Empire Offshore Wind: Empire Wind Project (EW 1 and EW 2)

Request for Rulemaking and Letter of Authorization for Taking of Marine Mammals Incidental to Construction Activities on the Outer Continental Shelf (OCS) within Lease OCS-A 0512 and Associated Submarine Export Cable Routes

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ACRONYMS AND ABBREVIATIONS

°C	degree Celsius
μPa	microPascal
ac	acre
Applicant	Empire
BOEM	Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
CRM	Coastal Relief Model
COP	Construction and Operations Plan
dB	decibel
DMA	Dynamic Management Area
Empire	Empire Offshore Wind LLC
ESA	Endangered Species Act
EW 1	Empire Wind 1
EW 2	Empire Wind 2
ft	feet
FWRAM	Full Wave Range Dependent Acoustic Model
GEODAS	Geophysical Data System
GPS	global positioning system
ha	hectare
HDD	horizontal directional drilling
HF	high frequency
HRG	high-resolution geophysical
Hz	hertz
kJ	kilojoule
kHz	kilohertz
km	kilometer
km/h	kilometer per hour
km^2	square kilometer
L01	sound field representative location 1
L02	sound field representative location 2
L03	sound field representative location 3
L_E	L_E = unweighted sound exposure level (dB re 1 $\mu Pa^2 \cdot s$)
L_P	Lp= unweighted sound pressure (dB re 1 μPa)
L_{PK}	peak sound pressure
Lease Area	designated Renewable Energy Lease Area OCS-A 0512
LF	low frequency
m	meter
MBES	multi-beam echosounder
MEC	munitions and explosives of concern
mi	mile
MF	mid-frequency
MMPA	Marine Mammal Protection Act
MONM	Marine Operations Noise Model

ms	milliseconds
NARW	North Atlantic right whale
NGDC	National Geophysical Data Center
nm	nautical mile
NOAA	National Oceanographic and Atmospheric Administration
NOAA Fisheries	NOAA's National Marine Fisheries Service
OAS	obstacle avoidance sonar
OCS	Outer Continental Shelf
OSS 1	Offshore Substation for EW 1, also sound field representative location for Offshore Substation 1
OSS 2	Offshore Substation for EW 2, also sound field representative location for Offshore Substation 2
OW	Otariids Underwater
PAM	passive acoustic monitoring
PBR	potential biological removal
PK	peak sound exposure
POI	Point of Interconnection
PW	Phocids Underwater
ppt	part per thousand
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).
PSO	Protected Species Observer
PTS	permanent threshold shift
PT/MAG	Pipe Tracker/Magnetometer
R3-L04	sound field representative location 4 with harder soil conditions
R3-L07	sound field representative location 7 with harder soil conditions
RMS	root-mean square
ROW	right of way
SAR	Stock Assessment Report
SBP	sub-bottom profiler
SEL	Sound Exposure Level
SEL_{cum}	Cumulative Sound Exposure Level
SMA	Seasonal Management Area
SPL	sound pressure level
SSP	sound speed profile
SSS	sidescan sonar
T1-L05	sound field representative location 5 with normal soil conditions
T1-L08	sound field representative location 8 with normal soil conditions
TP	transition piece
TTS	temporary threshold shift
U3-L06	sound field representative location 6 with softer soil conditions
U3-L09	sound field representative location 9 with softer soil conditions
UME	Unusual Mortality Event
USBL	ultra-short baseline
UXO	unexploded ordnance

WNANMCS	Western North Atlantic Northern Migratory Coastal Stock
WNAOS	Western North Atlantic Offshore Stock
ZOI	zone of influence

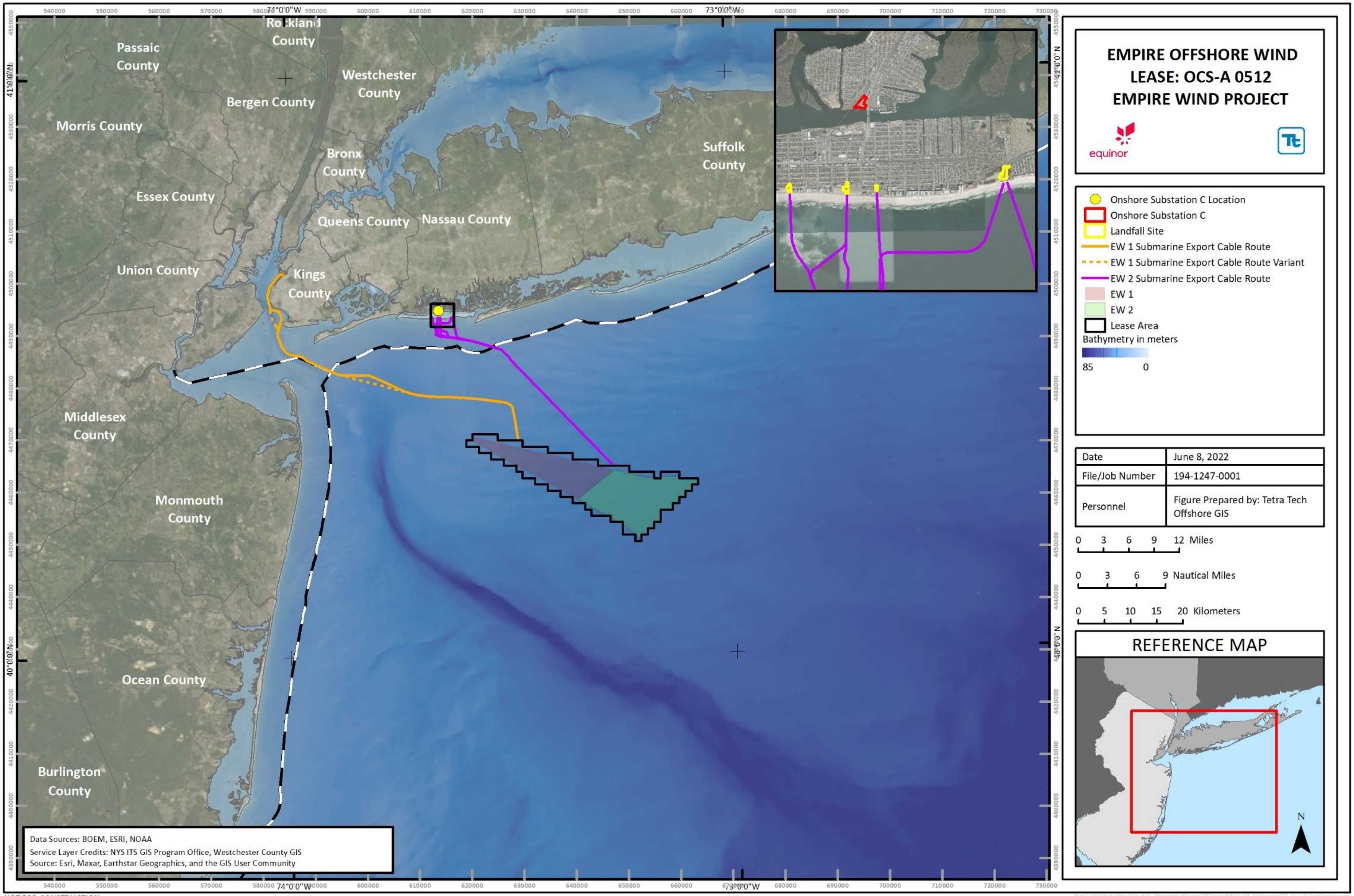
1. DESCRIPTION OF SPECIFIED ACTIVITY

1.1 Introduction

Empire Offshore Wind LLC (Empire, the Applicant) proposes to construct and operate an offshore wind farm located in the designated Renewable Energy Lease Area OCS-A 0512 (Lease Area; **Figure 1**) and in coastal waters where the submarine export cable routes will be established. The Applicant is proposing to develop the Lease Area in two wind farms in accordance with 30 Code of Federal Regulations (CFR) § 585.629. Empire Wind 1 (EW 1; western portion of Lease Area) and Empire Wind 2 (EW 2; eastern portion of Lease Area), being electrically isolated and independent from each other, will each be connected to their own points of interconnection (POIs) via individual submarine export cable routes. The Applicant submits this request for the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) to promulgate regulations and issue a Letter of Authorization (LOA) pursuant to Section 101(a)(5) of the Marine Mammal Protection Act (MMPA) and 50 CFR § 216 Subpart I to allow for the incidental harassment of small numbers of marine mammals resulting from survey and construction activities in the Project Area (Lease Area and submarine export cable siting corridors) during the development of EW 1 and EW 2. The Applicant intends to use high-resolution geophysical (HRG) equipment during survey activities in support of the Project; the Applicant also intends to use impact pile driving to install wind turbine generator (wind turbine) foundations and offshore substation foundations, and to use vibratory pile driving to install and remove temporary cofferdams to support horizontal directional drilling (HDD) at the export cable landfalls of the submarine export cables during offshore Project construction. Activities related to HRG surveys are proposed to initiate Q1 2024; cofferdam installation activities to initiate no earlier than Q1 2024 and impact pile driving activities are proposed to initiate no earlier than Q2 2025 (**Figure 2**). The Applicant is requesting authorization beginning in Q1 (January 01) 2024 through Q4 (December 31) 2028.

