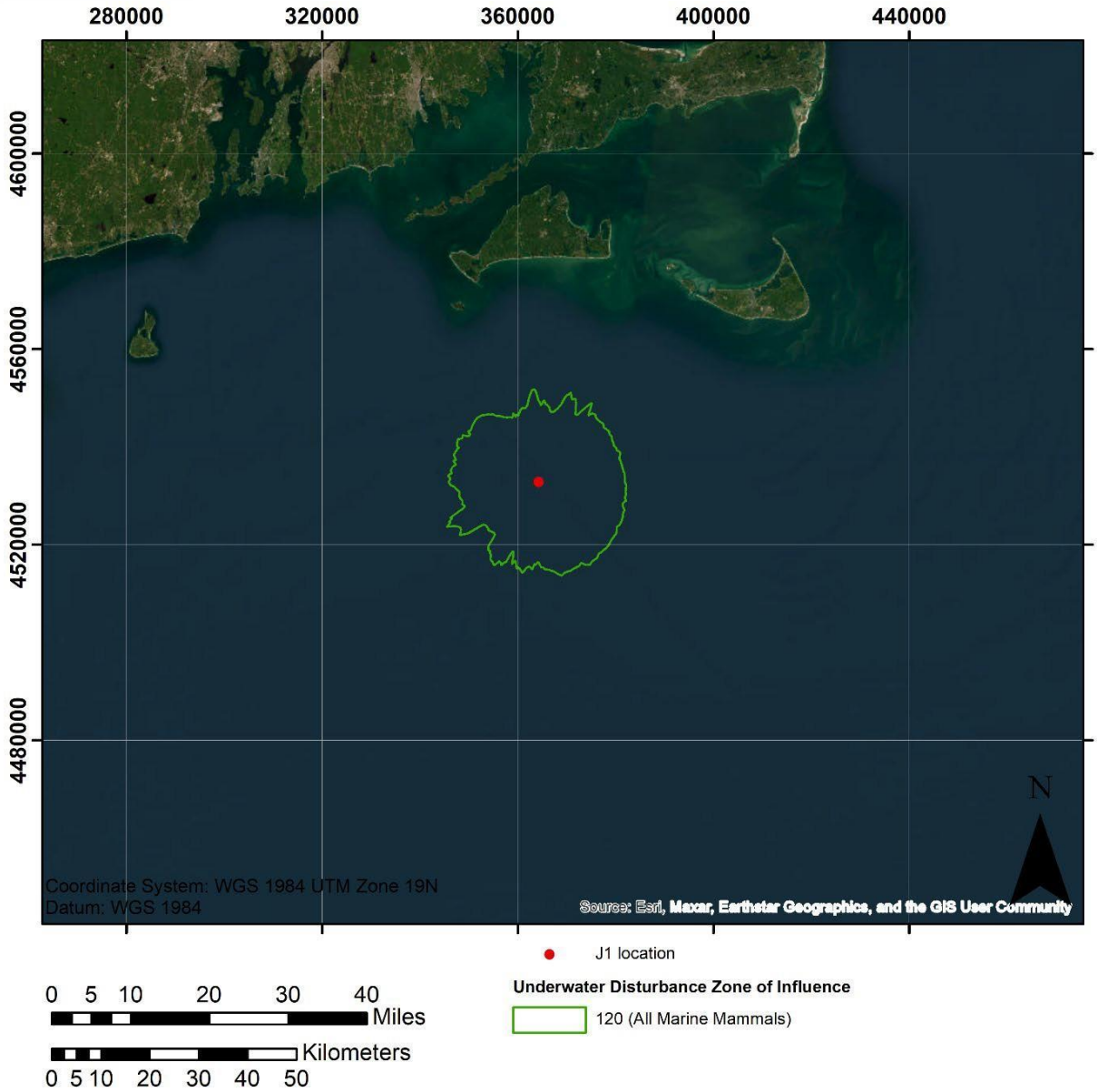

Figure 5. Location J1 – Underwater disturbance zone of influence for marine mammals for 24 hours of drilling.

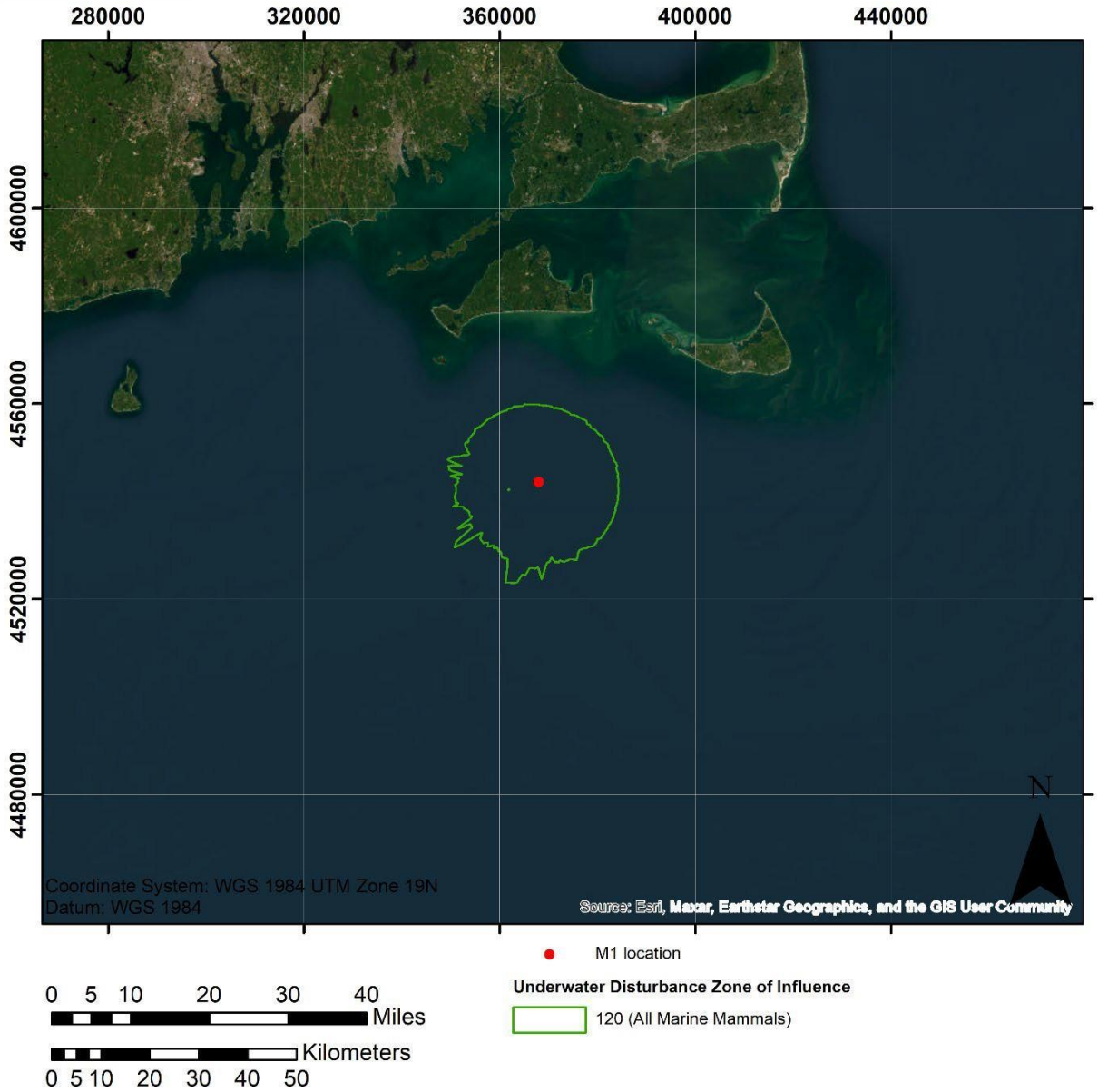

Figure 6. Location M1 – Underwater disturbance zone of influence for marine mammals for 24 hours of drilling