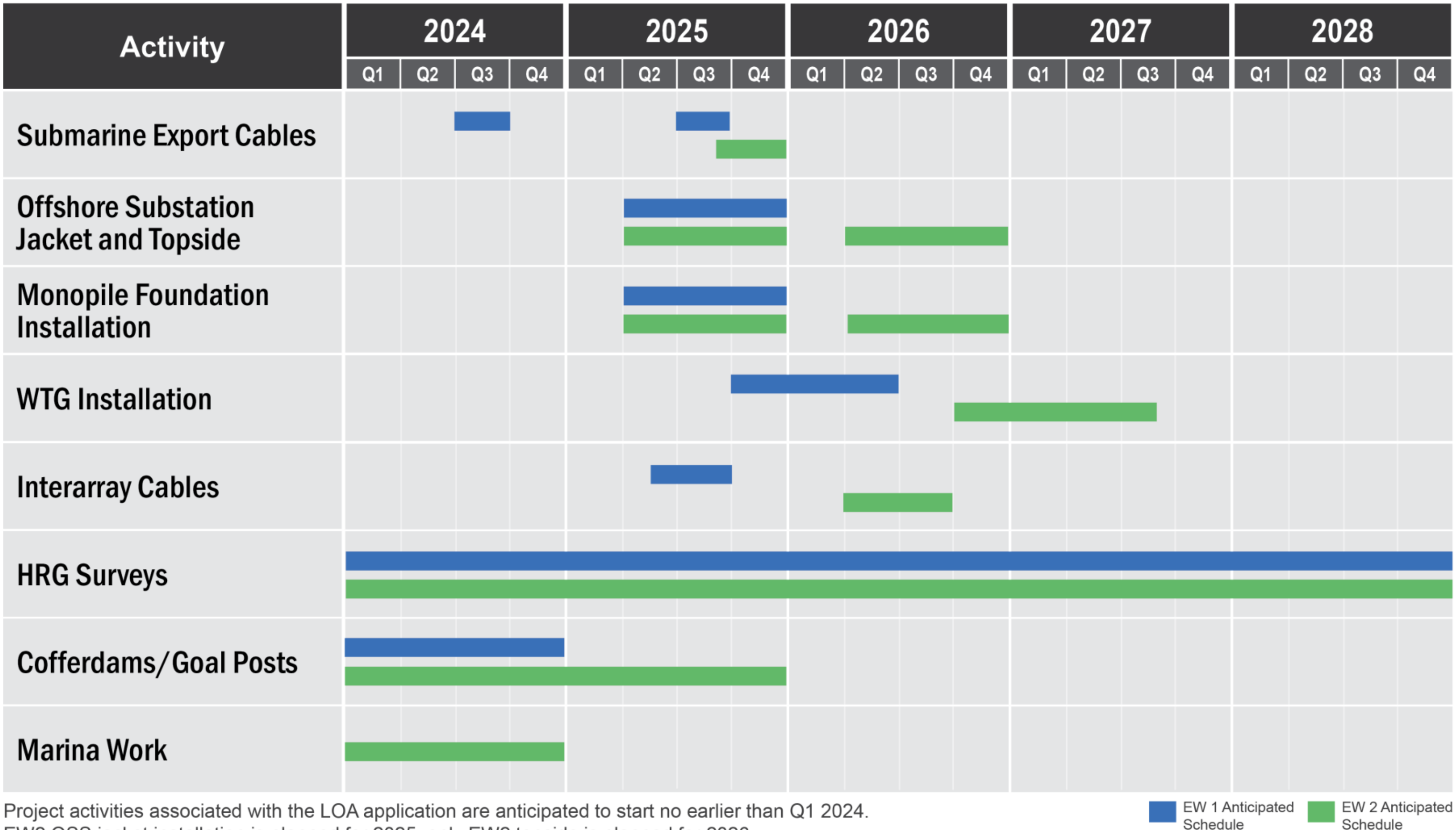
Both NOAA and the Bureau of Ocean Energy Management (BOEM) have advised that construction activities (including impact pile driving and vibratory driving) and sound producing HRG equipment operating below 180 kilohertz (kHz; e.g., sub-bottom profilers) have the potential to cause acoustic harassment to marine species, in particular marine mammals.

The regulations set forth in Section 101(a)(5) of the MMPA and 50 CFR § 216 Subpart I allow for the incidental take of marine mammals by a specific activity if the activity is found to have a negligible impact on the species or the stock(s) of marine mammals and will not result in unmitigable adverse impacts on the availability of the marine mammal species or stock(s) for certain subsistence uses. In order NOAA Fisheries to consider authorizing the taking by U.S. citizens of small numbers of marine mammals, incidental to a specified activity (other than commercial fishing), a written request must be submitted to the NOAA Assistant Administrator. This application constitutes such written request.



NOT FOR CONSTRUCTION

Figure 1 Empire Wind Project Area



Project activities associated with the LOA application are anticipated to start no earlier than Q1 2024.
EW2 OSS jacket installation is planned for 2025; only EW2 topside is planned for 2026.

Figure 2 Anticipated Construction Schedule

Note: Schedule shown represents current estimates at the time of LOA application submittal. Dates and durations could shift depending on factors such as weather delays, procurement, or contracting issues. HRG surveys could occur during any time of year but would not occur continuously.

1.2 Proposed Activity

The Applicant will conduct HRG surveys and install offshore infrastructure, including foundations, offshore substations, wind turbines, submarine export cables, interarray cables, and scour protection, within the approximately 79,350-acre (ac; 32,112 hectare [ha]) Lease Area and along the Project's submarine export cable routes between the Lease Area and the export cable landfalls. The applicant will also conduct marina work at the Onshore Substation C location. The Lease Area 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 1**). For the purpose of this application, the Project Area is defined as the Lease Area and both EW 1 and EW 2 submarine export cable siting corridors. Water depths in the Lease Area range from about 24 meters (m) (79 feet [ft]) to 43 m (141 ft). Project activities will include HRG survey activities, wind turbine and offshore substation foundation installation activities, and cable landfall and marina activities.

The purpose of the HRG surveys is to:

- Facilitate installation activities, including that of foundations, wind turbines, offshore substations, interarray cables, submarine export cables, and scour protection.

The purpose of the foundation installation is to:

- Install two offshore substation piled jacket foundations, with up to 6 legs and 12 piles each, within the Lease Area; and
- Install up to 147 wind turbine monopile foundations within the Lease Area.

The purpose of the cable landfall and marina activities is to transition the offshore export cable from the windfarm to the onshore export cable and onshore substation, which may entail:

- Installation of cofferdams at the exit points of the long-distance HDDs as part of landfall, if selected as the method for installation for each of the submarine export cables; or
- Installation of goal post piles for use during HDD activities to support casing pipe installation as part of landfall; and
- Removal of berthing piles and performing marina bulkhead work.

Under the MMPA, the "take" of marine mammals is prohibited, with certain exceptions. NOAA Fisheries and the U.S. Fish and Wildlife Service (USFWS) both share jurisdiction for overseeing the MMPA regulations. However, NOAA Fisheries is responsible for issuing take permits under MMPA, upon request, for authorization of incidental but not intentional "taking" of small numbers of cetaceans and pinnipeds by U.S. citizens or agencies who engage in a specified activity (other than commercial fishing) within a specified geographical region. The term "take," as defined in Section 3 (16 U.S.C. § 1362 [13]) of the MMPA, means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." "Harassment" was further defined in the 1994 amendments to the MMPA, with the designation of two levels of harassment; Level A and Level B. By definition, Level A harassment is any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock. Level B harassment is any act of pursuit, torment, or annoyance that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to; migration, breathing, nursing, breeding, feeding, or sheltering. NOAA Fisheries defines the threshold level for Level B harassment at a sound pressure level (SPL) root mean square (RMS) of 160 dB referenced at 1 microPascal (re 1 μPa) for impulsive/intermittent sound, averaged over the duration of the signal, and at 120 dB re 1 μPa for non-impulsive/continuous sound, with no relevant acceptable distance specified.

NOAA Fisheries provided guidance for assessing the impacts of anthropogenic sound on marine mammals under their regulatory jurisdiction, which includes whales, dolphins, seals, and sea lions; this was updated in 2018 (NOAA Fisheries 2018) from the previous guidance issued in 2016. The guidance specifically defines marine mammal hearing groups, develops auditory weighting functions, and identifies received levels, or acoustic threshold levels, above which individual marine mammals are predicted to experience changes in their hearing sensitivity (either a permanent threshold shift, PTS, or temporary threshold shift, TTS) for acute, incidental exposure to underwater sound. Under this guidance, any occurrence of PTS constitutes a Level A harassment, or injury, take. TTS and PTS effects may result from two characteristics of sound emitted by manmade sources: instantaneous peak sound pressure levels (L_{PK}) may cause damage to the inner ear, and/or the accumulated sound energy (cumulative sound exposure levels, SEL_{cum}) over the entire duration of a discrete or repeated noise exposure may induce auditory damage if it exceeds distinct threshold levels.

Research demonstrates that the frequency content of the sound plays a role in causing potential auditory damage. Sound outside the hearing range of the animal would be unlikely to affect its hearing, while the sound energy within the hearing range could be harmful. Under the NOAA Fisheries 2018 guidance, recognizing that marine mammal species do not have equal hearing capabilities, five hearing groups of marine mammals are defined as follows:

- Low-frequency (LF) Cetaceans - consists of the baleen whales (mysticetes) with a collective generalized hearing range of 7 Hz to 35 kilohertz (kHz).
- Mid-frequency (MF) Cetaceans - includes most of the dolphins, all toothed whales except for *Kogia* spp., and all the beaked and bottlenose whales with a generalized hearing range of approximately 150 Hz to 160 kHz.
- High-frequency (HF) Cetaceans - incorporates all of the true porpoises, the river dolphins, plus *Kogia* spp., *Cephalorhynchid* spp. (genus in the dolphin family Delphinidae), and two species of *Lagenorhynchus* (Peale's and hourglass dolphins) with a generalized hearing range estimated from 275 Hz to 160 kHz.
- Phocids Underwater (PW) - consists of true seals with a generalized underwater hearing range from 50 Hz to 86 kHz.
- Otariids Underwater (OW) - includes sea lions and fur seals with a generalized underwater hearing range from 60 Hz to 39 kHz.

Within these generalized hearing ranges, the ability to hear sounds varies with frequency, as demonstrated by examining audiograms of hearing sensitivity (NOAA Fisheries 2018; Southall et al. 2019). To reflect higher noise sensitivities at particular frequencies, auditory weighting functions were developed for each functional hearing group that reflected the best available data on hearing ability (composite audiograms), susceptibility to noise-induced hearing loss, impacts of noise on hearing, and data on equal latency (NOAA Fisheries 2018). These weighting functions are applied to individual sound received levels to reflect the susceptibility of each hearing group to noise-induced threshold shifts, which is not the same as the range of best hearing. NOAA Fisheries (2018) defined acoustic threshold levels at which PTS and TTS are predicted to occur for each hearing group for impulsive and non-impulsive signals (**Table 1**), which are presented in terms of dual metrics; cumulative sound energy level (SEL_{cum}) and L_{PK}.

Table 1 Acoustic Threshold Levels for Marine Mammals

Hearing Group	Impulsive Sounds			Non-Impulsive Sounds		
	PTS Onset	TTS Onset	Behavior	PTS Onset	TTS Onset	Behavior
Low-frequency cetaceans (LF)	219 dB (L_{PK}) 183 dB SEL	213 dB (L_{PK}) 168 dB SEL	160 dB SPL RMS	199 dB SEL	179 dB SEL	120 dB SPL RMS
Mid-frequency cetaceans (MF)	230 dB (L_{PK}) 185 dB SEL	224 dB (L_{PK}) 170 dB SEL		198 dB SEL	178 dB SEL	
High-frequency cetaceans (HF)	202 dB (L_{PK}) 155 dB SEL	196 dB (L_{PK}) 140 dB SEL		173 dB SEL	153 dB SEL	
Phocid pinnipeds underwater (PW)	218 dB (L_{PK}) 185 dB SEL	212 dB (L_{PK}) 170 dB SEL		201 dB SEL	181 dB SEL	

Sources: NOAA Fisheries 2018; Southall et al. 2019

Notes:
SEL = sound exposure level (dB re 1 μPa2·s); L_{PK} = peak sound pressure (dB re 1 μPa); RMS SPL = root mean square sound pressure (dB re 1 μPa); TTS = temporary threshold shift; PTS = permanent threshold shift

1.2.1 Foundation Installation

The Applicant will conduct pile driving activities to support installation of wind turbine and offshore substation foundations. Impact pile driving involves weighted hammers that drive a pile into the seafloor. Different methods for lifting the weight include the use of hydraulic, steam, or diesel-powered machines. The acoustic energy is created upon impact and the energy travels into the water along several different paths: (1) from the top of the pile where the hammer hits, through the air, into the water; (2) from the top of the pile, down the pile, radiating into the air while travelling down the pile, from air into water; (3) from the top of the pile, down the pile, radiating directly into the water from the length of pile below the waterline; and (4) down the pile radiating into the ground, travelling through the ground and radiating back into the water. Near the pile, acoustic energy arrives from different paths with different associated phase and time lags, which creates a pattern of destructive and constructive interference. Farther away from the pile, the water and seafloor born energy are the dominant pathways. The underwater noise generated by a pile-driving strike depends primarily on the following factors:

1. Geotechnical strength properties of the sediments at the installation location;
2. The impact energy and type of pile driving hammer;
3. The size and type of the pile; and
4. Water depth.

Empire anticipates that up to 147 wind turbine monopile foundations (138 wind turbine foundations for the total capacity and nine additional wind turbine foundations to allow for overplanting[1]) and two offshore

[1] Overplanting is currently under review for both EW 1 and EW 2. Overplanting is the installation of a number of wind turbines such that the total nameplate capacity exceeds the power generation target. Overplanting allows improvement in wind turbine availability (i.e., availability during maintenance outages) and potentially increased production at lower wind speeds. The Applicant is required to request additional capacity in its interconnection requests if additional

substation piled jacket foundations will be installed in the Lease Area within EW 1 and EW 2. Up to two wind turbine monopile foundations are expected to be installed per day. Monopile foundations will be tapered and will have a maximum diameter of 36.1 ft (11 m). The offshore substation piled jacket foundations will have up to 12 pin piles, each with a maximum diameter of 8.2 ft (2.5 m), and will have either 6 legs (2 pin piles per leg) or four legs (three pin piles per leg). Up to three pin piles are expected to be installed per day. No more than 24 wind turbine monopiles may be installed in any month and no more than 96 wind turbine monopiles may be installed in any year. Empire anticipates that 96 wind turbine monopiles will be installed in 2025 and the remaining 51 wind turbine monopiles will be installed in 2026, and that both offshore substation (OSS) piled jacket foundations will be constructed in 2025 and therefore estimates that a total of 24 pin piles will be installed in 2025. It is possible but not anticipated that wind turbine monopile foundations and OSS piled jacket foundations could be installed in later time periods (within the 5-year effective period of the LOA) should permitting or scheduling delays occur. Impact pile driving will not occur from January 1 through April 30. In addition, impact pile driving will not occur from December 1 through December 31, unless unanticipated delays due to weather or technical problems arise that necessitate extending pile driving into December. Only one foundation would be installed via pile driving at any given time for the Project.

The amount of sound generated during pile driving varies with the number of required strikes and the energy required to drive piles to a desired depth and depends on the sediment resistance encountered. Sediment types with greater resistance require higher hammer energy and/or an increased number of strikes relative to installations in softer sediment. The driving energy applied is adjusted to the soil resistance up to the maximum capacity of the hammer in use. Maximum sound levels usually occur during the last stage of impact pile driving where the greatest resistance is encountered . The make and model of impact hammers (IHC S-5500 and IHC S-4000 for wind turbine foundations and offshore substation jacket foundations respectively) and the representative hammering schedule used in the acoustic modeling effort were provided by Empire in coordination with potential hammer suppliers. Empire anticipates that monopiles would be 9.6 m in diameter, however, for softer soils there is the possibility that monopiles up to 11m in diameter may be necessary for purposes of pile loading and stability. For the purposes of this application, the Applicant considered representative hammering schedules for both typical monopile foundation locations and "difficult to drive" monopile foundation locations. Typical monopile foundation locations are those where the standard hammer energy (**Table 2**) would be sufficient to complete installation of the foundation to the target penetration depth. Typical monopile foundations were analyzed for both 9.6-m and 11-m diameter piles at various embedment depths (see Section 6). "Difficult to drive" foundation locations would require higher hammer energies (**Table 3**) and/or additional hammer strikes to complete foundation installation to the target penetration depth. Difficult-to-drive scenarios would only utilize 9.6-m piles, as the larger 11-m diameter monopiles could not be driven to the target embedment depth in the soil conditions associated with difficult to drive locations. The Applicant estimates that as many as 17 total foundations may be difficult to drive (including as many as 7 difficult to drive foundations for EW 1 and as many as 10 difficult to drive foundations for EW 2). This number represents a conservative estimate; the actual number will be informed by additional analysis of geotechnical data and other studies that will occur prior to construction. Final locations that are anticipated to be difficult to drive will be known in advance of construction.

nameplate capacity is installed in the Lease Area; Empire Wind has sought an additional interconnection of up to 48 MW, allowing for the overplanting of up to three 15-MW wind turbines for EW 1. Empire Wind has sought an additional interconnection request of up to 90 MW, allowing for the overplanting of up to six 15-MW wind turbines for EW 2.

The number of strikes at each of the hammer energy levels needed to drive monopiles at typical foundation locations for the 9.6 m piles are listed in **Table 2.** The number of strikes at each of the hammer energy levels needed to drive monopiles at difficult to drive foundation locations for the 9.6 m piles are listed in **Table 3.** The number of strikes at each of the hammer energy levels needed to drive monopiles at typical foundation locations for the 11-m piles under different embedment depth scenarios are listed in **Table 4, Table 5,** and **Table 6.** The number of strikes at each of the hammer energy levels needed to drive the jacket foundation pin piles are listed in **Table 7 (EW 1 OSS 1),** and **Table 8 (EW 2 OSS 2)**. These pile driving scenarios ae described further in Section 6.