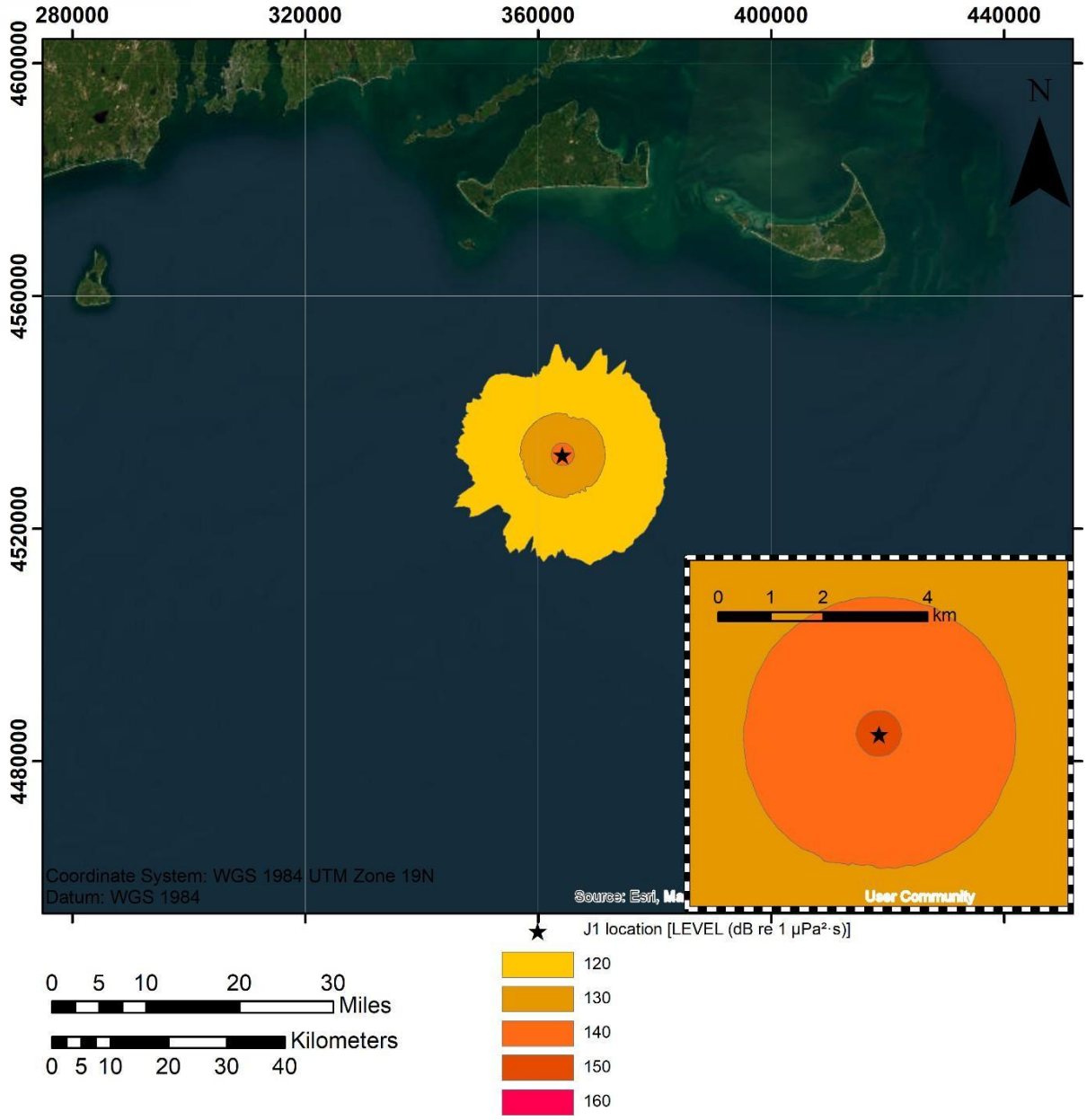

Figure 7. Location J1 – Modeled unweighted sound exposure level for 24 hours of drilling.

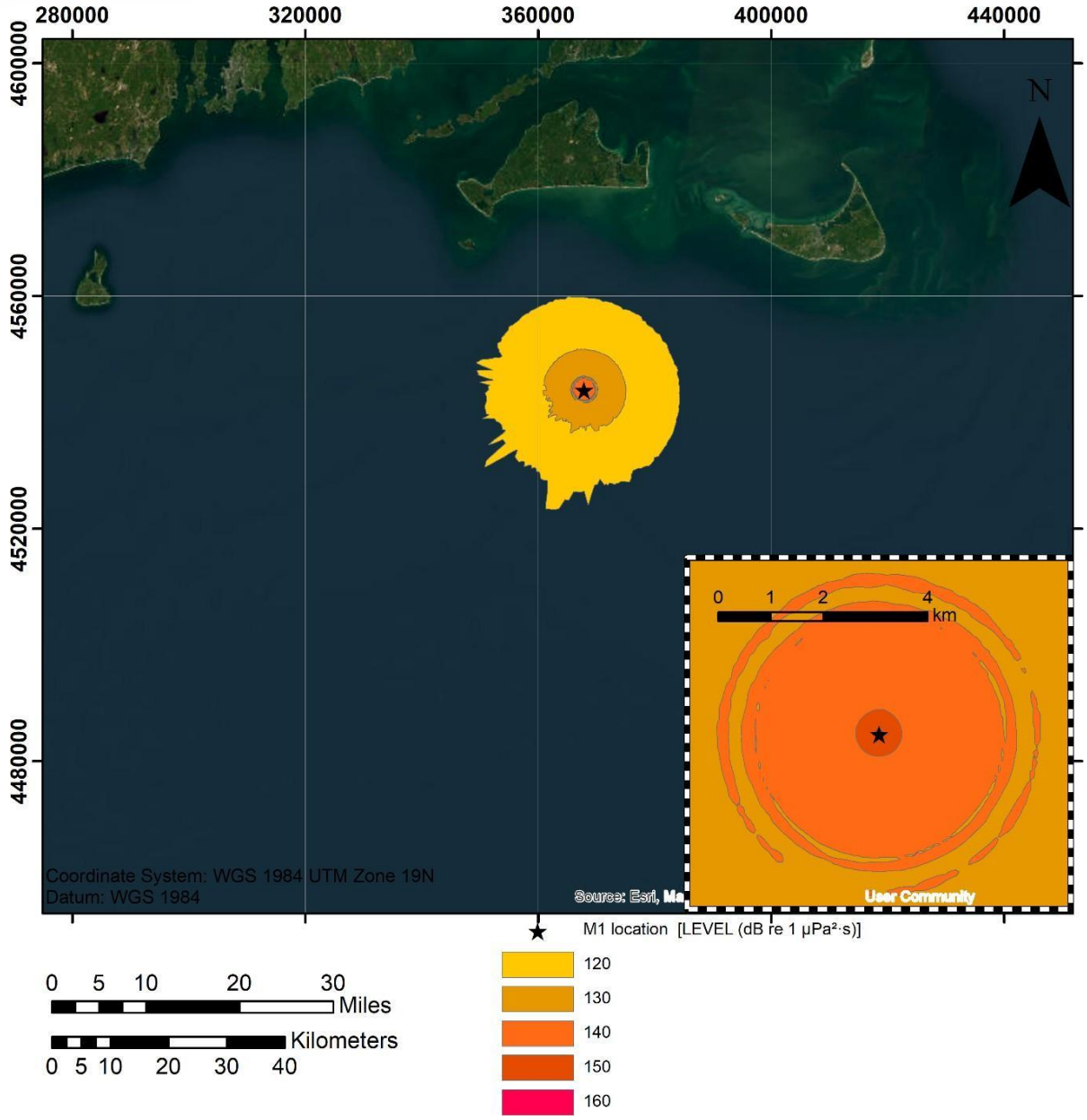

Figure 8. Location M1 – Modeled unweighted sound exposure level for 24 hours of drilling.

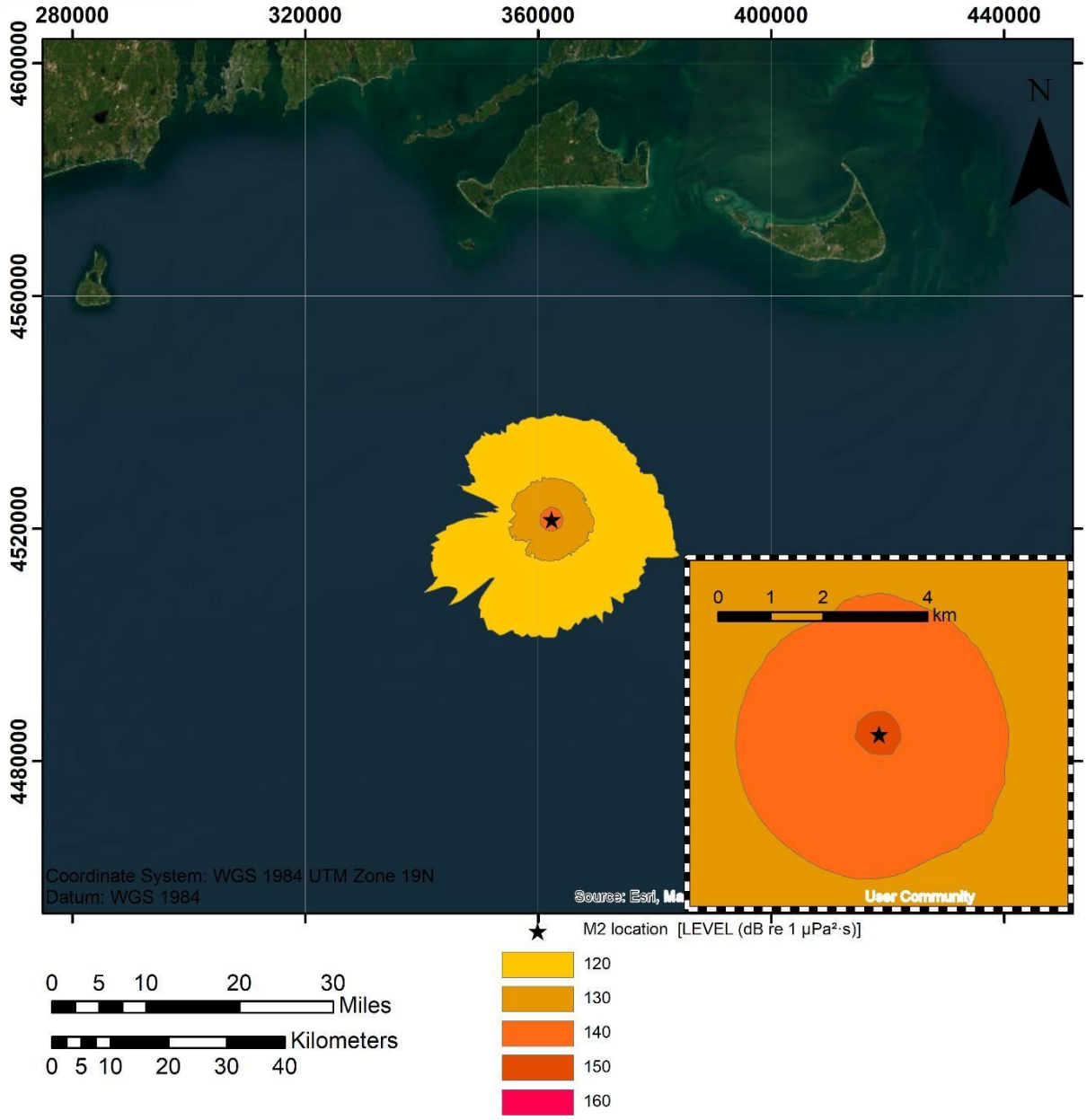

Figure 9. Location M2 – Modeled unweighted sound exposure level for 24 hours of drilling.

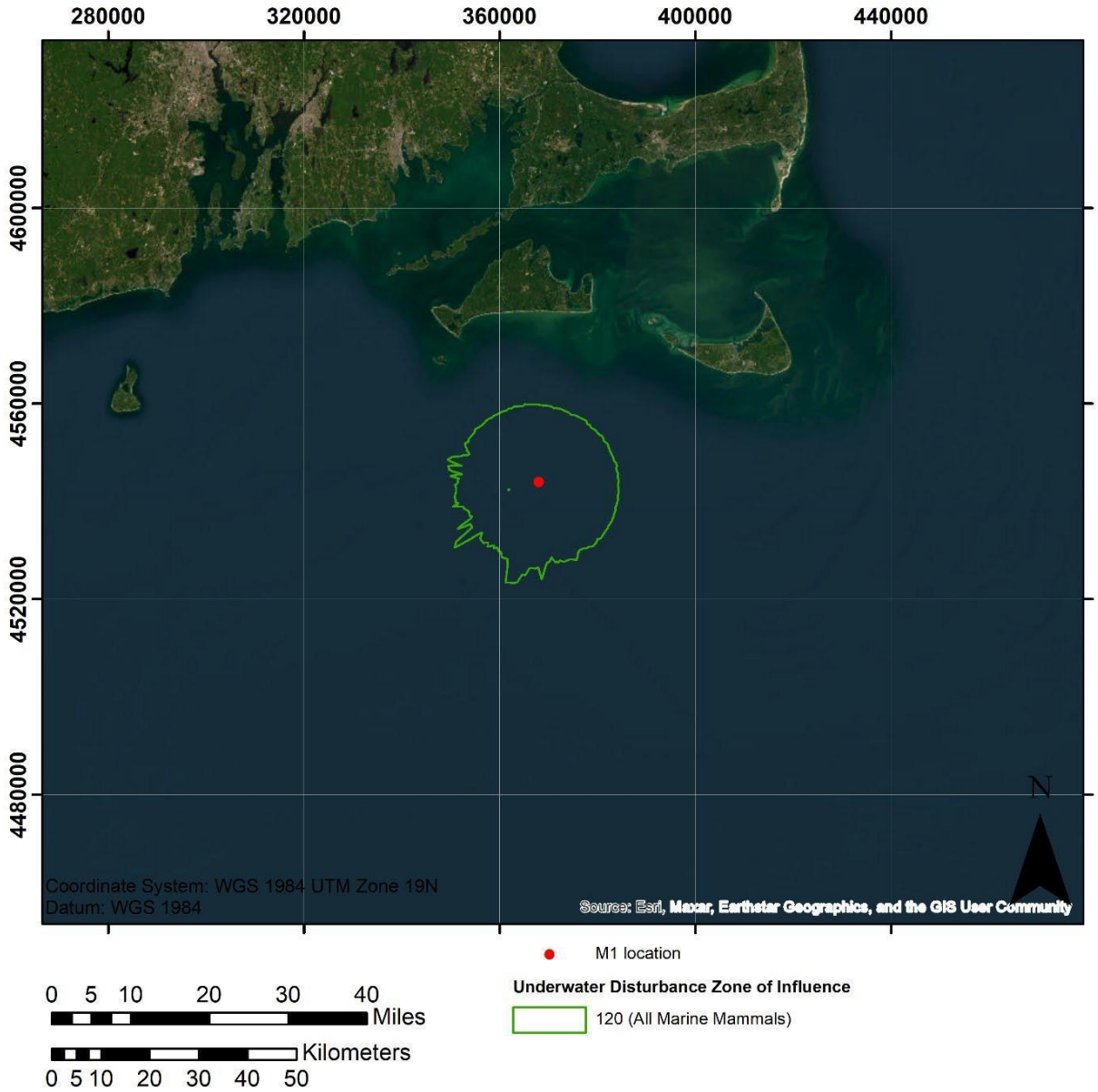

Figure 10. Location M2 – Underwater disturbance zone of influence for marine mammals for 24 hours of drilling.

K.3.2. Exposure Estimates

The zone of influence (ZOI) is a representation of the maximum extent of the ensonified area around a sound source over a 24-hour period. The ZOI was obtained directly from the acoustic propagation modeling results, where the ensonified area was summed over the gridded maximum-over-depth sound fields corresponding to each of the acoustic thresholds for injury and behavioral response. Exposures were estimated at each location and for all species using:

$$\text{exposures} = \text{ZOI} \times \text{density}, \tag{I-2}$$

where density is from Table 6.

Exposure estimates were calculated for the months of May through September (modeled using the summer sound speed profile) for drilling at sites M1, M2, and J1. The numbers of exposures of marine mammals to sound above injury and behavioral thresholds are provided in Sections K.3.3.1 and K.3.4.1 for site J1, Sections K.3.3.2 and K.3.4.2 for site M1, and Sections K.3.3.3 and K.3.4.3 for site M2. Sections K.3.3.4 and K.3.4.4 provide the maximum exposures from the three locations for each species at each attenuation.

Harbor porpoises had the highest number of injury exposures (0.17) at location M1 for Construction Schedule B and without sound attenuation. When broadband sound attenuation of 10 dB is applied to this case, the exposure estimate is reduced to <0.01.

In all cases, the exposure estimation showed no sea turtle exposures above any threshold at any location.