Table 2 Monopile Foundations: The hammer energy schedule and number of strikes for monopiles under the typical pile driving scenario-9.6 m pile (IHC S-5500 hammer)

Energy Level (kJ)	Strike Count	Pile Penetration Depth (m)
Initial sink depth		2
450	1607	12
800	731	5
1400	690	4
1700	1050	6
2300	1419	9
Total	**5497**	**38**
Strike rate (strikes/min)	30	

Table 3 Monopile Foundations: The hammer energy schedule and number of strikes for monopiles under the difficult-to-drive scenario-9.6 m pile (IHC S-5500 hammer)

Energy Level (kJ)	Strike Count	Pile Penetration Depth (m)
Initial sink depth	-	2
450	1607	12
800	731	5
1400	690	4
1700	1050	6
2300	1087	4
5225	2000	5
Total	**7165**	**38**
Strike rate (strikes/min)	30	

Table 4 Monopile Foundations: The hammer energy schedule and number of strikes for monopiles under the typical pile driving scenario-11 m pile (35-m embedment depth) (IHC S-5500 hammer)

Energy Level (kJ)	Strike Count	Pile Penetration Depth (m)
Initial sink depth		1
500	1168	14
750	433	3
1100	265	2
2000	2159	15
Total	**4025**	**35**
Strike rate (strikes/min)	30	

Table 5 Monopile Foundations: The hammer energy schedule and number of strikes for monopiles under the typical pile driving scenario-11 m pile (40-m embedment depth) (IHC S-5500 hammer)

Energy Level (kJ)	Strike Count	Pile Penetration Depth (m)
Initial sink depth		3
500	1339	14
750	857	6
1000	632	4
1500	1109	7
2000	326	2
2500	656	4
Total	**4919**	**40**
Strike rate (strikes/min)	30	

Table 6 Monopile Foundations: The hammer energy schedule and number of strikes for monopiles under the typical pile driving scenario-11 m pile (55-m embedment depth) (IHC S-5500 hammer)

Energy Level (kJ)	Strike Count	Pile Penetration Depth (m)
Initial sink depth		5
450	622	6
750	2781	20
1000	1913	12
1300	2019	12
Total	**7335**	**55**
Strike rate (strikes/min)	30	

Table 7 Jacket Foundations: The hammer energy schedule and number of strikes for pin piles supporting the jacket foundation for the OSS 1 (IHC S-4000 hammer)

Energy Level (kJ)	Strike Count	Pile Penetration Depth (m)
(Initial sink depth)		8
500	1799	30
750	1469	12
2000	577	4
3200	495	2
Total	**4340**	**56**
Strike rate (strikes/min)	30	

The hammer energy schedule for the maximum potential embedment depth for pin piles (60 m) was also modeled, see Section 6 for additional detail.

Table 8 Hammer energy schedule and number of strikes for pin piles supporting the jacket foundation for the OSS 2 (IHC S-4000 hammer)

Energy Level (kJ)	Strike Count	Pile Penetration Depth (m)
(Initial sink depth)		5
500	1206	22
750	1153	9
2000	790	7
3200	562	4
Total	**3711**	**47**
Strike rate (strikes/min)	30	

The hammer energy schedule for the maximum potential embedment depth for pin piles (60 m) was also modeled, see Section 6 for further detail.

Based on the frequency ranges of the potential impact pile driving activities and hearing ranges of the marine mammals that have the potential to occur in the Project Area, impact pile driving activities will have the potential to result in Level A and Level B harassment of marine mammals.

1.2.2 Cable Landfall and Marina Activities

1.2.2.1 Cable Landfall

The exit point of the long-distance HDD will be just offshore from the export cable landfall(s). The offshore exit locations require some seafloor preparation to collect any drilling fluids that localize during HDD completion. Preparation will include excavation of pits at each offshore exit location and may also include installation of a temporary steel casings on the exit side from a jack-up barge to below the mudline. Casings may or may not be supported by goal posts. The jack-up barge will also house a drill rig. Seabed preparation may also be completed with installation of a cofferdam for each HDD and excavating to remove material from the cofferdam.

If required, the temporary offshore cofferdams will be constructed by installing 0.61-m (24-inch) steel sheet piles in a tight configuration around an area of up to 30 m by 30 m (100 ft by 100 ft). 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 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.

One export cable landfall location has been selected for EW 1 while four export cable landfall locations are under consideration for EW 2. A total of up to five temporary cofferdams may be constructed (as many as two cofferdams for EW 1 and as many as three cofferdams for EW 2). The potential sites of the cofferdams, and associated vibratory pile driving, are provided in **Table 9**. Installation of temporary cofferdams using vibratory driving, if needed, would occur in 2024 for EW 1 and in 2024 and 2025 for EW 2. For the analysis in this application, a representative location was selected for EW 2 as the potential sites were in close proximity along the southern shore of Long Island, from Jones Beach to the east, to the western portion of the barrier island of Long Beach, to the west and therefore have similar environmental parameters and marine mammal occurrence. Variation in the final cofferdam design is possible, with designs ranging from 30 to 40 sheet piles per cofferdam. To be conservative, up to 60 sheet piles per cofferdam have been accounted for in the modeling.

Table 9 Potential Locations for Cofferdam Installation

Scenario	Description	Location (Lat/Long)
EW 1	Vibratory Pile Driving	40.66261, -74.0127
EW 2	Vibratory Pile Driving	40.579, -73.6326

Note: Up to two cofferdams may be installed at EW 1 and up to three may be installed at EW 2.

Based on the frequencies of vibratory pile driving activities and hearing ranges of the marine mammals that have the potential to occur in the Project Area, vibratory pile driving activities will have the potential to result in Level B harassment of marine mammals. No Level A harassment is anticipated as a result of vibratory pile driving activities.

As an alternative to use of cofferdams for the cable landfall, goal posts may be used to assist in the installation of a casing pipe for cable landfall. For the goal post installation process, a barge with necessary support equipment is first mobilized and anchored into position. The support equipment on the barge will include at least one crane, a hydraulic hammer mounted at the end of the crane hook or load block, and the piles to be driven. An additional crane, trackhoe, or similar equipment may also be located on the support barge to aid in the handling of the goal post piles. For each HDD installation, it is estimated that three to five goal posts will need to be installed to support the casing pipe. For each goal post, a total of two 12-inch steel piles must be driven to complete a single goal post installation, with 2,000 strikes per pile. The piles are installed by attaching the hydraulic hammer to the end of the pile, and lifting the hydraulic hammer with the crane, and swinging the pile into place for the goal post installation. The hydraulic hammer then drives the pile into the subsea floor by repeated percussive blows until the pile reaches a sufficient depth where enough strength to support the casing pipe is achieved. This process is repeated until all piles necessary for the goal post are installed.

Note that cable landfall activities will require either an excavation pit, cofferdam installation, or goal post installation. Harassment of marine mammals is not expected as a results of the excavation pit scenario. As cofferdam installation or goal post installation may occur, but not both, acoustic modeling was completed for both the cofferdam and goal past alternatives and the most impactful scenario was carried forward to the exposure analysis (see Section 6.2).

1.2.2.2 Marina Activities

Marina construction activities will also be completed along the Onshore Substation C location, including removing berthing piles and bulkhead repair. Up to 130 12-inch diameter timber berthing piles would be removed using a combination of a crane and vibratory hammer, depending on the condition of the piles. Two piles would be removed each hour. Up to 15 piles a day would be removed over the course of two weeks, noting that due to the use of the crane rather than vibratory removal when feasible , overall noise generation would be kept to a minimum. Vibratory installation of 24-inch z-type steel sheet piles would also occur at the marina bulkheads, consisting of 20 piles per day, with installation occurring for approximately 1 hour of noise generation time per day for 35 days.

1.2.3 HRG Survey Activities

The Applicant will conduct HRG surveys in the marine environment of the approximately 321-km^2 (square kilometers 79,350-acre) Lease Area located approximately 14 nm from Jones Beach, New York (see **Figure 1**). Additionally, surveys will be conducted along the submarine export cable route corridors, interarray cable locations, and export cable landfall sites. The HRG survey activities will include the following equipment summarized in **Table 10**, or comparable sources.

Based on the operating frequencies of some types of HRG survey equipment and the hearing ranges of the marine mammals that have the potential to occur in the Project Area, HRG survey activities will have the potential to result in Level B harassment of marine mammals. No Level A harassment is anticipated as a result of HRG survey activities.