Table 26 and Table 27 show the number of days per month and year during which drilling may be required during pile installation for Schedules A and B, respectively. Pile installation is expected to occur during year 2 and year 3 of the five-year proposed Construction Schedule (2025-2029) under Schedule A or during years 2 through 4 under Schedule B.

Table 26. Construction Schedule A: Number of pile driving days during which drilling may be required, used in exposure estimation.

Month	Construction Schedule A		
	Year 2 (2026)	Year 3 (2027)	2-Year total
May	2	1	**3**
Jun	4	2	**6**
Jul	7	2	**9**
Aug	7	4	**11**
Sep	8	2	**10**
Oct	3	2	**5**
Nov	2	2	**4**
Dec	0	0	**0**
Total	**33**	**15**	**48**

Table 27. Construction Schedule B: Number of pile driving days during which drilling may be required, used in exposure estimation.

Month	Construction Schedule B			
	Year 2 (2026)	Year 3 (2027)	Year 4 (2028)	3-Year total
May	2	1	1	**4**
Jun	4	4	2	**10**
Jul	3	4	2	**9**
Aug	4	4	1	**9**
Sep	4	4	1	**9**
Oct	2	1	1	**4**
Nov	1	1	1	**3**
Dec	0	0	0	**0**
Total	**20**	**19**	**9**	**48**

K.3.3. Construction Schedule A Estimates

K.3.3.1 Site J1

Table 28. Construction Schedule A, All Years Summed, Site J1: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.04	<0.01	<0.01	127.33	21.32	13.17
	Minke whale	0.11	<0.01	<0.01	332.39	55.64	34.38
	Humpback whale	0.03	<0.01	<0.01	89.47	14.98	9.25
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	23.30	3.90	2.41
	Sei whale[a]	<0.01	<0.01	<0.01	17.62	2.95	1.82
MF	Atlantic white sided dolphin	0	0	0	820.78	137.40	84.91
	Atlantic spotted dolphin	0	0	0	64.83	10.85	6.71
	Common dolphin	0	0	0	7495.29	1254.74	775.35
	Bottlenose dolphin, offshore	0	0	0	667.97	111.82	69.10
	Risso's dolphin	0	0	0	49.48	8.28	5.12
	Long-finned pilot whale	0	0	0	88.30	14.78	9.13
	Short-finned pilot whale	0	0	0	22.07	3.70	2.28
	Sperm whale[a]	0	0	0	27.58	4.62	2.85
HF	Harbor porpoise	0.13	<0.01	<0.01	633.55	106.06	65.54
PPW	Gray seal	<0.01	0	0	317.36	53.13	32.83
	Harbor seal	<0.01	0	0	476.04	79.69	49.24
	Harp seal	<0.01	0	0	340.03	56.92	35.17

[a] Listed as Endangered under the ESA.

Table 29. Construction Schedule A, Year 2, Site J1: The mean number of marine mammals predicted to receive sound levels above exposure criteriawith sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.03	<0.01	<0.01	90.40	15.13	9.35
	Minke whale	0.08	<0.01	<0.01	231.73	38.79	23.97
	Humpback whale	0.02	<0.01	<0.01	61.10	10.23	6.32
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	15.44	2.59	1.60
	Sei whale[a]	<0.01	<0.01	<0.01	11.45	1.92	1.18
MF	Atlantic white sided dolphin	0	0	0	560.31	93.80	57.96
	Atlantic spotted dolphin	0	0	0	44.32	7.42	4.58
	Common dolphin	0	0	0	5240.26	877.24	542.08
	Bottlenose dolphin, offshore	0	0	0	461.08	77.19	47.70
	Risso's dolphin	0	0	0	34.22	5.73	3.54
	Long-finned pilot whale	0	0	0	60.70	10.16	6.28
	Short-finned pilot whale	0	0	0	15.18	2.54	1.57
	Sperm whale[a]	0	0	0	18.93	3.17	1.96
HF	Harbor porpoise	0.09	<0.01	<0.01	427.68	71.60	44.24
PPW	Gray seal	<0.01	0	0	201.97	33.81	20.89
	Harbor seal	<0.01	0	0	302.96	50.72	31.34
	Harp seal	<0.01	0	0	216.40	36.23	22.39

[a] Listed as Endangered under the ESA.

Table 30. Construction Schedule A, Year 3, Site J1: The mean number of marine mammals predicted to receive sound levels above exposure criteriawith sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.01	<0.01	<0.01	36.93	6.18	3.82
	Minke whale	0.03	<0.01	<0.01	100.67	16.85	10.41
	Humpback whale	<0.01	<0.01	<0.01	28.37	4.75	2.93
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	7.86	1.32	0.81
	Sei whale[a]	<0.01	<0.01	<0.01	6.17	1.03	0.64
MF	Atlantic white sided dolphin	0	0	0	260.47	43.60	26.94
	Atlantic spotted dolphin	0	0	0	20.51	3.43	2.12
	Common dolphin	0	0	0	2255.03	377.50	233.27
	Bottlenose dolphin, offshore	0	0	0	206.89	34.63	21.40
	Risso's dolphin	0	0	0	15.26	2.55	1.58
	Long-finned pilot whale	0	0	0	27.59	4.62	2.85
	Short-finned pilot whale	0	0	0	6.90	1.15	0.71
	Sperm whale[a]	0	0	0	8.65	1.45	0.89
HF	Harbor porpoise	0.04	<0.01	<0.01	205.87	34.46	21.30
PPW	Gray seal	<0.01	0	0	115.39	19.32	11.94
	Harbor seal	<0.01	0	0	173.08	28.97	17.90
	Harp seal	<0.01	0	0	123.63	20.70	12.79

[a] Listed as Endangered under the ESA.

K.3.3.2 Site M1

Table 31. Construction Schedule A, All Years Summed, Site M1: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.04	<0.01	<0.01	114.85	19.78	12.39
	Minke whale	0.11	<0.01	<0.01	299.82	51.65	32.34
	Humpback whale	0.03	<0.01	<0.01	80.70	13.90	8.70
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	21.02	3.62	2.27
	Sei whale[c]	<0.01	<0.01	<0.01	15.89	2.74	1.71
MF	Atlantic white sided dolphin	0	0	0	740.35	127.53	79.86
	Atlantic spotted dolphin	0	0	0	58.48	10.07	6.31
	Common dolphin	0	0	0	6760.79	1164.56	729.26
	Bottlenose dolphin, offshore	0	0	0	602.51	103.78	64.99
	Risso's dolphin	0	0	0	44.63	7.69	4.81
	Long-finned pilot whale	0	0	0	79.64	13.72	8.59
	Short-finned pilot whale	0	0	0	19.91	3.43	2.15
	Sperm whale[a]	0	0	0	24.88	4.29	2.68
HF	Harbor porpoise	0.16	<0.01	<0.01	571.47	98.44	61.64
PPW	Gray seal	<0.01	0	0	286.26	49.31	30.88
	Harbor seal	<0.01	0	0	429.39	73.96	46.32
	Harp seal	<0.01	0	0	306.70	52.83	33.08

[a] Listed as Endangered under the ESA.

Table 32. Construction Schedule A, Year 2, Site M1: The mean number of marine mammals predicted to receive sound levels above exposure criteriawith sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.03	<0.01	<0.01	81.54	14.05	8.80
	Minke whale	0.08	<0.01	<0.01	209.02	36.00	22.55
	Humpback whale	0.02	<0.01	<0.01	55.11	9.49	5.94
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	13.93	2.40	1.50
	Sei whale[a]	<0.01	<0.01	<0.01	10.33	1.78	1.11
MF	Atlantic white sided dolphin	0	0	0	505.41	87.06	54.52
	Atlantic spotted dolphin	0	0	0	39.98	6.89	4.31
	Common dolphin	0	0	0	4726.74	814.19	509.85
	Bottlenose dolphin, offshore	0	0	0	415.90	71.64	44.86
	Risso's dolphin	0	0	0	30.86	5.32	3.33
	Long-finned pilot whale	0	0	0	54.76	9.43	5.91
	Short-finned pilot whale	0	0	0	13.69	2.36	1.48
	Sperm whale[a]	0	0	0	17.08	2.94	1.84
HF	Harbor porpoise	0.11	<0.01	<0.01	385.77	66.45	41.61
PPW	Gray seal	<0.01	0	0	182.18	31.38	19.65
	Harbor seal	<0.01	0	0	273.27	47.07	29.48
	Harp seal	<0.01	0	0	195.19	33.62	21.05

[a] Listed as Endangered under the ESA.