Table 10 Summary of HRG Equipment Proposed for Use

Category	Representative HRG Equipment a/	Operating Frequencies (kHz)	RMS Source Level	Peak Source Level	Primary beamwidth (degrees)	Pulse Duration (milliseconds [ms])	Pulse Repetition (Hz)
Subsea Positioning / Ultra-short baseline (USBL)	Kongsberg HiPAP 501/502 USBL	21 - 31	190	207	Omni	2	0.5-2
	iXblue, IxSea GAPS Beacon System	8–16	188	194	Omni	10	1
	Sonardyne Ranger 2 and Mini Ranger 2 USBL HPT 3000/5/7000	19–34	200	206	Omni	5	1
Multi-beam echosounder (MBES)	Reson Seabat T20P multibeam echosounder a/	200-400	221	227	90	0.253	
	Reson 7111*	100	224	228	6	1.35	
	Kongsberg EM2040Quad	200-400					
	R2 Sonic 2026	170-450	191	221	1	1.115	
	R2 Sonic 2024	200- 700					
SSS	Klein 3900 SSS a/	445-900	200	226	1.8	0.1	
SBP	EdgeTech DW106	1 to 6	194	197	Omni	<66	8
	EdgeTech 424 a/	4-20	180	186	122	4.8	
	Innomar, SES-2000 compact	85–115	232	238	4	40	1
	Innomar, SES-2000 Light & Light Plus	85–115	232	238	4	40	1
	Innomar, SES-2000 Standard & Standard Plus	85–115	234	240	1-3.5	60	1.5
	Innomar, SES-2000 Smart	90–110	229	235	5	40	0.5
	Innomar, SES-2000 Medium-70	60-80	240	246	3	40	5
	Teledyne Benthos Chirp III - TTV 170	2 to 7	219	225	100	60	15
Obstacle Avoidance Sonar ROV	Coda Octopus 3D	240-300					20

Note:
a/ Equipment specifications found in the 2016 Crocker and Frantantonio Report. Equipment selected would be the same or similar.

1.2.4 Activities Not Considered in Request for Authorization

Additional potential activities associated with the Project include port construction and removal or detonation of unexploded ordnance/munitions and explosives of concern (UXO/MEC); however, port construction activities would be conducted by a separate entity and would serve the broader offshore wind industry than just the Project; Empire would therefore not be the applicant for the authorization of marine mammal take incidental to these activities if an authorization for incidental take is warranted, and these activities are therefore not analyzed further in this application. Likewise, any activity associated with removal or detonation of UXO/MEC (should it be deemed necessary) would be conducted by the US Navy or other qualified entity independent of Empire. Up to 12 piles would also be installed along the cable bridge at the northern end of Barnum Island in a narrow channel with water depths of only (1 m) 3 ft. Due to the more inland location and very shallow water depths, marine mammal are not expected in the vicinity, and therefore, no take is anticipated from this activity.

2. DATES, DURATION, AND SPECIFIED GEOGRAPHIC REGION

2.1 Dates and Duration

2.1.1 Foundation Installation

2.1.1.1 EW 1

Up to 57 wind turbine monopile foundations may be installed via impact pile driving in EW 1. Once the installation vessel is in place, the steel pile is lifted into a vertical position and lowered onto the seabed. The steel pile is then pile driven into the seabed. Pile driving is conducted with the use of a large crane mounted hydraulic impact hammer being dropped, or driven, onto the top of a foundation pile, and driving it into the ground. The hammer energy and duration are dependent on geological soil conditions, pile type and diameter and most suitable technology. Following pile driving, the transition piece (TP) and secondary ancillary equipment are installed onto the steel pile. Only one foundation is proposed to be installed via pile driving at a given time for the Project (i.e., there will be no overlap in pile driving activities between EW 1 and EW 2).

One offshore substation piled jacket foundation will be installed via impact pile driving in EW 1 requiring the installation of up to 12 pin piles. Once the installation vessel is in place, the jacket structure is lifted from the vessel and lowered onto the seabed. The support piles are placed in the jacket structure and then driven into the seabed. The piles will be driven using the same methodology as described for monopiles. Jacket piles will be in one single piece. Following pile driving of the support piles, the jacket structure is secured to the driven piles. Only one foundation is proposed to be installed via pile driving at a given time for the Project (i.e., there will be no overlap in pile driving activities between EW 1 and EW 2).

Foundation installation activities in EW 1 are expected to commence no earlier than Q2 2025 (**Figure 2**). Each monopile pile will require a maximum of up to 3.5 hours of impact pile driving and each pin pile will require a maximum of up to 4.2 hours of impact pile driving. It is anticipated monopile and piled jacket foundations will be installed between Q2 2025 and Q4 2025 in EW 1 (**Figure 2**)(it is possible but not anticipated that EW 1 monopile foundations and piled jacket foundations could be installed outside of the time frames described above due to schedule delays). Impact pile driving for EW 1 will not occur from January 1 through April 30. In addition, impact pile driving will not occur from December 1 through December 31, unless unanticipated delays due to weather or technical problems arise that necessitate extending pile driving into December.

2.1.1.2 EW 2

Up to 90 wind turbine monopile foundations and one offshore substation piled jacket foundation may be installed via impact pile driving in EW 2 (39 in 2025 and 51 in 2026). The monopile and piled jacket installation methodologies will be the same as described for EW 1. Only one foundation is proposed to be installed via pile driving at a given time for the Project (i.e., there will be no overlap in pile driving activities between EW 1 and EW 2).

One offshore substation piled jacket foundation will be installed via impact pile driving in EW 2 requiring the installation of up to 12 pin piles. As with EW 1, once the installation vessel is in place, the jacket structure is lifted from the vessel and lowered onto the seabed. The support piles are placed in the jacket structure and then driven into the seabed. The piles will be driven using the same methodology as described for monopiles. Jacket piles will be in one single piece. Following pile driving of the support piles, the jacket structure is secured to the driven piles.

Foundation installation activities are expected to commence no earlier than Q2 2025 (**Figure 2**). Each pile will require up to 3.5 hours of impact pile driving and each pin pile will require a maximum of up to 5 hours of impact pile driving. It is anticipated monopile and piled jacket foundations will be installed between Q2 2025 and Q4 2026 in EW 2 (**Figure 2**)(it is possible but not anticipated that EW 2 monopile foundations and piled jacket foundations could be installed outside of the time frames described above due to schedule delays). Impact pile driving for EW 2 will not occur from January 1 through April 30. In addition, impact pile driving will not occur from December 1 through December 31, unless unanticipated delays due to weather or technical problems arise that necessitate extending pile driving into December.

2.1.2 Cable Landfall and Marina Activities

2.1.2.1 EW 1

The export cable landfall for the EW 1 export cable will occur at South Brooklyn Marine Terminal (SBMT), located in Brooklyn, New York, waterfront and adjacent to 1st Avenue/2nd Avenue. The exit point of the long-distance HDD, if utilized, will be just offshore. Up to two temporary offshore cofferdams may be required at the exit point of the long-distance HDD to minimize the release of sediment and drilling fluids into the marine environment, if necessary. If required, the temporary offshore cofferdams would be constructed by installing steel sheet piles in a tight configuration around an area of approximately 30 m by 30 m (100 ft by 100 ft). Cofferdam installation via vibratory pile driving along the nearshore portion of the EW 1 submarine export cable siting corridor is expected to occur in 2024 (**Figure 2**). Installation would take three days to complete per cofferdam, with an additional three days needed for removal per cofferdam. Work could occur during any season. If cofferdams are not utilized, three goal posts at each landfall may be used instead during the HDD landfall but would occur at the same locations. Each goal post would consist of two piles, with 2,000 strikes per pile and require 2 hours of driving time per goal post (two piles).

2.1.2.2 EW 2

The Applicant is evaluating several optional locations for the EW 2 export cable landfall; three cables will be required with associated HDDs and up to two export cable landfall locations may be required. Temporary offshore cofferdams may be required at the exit points of the long-distance HDD to minimize the release of sediment and drilling fluids into the marine environment. If required, the temporary offshore cofferdams would be constructed by installing steel sheet piles in a tight configuration around an area of approximately 30 m by 30 m (100 ft by 100 ft). Cofferdam installation via vibratory pile driving along the nearshore portions of the EW 2 submarine export cable siting corridor, if required, would occur in 2024 and 2025 (**Figure 2**). Installation would take three days to complete per cofferdam, with an additional three days needed for removal per cofferdam. Work would occur during any season. As described above, if cofferdams are not utilized, three to five goalposts at each landfall may be used instead during the HDD landfall but would occur at the same locations.

Marina work completed along the Onshore Substation C location would consist of two berthing piles removed each hour, with up to 15 piles a day removed over the course of 2 weeks and installation of sheet piles would also occur at the marina bulkhead consisting of 20 piles per day with total noise generation lasting up to 1 hour per day for 35 days.

2.1.3 HRG Survey Activities

HRG surveys are anticipated to commence no earlier than Q1 2024; duration of each survey varies as described in **Table 11**. This survey schedule is based on 24-hour operations and includes estimated weather down time.