Table 33. Construction Schedule A, Year 3, Site M1: The mean number of marine mammals predicted to receive sound levels above exposure criteriawith sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.01	<0.01	<0.01	33.31	5.74	3.59
	Minke whale	0.03	<0.01	<0.01	90.80	15.64	9.79
	Humpback whale	<0.01	<0.01	<0.01	25.59	4.41	2.76
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	7.09	1.22	0.76
	Sei whale[a]	<0.01	<0.01	<0.01	5.57	0.96	0.60
MF	Atlantic white sided dolphin	0	0	0	234.94	40.47	25.34
	Atlantic spotted dolphin	0	0	0	18.50	3.19	2.00
	Common dolphin	0	0	0	2034.04	350.37	219.40
	Bottlenose dolphin, offshore	0	0	0	186.62	32.15	20.13
	Risso's dolphin	0	0	0	13.76	2.37	1.48
	Long-finned pilot whale	0	0	0	24.89	4.29	2.68
	Short-finned pilot whale	0	0	0	6.22	1.07	0.67
	Sperm whale[a]	0	0	0	7.80	1.34	0.84
HF	Harbor porpoise	0.05	<0.01	<0.01	185.70	31.99	20.03
PPW	Gray seal	<0.01	0	0	104.08	17.93	11.23
	Harbor seal	<0.01	0	0	156.12	26.89	16.84
	Harp seal	<0.01	0	0	111.51	19.21	12.03

[a] Listed as Endangered under the ESA.

K.3.3.3 Site M2

Table 34. Construction Schedule A, All Years Summed, Site M2: The mean number of marine mammals predicted to receive sound levels above exposure criteriawith sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.04	<0.01	<0.01	143.37	19.91	12.54
	Minke whale	0.10	<0.01	<0.01	374.26	51.99	32.74
	Humpback whale	0.03	<0.01	<0.01	100.74	13.99	8.81
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	26.24	3.64	2.30
	Sei whale[a]	<0.01	<0.01	<0.01	19.84	2.76	1.74
MF	Atlantic white sided dolphin	0	0	0	924.17	128.37	80.85
	Atlantic spotted dolphin	0	0	0	73.00	10.14	6.39
	Common dolphin	0	0	0	8439.42	1172.27	738.28
	Bottlenose dolphin, offshore	0	0	0	752.11	104.47	65.79
	Risso's dolphin	0	0	0	55.71	7.74	4.87
	Long-finned pilot whale	0	0	0	99.42	13.81	8.70
	Short-finned pilot whale	0	0	0	24.85	3.45	2.17
	Sperm whale[a]	0	0	0	31.05	4.31	2.72
HF	Harbor porpoise	0.13	<0.01	<0.01	713.36	99.09	62.40
PPW	Gray seal	<0.01	0	0	357.33	49.63	31.26
	Harbor seal	<0.01	0	0	536.00	74.45	46.89
	Harp seal	<0.01	0	0	382.86	53.18	33.49

[a] Listed as Endangered under the ESA.

Table 35. Construction Schedule A, Year 2, Site M2: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.03	<0.01	<0.01	101.78	14.14	8.90
	Minke whale	0.07	<0.01	<0.01	260.92	36.24	22.82
	Humpback whale	0.02	<0.01	<0.01	68.80	9.56	6.02
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	17.39	2.42	1.52
	Sei whale[a]	<0.01	<0.01	<0.01	12.89	1.79	1.13
MF	Atlantic white sided dolphin	0	0	0	630.89	87.63	55.19
	Atlantic spotted dolphin	0	0	0	49.91	6.93	4.37
	Common dolphin	0	0	0	5900.35	819.58	516.16
	Bottlenose dolphin, offshore	0	0	0	519.16	72.11	45.42
	Risso's dolphin	0	0	0	38.53	5.35	3.37
	Long-finned pilot whale	0	0	0	68.35	9.49	5.98
	Short-finned pilot whale	0	0	0	17.09	2.37	1.49
	Sperm whale[a]	0	0	0	21.32	2.96	1.86
HF	Harbor porpoise	0.09	<0.01	<0.01	481.56	66.89	42.13
PPW	Gray seal	<0.01	0	0	227.41	31.59	19.89
	Harbor seal	<0.01	0	0	341.12	47.38	29.84
	Harp seal	<0.01	0	0	243.66	33.84	21.31

[a] Listed as Endangered under the ESA.

Table 36. Construction Schedule A, Year 3, Site M2: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.01	<0.01	<0.01	41.58	5.78	3.64
	Minke whale	0.03	<0.01	<0.01	113.35	15.74	9.92
	Humpback whale	<0.01	<0.01	<0.01	31.94	4.44	2.79
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	8.85	1.23	0.77
	Sei whale[a]	<0.01	<0.01	<0.01	6.95	0.97	0.61
MF	Atlantic white sided dolphin	0	0	0	293.28	40.74	25.66
	Atlantic spotted dolphin	0	0	0	23.09	3.21	2.02
	Common dolphin	0	0	0	2539.08	352.69	222.12
	Bottlenose dolphin, offshore	0	0	0	232.95	32.36	20.38
	Risso's dolphin	0	0	0	17.18	2.39	1.50
	Long-finned pilot whale	0	0	0	31.07	4.32	2.72
	Short-finned pilot whale	0	0	0	7.77	1.08	0.68
	Sperm whale[a]	0	0	0	9.74	1.35	0.85
HF	Harbor porpoise	0.04	<0.01	<0.01	231.80	32.20	20.28
PPW	Gray seal	<0.01	0	0	129.92	18.05	11.37
	Harbor seal	<0.01	0	0	194.88	27.07	17.05
	Harp seal	<0.01	0	0	139.20	19.34	12.18

[a] Listed as Endangered under the ESA.

K.3.3.4 Maximum

Table 37. Construction Schedule A, All Years Summed, Max: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.04	<0.01	<0.01	143.37	21.32	13.17
	Minke whale	0.11	<0.01	<0.01	374.26	55.64	34.38
	Humpback whale	0.03	<0.01	<0.01	100.74	14.98	9.25
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	26.24	3.90	2.41
	Sei whale[a]	<0.01	<0.01	<0.01	19.84	2.95	1.82
MF	Atlantic white sided dolphin	0	0	0	924.17	137.40	84.91
	Atlantic spotted dolphin	0	0	0	73.00	10.85	6.71
	Common dolphin	0	0	0	8439.42	1254.74	775.35
	Bottlenose dolphin, offshore	0	0	0	752.11	111.82	69.10
	Risso's dolphin	0	0	0	55.71	8.28	5.12
	Long-finned pilot whale	0	0	0	99.42	14.78	9.13
	Short-finned pilot whale	0	0	0	24.85	3.70	2.28
	Sperm whale[a]	0	0	0	31.05	4.62	2.85
HF	Harbor porpoise	0.16	<0.01	<0.01	713.36	106.06	65.54
PPW	Gray seal	<0.01	0	0	357.33	53.13	32.83
	Harbor seal	<0.01	0	0	536.00	79.69	49.24
	Harp seal	<0.01	0	0	382.86	56.92	35.17

[a] Listed as Endangered under the ESA.

Table 38. Construction Schedule A, Year 2, Max: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.03	<0.01	<0.01	101.78	15.13	9.35
	Minke whale	0.08	<0.01	<0.01	260.92	38.79	23.97
	Humpback whale	0.02	<0.01	<0.01	68.80	10.23	6.32
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	17.39	2.59	1.60
	Sei whale[a]	<0.01	<0.01	<0.01	12.89	1.92	1.18
MF	Atlantic white sided dolphin	0	0	0	630.89	93.80	57.96
	Atlantic spotted dolphin	0	0	0	49.91	7.42	4.58
	Common dolphin	0	0	0	5900.35	877.24	542.08
	Bottlenose dolphin, offshore	0	0	0	519.16	77.19	47.70
	Risso's dolphin	0	0	0	38.53	5.73	3.54
	Long-finned pilot whale	0	0	0	68.35	10.16	6.28
	Short-finned pilot whale	0	0	0	17.09	2.54	1.57
	Sperm whale[a]	0	0	0	21.32	3.17	1.96
HF	Harbor porpoise	0.11	<0.01	<0.01	481.56	71.60	44.24
PPW	Gray seal	<0.01	0	0	227.41	33.81	20.89
	Harbor seal	<0.01	0	0	341.12	50.72	31.34
	Harp seal	<0.01	0	0	243.66	36.23	22.39

[a] Listed as Endangered under the ESA.