Table 11 HRG Survey Schedule

Task	Duration	Expected Start	Expected Completion	Acoustic Equipment	Comments
Monopile/TP Phase 1					
Seabed Preparation- pre-installation (rock installation) 54 MP/TP	59 d	3/10/2025	5/7/2025	USBL, MBES, Obstacle avoidance sonar (OAS)	-
Installation of 54 Monopiles &TPs	120 d	5/1/2025	8/28/2025	USBL, OAS	-
Scour protection 54 MP	78 d	5/31/2025	8/16/2025	USBL, OAS	-
Monopiles/TP Phase 2					
Seabed Preparation Pre - MP 30 Off	23 d	5/8/2025	5/30/2025	USBL, MBES, OAS	-
Scour protection 30 MPs	30 d	8/17/2025	9/15/2025	USBL, OAS	-
Installation of first batch EW 2 15 MP/TPs (campaign 1 2025)	41 d	8/29/2025	10/8/2025	USBL, OAS	-
Installation of second batch 15 Monopiles & TPs (campaign 1 2025)	41 d	10/9/2025	11/18/2025	USBL, OAS	-
Seabed Preparation Pre - 54 Off MP	42 d	4/1/2026	5/12/2026	USBL, MBES, OAS	-
Installation of 54 MPs & TPs (2026)	121 d	5/1/2026	8/29/2026	USBL, OAS	-
Scour protection 54 MPs 41 d	41 d	7/27/2026	9/5/2026	USBL, OAS	-
Interarray Cable Installation Phase 1					
Pre-lay Survey at field	18 d	2/1/2025	2/18/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	-
Pre-lay Grapnel Run & OOS Clearance at field 54 sections	35 d	1/4/2025	5/5/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	SSS, MBES, SBP, PT/MAG - Usage during scope ca. 40% of time
Removal of out of service cables (EW 1 & EW 2)	20 d	6/16/2025	7/5/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	SSS, MBES, SBP, PT/MAG - Usage during scope ca. 30% of time
Campaign 1: Installation #1 25 cables sections	27 d	7/6/2025	8/1/2025	USBL, SSS, MBES, PT/MAG, OAS	-

Task	Duration	Expected Start	Expected Completion	Acoustic Equipment	Comments
Termination & Testing of 54 cables section	59 d	7/30/2025	9/26/2025	USBL, OAS	-
Post-lay Trenching campaign 54 cables	56 d	8/2/2025	9/26/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	SBP - Usage during scope ca. 0-30% of time
Campaign 1: Installation #2a 17 cables sections (before OSS)	19 d	8/15/2025	9/2/2025	USBL, OAS	-
Campaign 1: Installation #2b 8 cables sections (after OSS)	9 d	9/3/2025	9/11/2025	USBL, OAS	-
Protection of cables over scour protection – Rock installation 54 sections	26 d	9/3/2025	9/28/2025	USBL, MBES, OAS	-
Campaign 1: Installation #3 4 cables sections	5 d	9/17/2025	9/21/2025	USBL, OAS	-
Rock Installation Trenching remedial	10 d	9/29/2025	10/8/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	SBP - Usage during scope ca. 0-30% of time
As-Built Survey	18 d	10/8/2025	10/27/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	
Submarine Export Cables phase 1					
Construction vessel: Pre Lay Grapnel Run and Route Clearance	17 d	7/1/2024	7/17/2024	USBL, SSS, MBES, SBP, PT/MAG, OAS	SSS, MBES, SBP, PT/MAG - Usage during scope ca. 40% of time
Nearshore Cable: Pre-lay Jetting run (2X)	36 d	7/1/2024	8/5/2024	USBL, SSS, MBES, PT/MAG, OAS	-
Construction vessel: Pre Lay Crossing Protection Construction + mattress install	33 d	7/3/2024	8/4/2024	USBL, OAS	-
Nearshore Cable 1: Installation from KP13 to SBMT (barge) & pull-in	12 d	8/6/2024	8/17/2024	USBL, OAS	-

Task	Duration	Expected Start	Expected Completion	Acoustic Equipment	Comments
Nearshore Cable 1: Installation from KP13 to KP28 (Skagerak) & wet storage	12 d	8/6/2024	8/17/2024	USBL, OAS	-
Nearshore Cable 2: Installation from KP13 to KP28 (Skagerak) & wet storage	12 d	8/18/2024	8/29/2024	USBL, OAS	-
Nearshore Cable 2: Installation from KP13 to SBMT (barge) & pull-in	12 d	8/18/2024	8/29/2024	USBL, OAS	-
Cable L1: joint & lay towards lease area & lay down	19 d	3/28/2025	4/15/2025	USBL, OAS	-
Cable L2: Sail to KP 28, pick up nearshore cable 2 end, joint & lay towards lease area & lay down	20 d	4/16/2025	5/5/2025	USBL, OAS	-
Nearshore Termination: Cable 2 termination	14 d	4/21/2025	5/4/2025	USBL, OAS	-
Nearshore Termination: Cable 1 termination	14 d	4/21/2025	5/4/2025	USBL, OAS	-
IM05a First Submarine Export Cable wet sored ready for pull-in	0d	5/1/2025	4/30/2025	USBL, OAS	-
OSS Pull-in Support cable L2	4 d	8/7/2025	8/10/2025	USBL, OAS	-
CLV: Pull-in to OSS cable L2	4 d	8/7/2025	8/10/2025	USBL, OAS	-
OSS Pull-in Support L1	4 d	8/11/2025	8/14/2025	USBL, OAS	-
CLV: Pull-in to OSS cable L1	4 d	8/11/2025	8/14/2025	USBL, OAS	-
Stage 2 Commissioning of Cable L2 at OSS	7 d	8/11/2025	8/17/2025	USBL, OAS	-
Stage 1 Commissioning of Cable L1 at OSS	7 d	8/15/2025	8/21/2025	USBL, OAS	-
As-Built Survey	17d	8/21/2025	9/7/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	-

Task	Duration	Expected Start	Expected Completion	Acoustic Equipment	Comments
Interarray Cables Installation Phase 2					
Pre-lay Survey incl Data Processing & Reporting	24 d	2/1/2026	2/24/2026	USBL, SSS, MBES, SBP, PT/MAG, OAS	-
Pre-lay Grapnel Run & OSS clearance at field 84 sections	46 d	3/1/2026	4/15/2026	USBL, SSS, MBES, SBP, PT/MAG, OAS	SSS, MBES, SBP, PT/MAG - Usage during scope ca. 40% of time
Installation # 1 25 cables sections	27 d	5/1/2026	5/27/2026	USBL, OAS	-
Installation # 2 25 cables sections (EW 2)	27 d	6/10/2026	7/6/2026	USBL, OAS	-
Termination & testing of 84 cables (EW 2)	90 d	6/10/2026	9/7/2026	USBL, OAS	-
Post- lay Trenching 84 cables	87 d	6/13/2026	9/7/2026	USBL, SSS, MBES, SBP, PT/MAG, OAS	SBP - Usage during scope ca. 0-30% of time
Installation # 3a 16 cables sections (EW 2)	17 d	7/20/2026	8/05/2026	USBL, OAS	-
Installation # 3b 9 cables sections (EW 2)	10 d	8/6/2026	8/15/2026	USBL, OAS	-
Protection of cables over scour protection – Rock installation 84 sections	33 d	8/7/2026	9/8/2026	USBL, MBES, OAS	-
Installation # 4 9 cables sections (EW 2)	11 d	8/23/2026	9/2/2026	USBL, OAS	-
Rock Installation Trenching remedial	14 d	9/9/2026	9/22/2026	USBL, SSS, MBES, SBP, PT/MAG, OAS	SBP - Usage during scope ca. 0-30% of time
As-Built Survey	24d	9/22/2026	10/17/2026	USBL, SSS, MBES, SBP, PT/MAG, OAS	-

Task	Duration	Expected Start	Expected Completion	Acoustic Equipment	Comments
Submarine Export Cables Phase 2					
Campaign 1: Pre-lay Grapnel Run (PLGR) & route clearance landfall to lease area	24 d	5/8/2025	5/31/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	SSS, MBES, SBP, PT/MAG - Usage during scope ca. 40% of time
Campaign 1: Lay & trench L1 to Long beach	18 d	6/29/2025	7/16/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	SBP - Usage during scope ca. 0-30% of time
Campaign 1: Lay & trench L12 to Long beach	22 d	7/17/2025	8/7/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	SBP - Usage during scope ca. 0-30% of time
Campaign 2: Pre-lay Grapnel Run (PLGR) & route clearance landfall L1, L2, L3 12	12 d	8/30/2025	9/10/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	SSS, MBES, SBP, PT/MAG - Usage during scope ca. 40% of time
Campaign 2: Recover L1 & HDD pull-in incl diver assistant trenching	7 d	9/3/2025	9/9/2025	USBL, SSS, MBES, PT/MAG, OAS	SSS, MBES, PT/MAG, OAS - Usage during scope ca. 0-20%
CLV: Pull-in at OSS Jacket cable	4 d	9/5/2025	9/8/2025	USBL, OAS	-
Campaign 2: Recover L2 & HDD pull-in incl diver assistant trenching	7 d	9/10/2025	9/16/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	SSS, MBES, PT/MAG, OAS - Usage during scope ca. 0-20%
Campaign 2; Trench L1 & L2 nearshore sections	6 d	9/17/2025	9/22/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	SBP - Usage during scope ca. 0-30% of time
Campaign2: Initiate & Pull-in L3 through HDD & trenching L3	3 d	9/26/2025	9/25/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	SBP - Usage during scope ca. 0-20% of time
Campaign 2: Lay & trench L3 to federal waters incl wow (15 km)	30 d	9/26/2025	10/25/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	SBP - Usage during scope ca. 0-20% of time
Campaign 2: Lay & trench L3 to lease area (41 km)	25 d	10/26/2025	11/19/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	SBP - Usage during scope ca. 0-20% of time
Campaign 2: Remedial trenching L1+ L2	20 d	10/12/25	12/21/2025	USBL, SSS, MBES, SBP, PT/MAG, OAS	SBP - Usage during scope ca. 0-30% of time
Campaign 2: Allowance for survey with Capjet incl WOW	12 d	12/10/2025	12/21/2025	USBL, SSS, MBES, PT/MAG, OAS	-