Table 39. Construction Schedule A, Year 3, Max: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.01	<0.01	<0.01	41.58	6.18	3.82
	Minke whale	0.03	<0.01	<0.01	113.35	16.85	10.41
	Humpback whale	<0.01	<0.01	<0.01	31.94	4.75	2.93
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	8.85	1.32	0.81
	Sei whale[a]	<0.01	<0.01	<0.01	6.95	1.03	0.64
MF	Atlantic white sided dolphin	0	0	0	293.28	43.60	26.94
	Atlantic spotted dolphin	0	0	0	23.09	3.43	2.12
	Common dolphin	0	0	0	2539.08	377.50	233.27
	Bottlenose dolphin, offshore	0	0	0	232.95	34.63	21.40
	Risso's dolphin	0	0	0	17.18	2.55	1.58
	Long-finned pilot whale	0	0	0	31.07	4.62	2.85
	Short-finned pilot whale	0	0	0	7.77	1.15	0.71
	Sperm whale[a]	0	0	0	9.74	1.45	0.89
HF	Harbor porpoise	0.05	<0.01	<0.01	231.80	34.46	21.30
PPW	Gray seal	<0.01	0	0	129.92	19.32	11.94
	Harbor seal	<0.01	0	0	194.88	28.97	17.90
	Harp seal	<0.01	0	0	139.20	20.70	12.79

[a] Listed as Endangered under the ESA.

K.3.4. Construction Schedule B Estimates

K.3.4.1 Site J1

Table 40. Construction Schedule B, All Years Summed, Site J1: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.04	<0.01	<0.01	129.57	21.69	13.40
	Minke whale	0.13	<0.01	<0.01	393.68	65.90	40.72
	Humpback whale	0.03	<0.01	<0.01	96.19	16.10	9.95
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	26.30	4.40	2.72
	Sei whale[a]	<0.01	<0.01	<0.01	20.00	3.35	2.07
MF	Atlantic white sided dolphin	0	0	0	898.59	150.43	92.95
	Atlantic spotted dolphin	0	0	0	56.34	9.43	5.83
	Common dolphin	0	0	0	7237.58	1211.60	748.69
	Bottlenose dolphin, offshore	0	0	0	656.82	109.95	67.94
	Risso's dolphin	0	0	0	46.25	7.74	4.78
	Long-finned pilot whale	0	0	0	88.30	14.78	9.13
	Short-finned pilot whale	0	0	0	22.07	3.70	2.28
	Sperm whale[a]	0	0	0	25.19	4.22	2.61
HF	Harbor porpoise	0.15	0.01	<0.01	684.22	114.54	70.78
PPW	Gray seal	<0.01	0	0	368.51	61.69	38.12
	Harbor seal	<0.01	0	0	552.77	92.54	57.18
	Harp seal	<0.01	0	0	394.84	66.10	40.84

[a] Listed as Endangered under the ESA.

Table 41. Construction Schedule B, Year 2, Site J1: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.02	<0.01	<0.01	52.76	8.83	5.46
	Minke whale	0.05	<0.01	<0.01	165.66	27.73	17.14
	Humpback whale	0.01	<0.01	<0.01	40.27	6.74	4.17
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	11.79	1.97	1.22
	Sei whale[a]	<0.01	<0.01	<0.01	8.78	1.47	0.91
MF	Atlantic white sided dolphin	0	0	0	379.48	63.53	39.25
	Atlantic spotted dolphin	0	0	0	25.03	4.19	2.59
	Common dolphin	0	0	0	3080.69	515.72	318.68
	Bottlenose dolphin, offshore	0	0	0	272.25	45.58	28.16
	Risso's dolphin	0	0	0	19.69	3.30	2.04
	Long-finned pilot whale	0	0	0	36.79	6.16	3.81
	Short-finned pilot whale	0	0	0	9.20	1.54	0.95
	Sperm whale[a]	0	0	0	10.76	1.80	1.11
HF	Harbor porpoise	0.06	<0.01	<0.01	304.10	50.91	31.46
PPW	Gray seal	<0.01	0	0	164.99	27.62	17.07
	Harbor seal	<0.01	0	0	247.48	41.43	25.60
	Harp seal	<0.01	0	0	176.77	29.59	18.29

[a] Listed as Endangered under the ESA.

Table 42. Construction Schedule B, Year 3, Site J1: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.02	<0.01	<0.01	53.82	9.01	5.57
	Minke whale	0.05	<0.01	<0.01	151.13	25.30	15.63
	Humpback whale	0.01	<0.01	<0.01	36.80	6.16	3.81
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	8.63	1.44	0.89
	Sei whale[a]	<0.01	<0.01	<0.01	6.68	1.12	0.69
MF	Atlantic white sided dolphin	0	0	0	337.07	56.43	34.87
	Atlantic spotted dolphin	0	0	0	20.96	3.51	2.17
	Common dolphin	0	0	0	2901.79	485.77	300.17
	Bottlenose dolphin, offshore	0	0	0	265.71	44.48	27.49
	Risso's dolphin	0	0	0	18.57	3.11	1.92
	Long-finned pilot whale	0	0	0	34.95	5.85	3.62
	Short-finned pilot whale	0	0	0	8.74	1.46	0.90
	Sperm whale[a]	0	0	0	10.44	1.75	1.08
HF	Harbor porpoise	0.05	<0.01	<0.01	234.75	39.30	24.28
PPW	Gray seal	<0.01	0	0	115.12	19.27	11.91
	Harbor seal	<0.01	0	0	172.68	28.91	17.86
	Harp seal	<0.01	0	0	123.34	20.65	12.76

[a] Listed as Endangered under the ESA.

Table 43. Construction Schedule B, Year 4, Site J1: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	<0.01	<0.01	<0.01	22.99	3.85	2.38
	Minke whale	0.03	<0.01	<0.01	76.89	12.87	7.95
	Humpback whale	<0.01	<0.01	<0.01	19.11	3.20	1.98
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	5.88	0.98	0.61
	Sei whale[a]	<0.01	<0.01	<0.01	4.55	0.76	0.47
MF	Atlantic white sided dolphin	0	0	0	182.04	30.47	18.83
	Atlantic spotted dolphin	0	0	0	10.36	1.73	1.07
	Common dolphin	0	0	0	1255.10	210.11	129.83
	Bottlenose dolphin, offshore	0	0	0	118.86	19.90	12.30
	Risso's dolphin	0	0	0	7.98	1.34	0.83
	Long-finned pilot whale	0	0	0	16.56	2.77	1.71
	Short-finned pilot whale	0	0	0	4.14	0.69	0.43
	Sperm whale[a]	0	0	0	3.99	0.67	0.41
HF	Harbor porpoise	0.03	<0.01	<0.01	145.37	24.34	15.04
PPW	Gray seal	<0.01	0	0	88.41	14.80	9.15
	Harbor seal	<0.01	0	0	132.61	22.20	13.72
	Harp seal	<0.01	0	0	94.72	15.86	9.80

[a] Listed as Endangered under the ESA.

K.3.4.2 Site M1

Table 44. Construction Schedule B, All Years Summed, Site M1: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.04	<0.01	<0.01	116.87	20.13	12.61
	Minke whale	0.13	<0.01	<0.01	355.10	61.17	38.30
	Humpback whale	0.03	<0.01	<0.01	86.76	14.94	9.36
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	23.72	4.09	2.56
	Sei whale[a]	<0.01	<0.01	<0.01	18.04	3.11	1.95
MF	Atlantic white sided dolphin	0	0	0	810.53	139.62	87.43
	Atlantic spotted dolphin	0	0	0	50.82	8.75	5.48
	Common dolphin	0	0	0	6528.34	1124.52	704.19
	Bottlenose dolphin, offshore	0	0	0	592.46	102.05	63.91
	Risso's dolphin	0	0	0	41.71	7.19	4.50
	Long-finned pilot whale	0	0	0	79.64	13.72	8.59
	Short-finned pilot whale	0	0	0	19.91	3.43	2.15
	Sperm whale[a]	0	0	0	22.72	3.91	2.45
HF	Harbor porpoise	0.17	<0.01	<0.01	617.17	106.31	66.57
PPW	Gray seal	<0.01	0	0	332.40	57.26	35.85
	Harbor seal	<0.01	0	0	498.60	85.89	53.78
	Harp seal	<0.01	0	0	356.15	61.35	38.42

[a] Listed as Endangered under the ESA.

Table 45. Construction Schedule B, Year 2, Site M1: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.02	<0.01	<0.01	47.59	8.20	5.13
	Minke whale	0.05	<0.01	<0.01	149.42	25.74	16.12
	Humpback whale	0.01	<0.01	<0.01	36.33	6.26	3.92
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	10.63	1.83	1.15
	Sei whale[a]	<0.01	<0.01	<0.01	7.92	1.36	0.85
MF	Atlantic white sided dolphin	0	0	0	342.29	58.96	36.92
	Atlantic spotted dolphin	0	0	0	22.57	3.89	2.44
	Common dolphin	0	0	0	2778.80	478.66	299.74
	Bottlenose dolphin, offshore	0	0	0	245.57	42.30	26.49
	Risso's dolphin	0	0	0	17.76	3.06	1.92
	Long-finned pilot whale	0	0	0	33.18	5.72	3.58
	Short-finned pilot whale	0	0	0	8.30	1.43	0.89
	Sperm whale[a]	0	0	0	9.71	1.67	1.05
HF	Harbor porpoise	0.08	<0.01	<0.01	274.30	47.25	29.59
PPW	Gray seal	<0.01	0	0	148.82	25.63	16.05
	Harbor seal	<0.01	0	0	223.23	38.45	24.08
	Harp seal	<0.01	0	0	159.45	27.47	17.20

[a] Listed as Endangered under the ESA.

Table 46. Construction Schedule B, Year 3, Site M1: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.02	<0.01	<0.01	48.55	8.36	5.24
	Minke whale	0.05	<0.01	<0.01	136.32	23.48	14.70
	Humpback whale	0.01	<0.01	<0.01	33.19	5.72	3.58
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	7.78	1.34	0.84
	Sei whale[a]	<0.01	<0.01	<0.01	6.02	1.04	0.65
MF	Atlantic white sided dolphin	0	0	0	304.04	52.37	32.80
	Atlantic spotted dolphin	0	0	0	18.90	3.26	2.04
	Common dolphin	0	0	0	2617.43	450.86	282.33
	Bottlenose dolphin, offshore	0	0	0	239.67	41.28	25.85
	Risso's dolphin	0	0	0	16.75	2.89	1.81
	Long-finned pilot whale	0	0	0	31.53	5.43	3.40
	Short-finned pilot whale	0	0	0	7.88	1.36	0.85
	Sperm whale[a]	0	0	0	9.41	1.62	1.02
HF	Harbor porpoise	0.06	<0.01	<0.01	211.74	36.47	22.84
PPW	Gray seal	<0.01	0	0	103.84	17.89	11.20
	Harbor seal	<0.01	0	0	155.76	26.83	16.80
	Harp seal	<0.01	0	0	111.26	19.16	12.00

[a] Listed as Endangered under the ESA.

Table 47. Construction Schedule B, Year 4, Site M1: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	<0.01	<0.01	<0.01	20.73	3.57	2.24
	Minke whale	0.03	<0.01	<0.01	69.35	11.95	7.48
	Humpback whale	<0.01	<0.01	<0.01	17.24	2.97	1.86
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	5.30	0.91	0.57
	Sei whale[a]	<0.01	<0.01	<0.01	4.10	0.71	0.44
MF	Atlantic white sided dolphin	0	0	0	164.20	28.28	17.71
	Atlantic spotted dolphin	0	0	0	9.34	1.61	1.01
	Common dolphin	0	0	0	1132.11	195.01	122.12
	Bottlenose dolphin, offshore	0	0	0	107.21	18.47	11.56
	Risso's dolphin	0	0	0	7.20	1.24	0.78
	Long-finned pilot whale	0	0	0	14.93	2.57	1.61
	Short-finned pilot whale	0	0	0	3.73	0.64	0.40
	Sperm whale[a]	0	0	0	3.60	0.62	0.39
HF	Harbor porpoise	0.04	<0.01	<0.01	131.12	22.59	14.14
PPW	Gray seal	<0.01	0	0	79.75	13.74	8.60
	Harbor seal	<0.01	0	0	119.62	20.60	12.90
	Harp seal	<0.01	0	0	85.44	14.72	9.22

[a] Listed as Endangered under the ESA.

K.3.4.3 Site M2

Table 48. Construction Schedule B, All Years Summed, Site M2: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.04	<0.01	<0.01	145.89	20.26	12.76
	Minke whale	0.12	<0.01	<0.01	443.27	61.57	38.78
	Humpback whale	0.03	<0.01	<0.01	108.30	15.04	9.47
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	29.61	4.11	2.59
	Sei whale[a]	<0.01	<0.01	<0.01	22.52	3.13	1.97
MF	Atlantic white sided dolphin	0	0	0	1011.78	140.54	88.51
	Atlantic spotted dolphin	0	0	0	63.44	8.81	5.55
	Common dolphin	0	0	0	8149.26	1131.97	712.89
	Bottlenose dolphin, offshore	0	0	0	739.56	102.73	64.70
	Risso's dolphin	0	0	0	52.07	7.23	4.56
	Long-finned pilot whale	0	0	0	99.42	13.81	8.70
	Short-finned pilot whale	0	0	0	24.85	3.45	2.17
	Sperm whale[a]	0	0	0	28.36	3.94	2.48
HF	Harbor porpoise	0.15	<0.01	<0.01	770.41	107.01	67.40
PPW	Gray seal	<0.01	0	0	414.93	57.64	36.30
	Harbor seal	<0.01	0	0	622.40	86.45	54.45
	Harp seal	<0.01	0	0	444.57	61.75	38.89

[a] Listed as Endangered under the ESA.

Table 49. Construction Schedule B, Year 2, Site M2: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.02	<0.01	<0.01	59.40	8.25	5.20
	Minke whale	0.05	<0.01	<0.01	186.52	25.91	16.32
	Humpback whale	0.01	<0.01	<0.01	45.35	6.30	3.97
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	13.27	1.84	1.16
	Sei whale[a]	<0.01	<0.01	<0.01	9.88	1.37	0.86
MF	Atlantic white sided dolphin	0	0	0	427.28	59.35	37.38
	Atlantic spotted dolphin	0	0	0	28.18	3.91	2.47
	Common dolphin	0	0	0	3468.75	481.82	303.44
	Bottlenose dolphin, offshore	0	0	0	306.55	42.58	26.82
	Risso's dolphin	0	0	0	22.17	3.08	1.94
	Long-finned pilot whale	0	0	0	41.42	5.75	3.62
	Short-finned pilot whale	0	0	0	10.36	1.44	0.91
	Sperm whale[a]	0	0	0	12.12	1.68	1.06
HF	Harbor porpoise	0.06	<0.01	<0.01	342.41	47.56	29.95
PPW	Gray seal	<0.01	0	0	185.77	25.80	16.25
	Harbor seal	<0.01	0	0	278.65	38.71	24.38
	Harp seal	<0.01	0	0	199.04	27.65	17.41

[a] Listed as Endangered under the ESA.

Table 50. Construction Schedule B, Year 3, Site M2: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.02	<0.01	<0.01	60.60	8.42	5.30
	Minke whale	0.04	<0.01	<0.01	170.17	23.64	14.89
	Humpback whale	0.01	<0.01	<0.01	41.44	5.76	3.62
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	9.71	1.35	0.85
	Sei whale[a]	<0.01	<0.01	<0.01	7.52	1.04	0.66
MF	Atlantic white sided dolphin	0	0	0	379.53	52.72	33.20
	Atlantic spotted dolphin	0	0	0	23.60	3.28	2.06
	Common dolphin	0	0	0	3267.31	453.84	285.82
	Bottlenose dolphin, offshore	0	0	0	299.18	41.56	26.17
	Risso's dolphin	0	0	0	20.91	2.91	1.83
	Long-finned pilot whale	0	0	0	39.35	5.47	3.44
	Short-finned pilot whale	0	0	0	9.84	1.37	0.86
	Sperm whale[a]	0	0	0	11.75	1.63	1.03
HF	Harbor porpoise	0.05	<0.01	<0.01	264.32	36.72	23.12
PPW	Gray seal	<0.01	0	0	129.62	18.00	11.34
	Harbor seal	<0.01	0	0	194.43	27.01	17.01
	Harp seal	<0.01	0	0	138.88	19.29	12.15

[a] Listed as Endangered under the ESA.