Task	Duration	Expected Start	Expected Completion	Acoustic Equipment	Comments
EW 2 Pull-in cables (L1, l2, L3) to OSS Topside EW 2	14 d	2/6/2026	2/19/2026	USBL, OAS	-
Termination L1, L2, L3 (splicing & routing)	25 d	2/15/2026	3/11/2026	USBL, OAS	-
As-Built Survey	24d	3/11/2026	4/4/2026	USBL, SSS, MBES, SBP, PT/MAG, OAS	-
Offshore Substation					
Offshore Hook-up & Commissioning	63 d	1/27/2026	3/30/2026	USBL, OAS	-
EW 2 OSS ready for Export cable pull-in	0 d	2/6/2026	2/5/2026	USBL, OAS	-
OSS Jacket and Piles Phase 1					
Installation of Jacket	2 d	6/28/2025	6/29/2025	USBL, OAS	-
Piling, grouting & cutting of legs of Jacket	4d	6/30/2025	7/3/2025	USBL, OAS	-
Jacket installed & Complete	0 d	7/3/2025	7/4/2025	USBL, OAS	-
Scour Protection	2 d	7/11/2025	7/12/2025	USBL, OAS	-
OSS Jacket and Piles Phase 2					
Installation of Jacket	2 d	8/30/2025	8/31/2025	USBL, OAS	-
Piling, grouting & cutting of legs of Jacket	4 d	9/1/2025	9/4/2025	USBL, OAS	-
Jacket installed & Complete	0 d	9/5/2025	9/5/2025	USBL, OAS	-
Scour Protection	2 d	9/12/2025	9/13/2025	USBL, OAS	-
Rock Installation - Surveys					
Survey within 60 days of commissioning	100 d	3/11/2026	6/19/2026	USBL, SSS, MBES, SBP, PT/MAG, OAS	-
Year 1 follow up Survey	100 d	6/19/2027	9/27/2027	USBL, SSS, MBES, SBP, PT/MAG, OAS	-

Task	Duration	Expected Start	Expected Completion	Acoustic Equipment	Comments
Year 2 follow up Survey	100 d	6/19/2028	9/27/2028	USBL, SSS, MBES, SBP, PT/MAG, OAS	-
Year 3 follow up Survey	100 d	6/19/2029	9/27/2029	USBL, SSS, MBES, SBP, PT/MAG, OAS	-

2.2 Specific Geographic Region

The geology and geomorphology in the New York Bight region are diverse with glacial deposits as a result of the Pleistocene Epoch sea level falls and rises, and more recent Flandrian transgression of sea level (Messina and Stoffer 1996). Analysis of geophysical and geotechnical survey data collected across the Lease Area indicates the current geological conditions underlying the Lease Area are generally flat. Water depths vary within the Lease Area from 24 m (78 ft) to 44 m (144 ft) (NAVD88), with deeper water depths in the southeast portion of the Lease Area. Slope gradient across the Lease Area is typically less than 1 degree. The seabed in the northwestern portion of the Lease Area has been interpreted to have undulating character.

The EW 1 submarine export cable route exits the Lease Area from the northwestern edge of the Lease Area and will travel northwest through Raritan Bay to the EW 1 export cable landfall in Brooklyn, New York. Current geological conditions underlying the EW 1 submarine export cable route trend with shoaling towards the shore, and with more significant variation in the bathymetry closer to shore, where dredging patterns influence the seabed. Water depths vary along the EW 1 submarine export cable route from 5.9 m (19.4 ft) to 31.7 m (104.0 ft) (NAVD88). Several channels exist along the submarine export cable route, both natural and anthropogenic. While the general gradient along the cable is less than 1 degree, isolated gradients of up to five degrees exist along the near shore portion of the route.

The EW 2 submarine export cable route exits the Lease Area from the central portion of the Lease Area and travels in a northwestern direction in a relatively straight line until turning north to the EW 2 export cable landfall in Long Beach, New York. Conditions along the EW 2 submarine export cable route exhibit a general trend of shoaling towards the shore. Water depth variations range, in the current surveyed and interpreted portion of the route, from 21.5 to 35.5 m (70 to 116 ft) (NAVD88). The slope gradient along the EW 2 submarine export cable route reaches a maximum of 1 degree.

Sea temperature data in the Project Area were collected from the World Ocean Atlas (NOAA 2013). Sea temperatures were analyzed down to a depth of 131 ft (40 m) and ranged from approximately 6 to 24 degrees Centigrade (°C) (43 to 75 degrees Fahrenheit [°F]). The warmest months (July, August, and September) experienced water temperatures ranging from 9 to 24 °C (48 to 75 °F), dependent on the water depths. The coldest months (February, March, and April), experienced water temperatures between 5 and 7 °C (41 and 45 °F), dependent on water depth. Water near the surface is consistently warmer than deeper water. Surface waters experience the most variation in temperature, with bottom waters maintaining more consistent temperatures. See **Appendix A** for a discussion of sound speed profile (SSP). Sediments in the Project Area are characterized as predominantly sands and fine sands in the New York Bight area, which includes the Lease Area and most of the submarine export cable routes, to predominantly clays and silts in New York Bay, which includes a section of the EW 1 submarine export cable route.

2.2.1 Foundation Installation

2.2.1.1 EW 1

Impact pile driving activities to install monopile and the piled jacket foundations will occur within the proposed wind turbine and offshore substation layout within EW 1 (**Figure 3**). The Lease Area is located approximately 14 mi (12 nm, 22 km) south of Long Island, New York, and 19.5 mi (16.9 nm, 31.4 km) east of Long Branch, New Jersey. The wind turbines and offshore substations will be located in the Wind Farm Development Area, which is a subset of the Lease Area[2]. EW 1 is located in the northwest portion of the Wind Farm Development Area.

2.2.1.2 EW 2

Impact pile driving activities to install monopile and the piled jacket foundations will occur within the proposed wind turbine and offshore substation layout within EW 2 (**Figure 3**). EW 2 is located in the southeast portion of the Wind Farm Development Area.

2.2.2 Cable Landfall and Marina Activities

2.2.2.1 EW 1

Vibratory pile driving activities to install the steel sheet pile cofferdams would occur at the exit point of the long-distance HDD. These would be installed offshore of the EW 1 export cable landfall, located at SBMT in Brooklyn, NY along the waterfront and adjacent to 1st Avenue/2nd Avenue (**Figure 1**). The EW 1 submarine export siting corridor itself begins on the northern edge of the EW 1 portion of the Wind Farm Development Area and extends northwest for approximately 40 nm (74 km). As an alternative to cofferdams, goals post installation using an impact hammer would be installed to support export cable landfall.

2.2.2.2 EW 2

Vibratory pile driving activities to install the steel sheet pile cofferdams would occur at the exit point of the long-distance HDD. These would be installed offshore of the proposed EW 2 export cable landfalls (**Figure 1**): EW 2 Landfall A (Riverside Boulevard), EW 2 Landfall B (Monroe Boulevard), EW 2 Landfall C (Lido Beach West Town Park), and/or Landfall E (Laurelton Boulevard). The EW 2 submarine export siting corridor itself begins on the northwest corner of the EW 2 portion of the Wind Farm Development Area and extends northwest for approximately 26 nm (48 km). As an alternative to cofferdams, goals post installation using an impact hammer would be installed to support export cable landfall. All marina work, both the berthing pile removal and bulkhead work, would be conducted at the Onshore Substation C location along inshore Long Island on the Wreck Lead Channel (**Figure 1**).

2.2.3 HRG Survey Activities

2.2.3.1 EW 1

The Applicant's survey activities will occur in the approximately 79,350-acre Empire Wind Project Lease Area and along cable route corridors as identified in **Figure 1**.

2.2.3.2 EW 2

The Applicant's survey activities will occur in the approximately 79,350-acre Empire Wind Project Lease Area and along cable route corridors as identified in **Figure 1**.

[2] The Applicant has committed to maintaining a minimum 1-nm (1.85-km) separation between the southern and northern periphery structures and the bordering traffic separation scheme (TSS) lanes. On this basis, the area within which structures can be built within the Lease Area is equal to 63,559 ac (25,721 hectares) (or approximately 80 percent of the total Lease Area).