Table 51. Construction Schedule B, Year 4, Site M2: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	<0.01	<0.01	<0.01	25.88	3.60	2.26
	Minke whale	0.02	<0.01	<0.01	86.57	12.03	7.57
	Humpback whale	<0.01	<0.01	<0.01	21.52	2.99	1.88
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	6.62	0.92	0.58
	Sei whale[a]	<0.01	<0.01	<0.01	5.12	0.71	0.45
MF	Atlantic white sided dolphin	0	0	0	204.97	28.47	17.93
	Atlantic spotted dolphin	0	0	0	11.66	1.62	1.02
	Common dolphin	0	0	0	1413.20	196.30	123.63
	Bottlenose dolphin, offshore	0	0	0	133.83	18.59	11.71
	Risso's dolphin	0	0	0	8.99	1.25	0.79
	Long-finned pilot whale	0	0	0	18.64	2.59	1.63
	Short-finned pilot whale	0	0	0	4.66	0.65	0.41
	Sperm whale[a]	0	0	0	4.49	0.62	0.39
HF	Harbor porpoise	0.03	<0.01	<0.01	163.68	22.74	14.32
PPW	Gray seal	<0.01	0	0	99.55	13.83	8.71
	Harbor seal	<0.01	0	0	149.32	20.74	13.06
	Harp seal	<0.01	0	0	106.66	14.81	9.33

[a] Listed as Endangered under the ESA.

K.3.4.4 Maximum

Table 52. Construction Schedule B, All Years Summed, Max: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.04	<0.01	<0.01	145.89	21.69	13.40
	Minke whale	0.13	<0.01	<0.01	443.27	65.90	40.72
	Humpback whale	0.03	<0.01	<0.01	108.30	16.10	9.95
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	29.61	4.40	2.72
	Sei whale[a]	<0.01	<0.01	<0.01	22.52	3.35	2.07
MF	Atlantic white sided dolphin	0	0	0	1011.78	150.43	92.95
	Atlantic spotted dolphin	0	0	0	63.44	9.43	5.83
	Common dolphin	0	0	0	8149.26	1211.60	748.69
	Bottlenose dolphin, offshore	0	0	0	739.56	109.95	67.94
	Risso's dolphin	0	0	0	52.07	7.74	4.78
	Long-finned pilot whale	0	0	0	99.42	14.78	9.13
	Short-finned pilot whale	0	0	0	24.85	3.70	2.28
	Sperm whale[a]	0	0	0	28.36	4.22	2.61
HF	Harbor porpoise	0.17	0.01	<0.01	770.41	114.54	70.78
PPW	Gray seal	<0.01	0	0	414.93	61.69	38.12
	Harbor seal	<0.01	0	0	622.40	92.54	57.18
	Harp seal	<0.01	0	0	444.57	66.10	40.84

[a] Listed as Endangered under the ESA.

Table 53. Construction Schedule B, Year 2, Max: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.02	<0.01	<0.01	59.40	8.83	5.46
	Minke whale	0.05	<0.01	<0.01	186.52	27.73	17.14
	Humpback whale	0.01	<0.01	<0.01	45.35	6.74	4.17
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	13.27	1.97	1.22
	Sei whale[a]	<0.01	<0.01	<0.01	9.88	1.47	0.91
MF	Atlantic white sided dolphin	0	0	0	427.28	63.53	39.25
	Atlantic spotted dolphin	0	0	0	28.18	4.19	2.59
	Common dolphin	0	0	0	3468.75	515.72	318.68
	Bottlenose dolphin, offshore	0	0	0	306.55	45.58	28.16
	Risso's dolphin	0	0	0	22.17	3.30	2.04
	Long-finned pilot whale	0	0	0	41.42	6.16	3.81
	Short-finned pilot whale	0	0	0	10.36	1.54	0.95
	Sperm whale[a]	0	0	0	12.12	1.80	1.11
HF	Harbor porpoise	0.08	<0.01	<0.01	342.41	50.91	31.46
PPW	Gray seal	<0.01	0	0	185.77	27.62	17.07
	Harbor seal	<0.01	0	0	278.65	41.43	25.60
	Harp seal	<0.01	0	0	199.04	29.59	18.29

[a] Listed as Endangered under the ESA.

Table 54. Construction Schedule B, Year 3, Max: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	0.02	<0.01	<0.01	60.60	9.01	5.57
	Minke whale	0.05	<0.01	<0.01	170.17	25.30	15.63
	Humpback whale	0.01	<0.01	<0.01	41.44	6.16	3.81
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	9.71	1.44	0.89
	Sei whale[a]	<0.01	<0.01	<0.01	7.52	1.12	0.69
MF	Atlantic white sided dolphin	0	0	0	379.53	56.43	34.87
	Atlantic spotted dolphin	0	0	0	23.60	3.51	2.17
	Common dolphin	0	0	0	3267.31	485.77	300.17
	Bottlenose dolphin, offshore	0	0	0	299.18	44.48	27.49
	Risso's dolphin	0	0	0	20.91	3.11	1.92
	Long-finned pilot whale	0	0	0	39.35	5.85	3.62
	Short-finned pilot whale	0	0	0	9.84	1.46	0.90
	Sperm whale[a]	0	0	0	11.75	1.75	1.08
HF	Harbor porpoise	0.06	<0.01	<0.01	264.32	39.30	24.28
PPW	Gray seal	<0.01	0	0	129.62	19.27	11.91
	Harbor seal	<0.01	0	0	194.43	28.91	17.86
	Harp seal	<0.01	0	0	138.88	20.65	12.76

[a] Listed as Endangered under the ESA.

Table 55. Construction Schedule B, Year 4, Max: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation.

Species		Injury			Behavior		
		Attenuation (dB)			Attenuation (dB)		
		0	10	12	0	10	12
LF	Fin whale[a]	<0.01	<0.01	<0.01	25.88	3.85	2.38
	Minke whale	0.03	<0.01	<0.01	86.57	12.87	7.95
	Humpback whale	<0.01	<0.01	<0.01	21.52	3.20	1.98
	North Atlantic right whale[a]	<0.01	<0.01	<0.01	6.62	0.98	0.61
	Sei whale[a]	<0.01	<0.01	<0.01	5.12	0.76	0.47
MF	Atlantic white sided dolphin	0	0	0	204.97	30.47	18.83
	Atlantic spotted dolphin	0	0	0	11.66	1.73	1.07
	Common dolphin	0	0	0	1413.20	210.11	129.83
	Bottlenose dolphin, offshore	0	0	0	133.83	19.90	12.30
	Risso's dolphin	0	0	0	8.99	1.34	0.83
	Long-finned pilot whale	0	0	0	18.64	2.77	1.71
	Short-finned pilot whale	0	0	0	4.66	0.69	0.43
	Sperm whale[a]	0	0	0	4.49	0.67	0.41
HF	Harbor porpoise	0.04	<0.01	<0.01	163.68	24.34	15.04
PPW	Gray seal	<0.01	0	0	99.55	14.80	9.15
	Harbor seal	<0.01	0	0	149.32	22.20	13.72
	Harp seal	<0.01	0	0	106.66	15.86	9.80

[a] Listed as Endangered under the ESA.

K.4. Summary

Marine mammal PTS injury is unlikely to occur from the proposed drilling construction because the ranges are <100 m at both sites for all hearing groups, except for low-frequency and high-frequency animals animals (FHWG 2008) whose predicted maximum acoustic ranges are ~300 m, with the furthest acoustic ranges predicted at the M2 site. Injury is not expected to occur for sea turtles as the ranges to threshold are detected at all the modeled locations. These distances may be considered conservative, because animals will be moving through the area during the potential 24-hour drilling activity per day.

The acoustic ranges to the behavioral thresholds for marine mammal hearing groups sounds SPL 120 dB re 1 µPa threshold (NMFS 2018) and sea turtles SPL 175 dB re 1 µPa threshold, without frequency weighting, are shown in Table 18-22 for locations J1, M1, and M2. The tables capture the ranges at attenuations, 0 dB, 10 dB, and 12 dB. The maximum unweighted behavioral acoustic ranges were found to extend to 20.73 km at J1, 21.65 km at M1, and 25.37 km at M2 location. Excluding 5% of the farthest points ($R_{95\%}$), the behavioral threshold ranges were 17.76 km at J1, 16.62 km at M1 and 19.67 at M2 location.

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