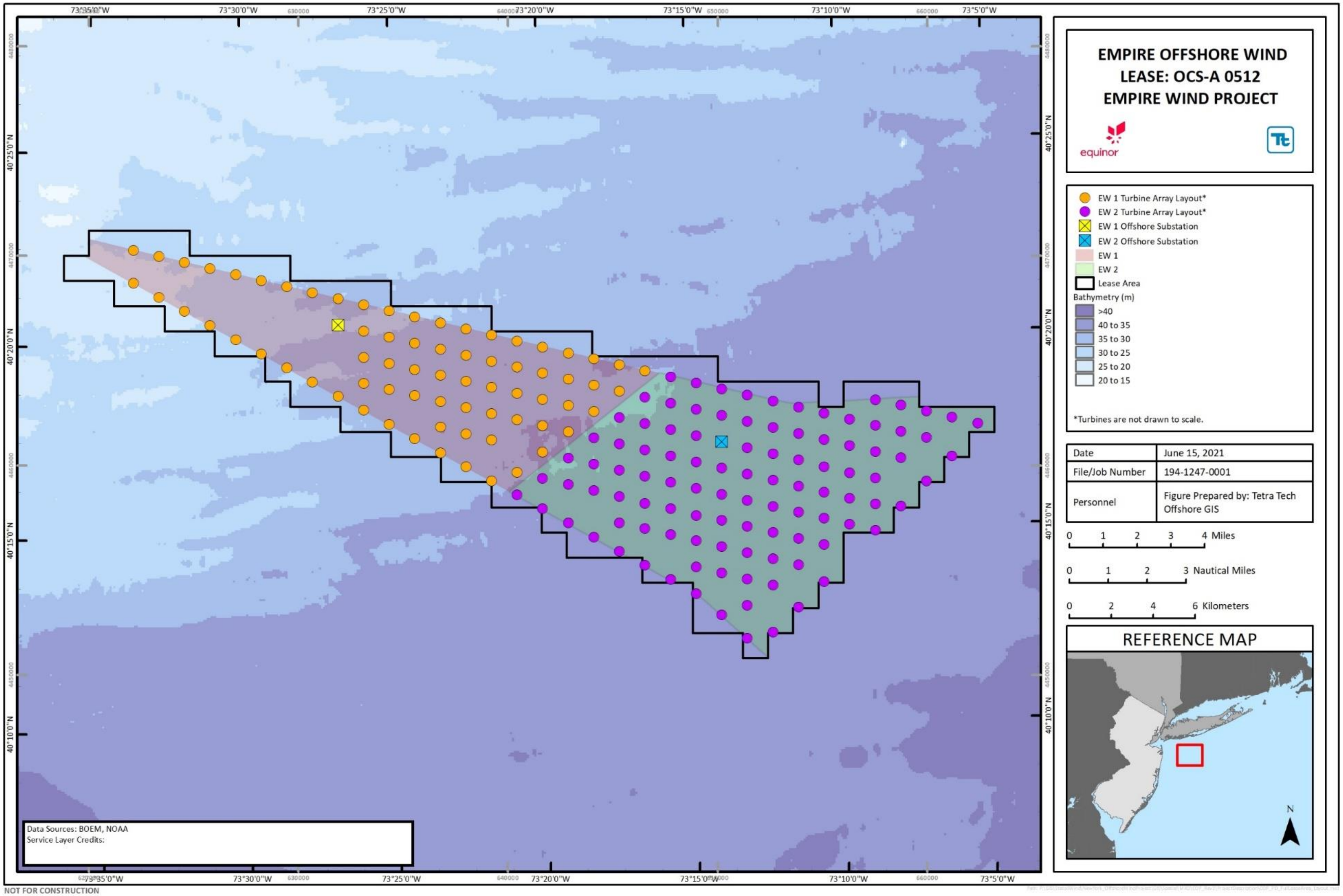


Figure 3 **Layout for Full Lease Area Build-Out, Locations Under Consideration (Maximum 149 structures)**

3. SPECIES AND NUMBERS OF MARINE MAMMALS

Marine mammals inhabit all of the world's oceans and are found in coastal, estuarine, and pelagic habitats. There are 38 marine mammals (cetaceans and pinnipeds) found in the Northwest Atlantic OCS region waters with documented ranges that include the Project Area. All 38 marine mammals listed in **Table 12** are protected by the MMPA and five are additionally federally listed as Endangered under the ESA. Of those 38 species, there are 20 considered common (known to be present either year-round or seasonally in the Project Area); two of these are ESA-listed as Endangered: the North Atlantic right whale and the fin whale. There is no Critical Habitat for any marine mammal species in the Project Area. Marine mammal species known to occur, within Northwest Atlantic OCS region waters are listed in **Table 12**. Since marine mammals are highly mobile, sightings recorded in waters of New York and New Jersey are considered synonymous with potential to occur in the Project Area (especially as the Project Area waters cover waters in both these states). The status and distribution of these species are discussed in Section 4.

Table 12 Marine Mammals Known to Occur in the Marine Waters in Coastal and Offshore New York

Name	Species Name	NY Status a/	Federal Status a/	Estimated Population	Stock	Known Project Area (NY and NJ) Distribution	Likelihood of Occurrence in the Project Area	Seasonal Occurrence
Mysticetes (Baleen Whales)								
Balaenopteridae (Rorquals)								
Blue whale	*Balaenoptera musculus*	E	E	Unknown	W. North Atlantic	Not well known; primarily deep waters	Unlikely	Seasonal; Winter, Fall
Fin whale	*Balaenoptera physalus*	E	E	6,802	W. North Atlantic	Throughout	Common	Year-round
Humpback whale	*Megaptera novaeangliae*	E	MMPA	1,396	North Atlantic	Becoming more coastal; may be in inlets.	Common	Year-round
Minke whale	*Balaenoptera acutorostrata*	N/A	MMPA	21,968	Canadian E. Coast	On and over continental shelf	Common	Seasonal
Sei whale	*Balaenoptera borealis*	E	E	6,292	Nova Scotia	Continental shelf and slope waters; throughout	Uncommon	Seasonal; Winter, Spring, Fall
Balaenidae (Right and Bowhead Whales)								
North Atlantic right whale	*Eubalaena glacialis*	E	E	368	Western Atlantic	Primarily coastal	Common	Seasonal; Winter, Spring, Fall
Odontocetes (Toothed Whales)								
Phocoenidae (Porpoises)								
Harbor porpoise	*Phocoena*	SC	MMPA	95,543	Gulf of Maine / Bay of Fundy	Great South Bay	Common	Seasonal

Name	Species Name	NY Status a/	Federal Status a/	Estimated Population	Stock	Known Project Area (NY and NJ) Distribution	Likelihood of Occurrence in the Project Area	Seasonal Occurrence
Physeteridae (Sperm Whales)								
Dwarf sperm whale	*Kogia sima*	N/A	MMPA	7,750	W. North Atlantic	Over outer continental shelf	Rare	Uncommon
Pygmy sperm whale	*Kogia breviceps*	N/A	MMPA	7,750	W. North Atlantic	Over continental slope	Rare	Uncommon
Sperm whale	*Physeter macrocephalus*	E	E	4,349	North Atlantic	Along and over continental shelf; around Montauk Point; Deep ocean waters	Unlikely	Year-round
Delphinidae (Dolphins)								
Atlantic spotted dolphin	*Stenella frontalis*	N/A	MMPA	39,921	W. North Atlantic	Primarily deeper waters	Common	Seasonal
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	N/A	MMPA	93,233	W. North Atlantic	On continental shelf and slope	Common	Seasonal
Bottlenose dolphin (Western North Atlantic, Offshore)	*Tursiops truncatus*	N/A	MMPA	62,851	W. North Atlantic	Coastal and offshore	Common	Year-round
Bottlenose dolphin (Western North Atlantic, Northern Migratory Coastal	*Tursiops truncatus*	N/A	MMPA	6,639	W. North Atlantic	Coastal and offshore	Common	Year-round

Name	Species Name	NY Status a/	Federal Status a/	Estimated Population	Stock	Known Project Area (NY and NJ) Distribution	Likelihood of Occurrence in the Project Area	Seasonal Occurrence
Clymene dolphin	*Stenella clymene*	N/A	MMPA	4,237	W. North Atlantic	Deep ocean waters	Extralimital	Uncommon
Common dolphin	*Delphinus delphis*	N/A	MMPA	172,974	W. North Atlantic	Coastal and offshore	Common	Year-round
False killer whale	*Pseudorca crassidens*	N/A	MMPA	1,791	W. North Atlantic	Deep ocean waters	Extralimital	Uncommon
Killer whale	*Orcinus orca*	N/A	MMPA	Unknown	W. North Atlantic	Over continental shelf and rise; Open sea and offshore waters	Uncommon	Uncommon
Long-finned pilot whale	*Globicephala melas*	N/A	MMPA	39,215	W. North Atlantic	Over continental shelf to slope	Common	Year-round
Short-finned pilot whale	*Globicephala macrorhynchus*	N/A	MMPA	28,924	W. North Atlantic	Over continental shelf to slope	Uncommon	Uncommon
Northern bottlenose whale	*Hyperoodon ampullatus*	N/A	MMPA	Unknown	W. North Atlantic	Deep ocean waters	Rare	Uncommon
Pantropical spotted dolphin	*Stenella attenuata*	N/A	MMPA	6,593	W. North Atlantic	Primarily deeper waters	Common	Year-round
Pygmy killer whale	*Feresa attenuata*	N/A	MMPA	Unknown	W. North Atlantic	Deep ocean waters	Rare	Uncommon
Risso's dolphin	*Grampus griseus*	N/A	MMPA	35,215	W. North Atlantic	Along continental slope	Common	Year-round
Rough-toothed dolphin	*Steno bredanensis*	N/A	MMPA	136	W. North Atlantic	Deep ocean waters	Extralimital	Uncommon

Name	Species Name	NY Status a/	Federal Status a/	Estimated Population	Stock	Known Project Area (NY and NJ) Distribution	Likelihood of Occurrence in the Project Area	Seasonal Occurrence
Spinner dolphin	*Stenella longirostris*	N/A	MMPA	4,102	W. North Atlantic	Deep ocean waters	Rare	Uncommon
Striped dolphin	*Stenella coeruleoalba*	N/A	MMPA	67,036	W. North Atlantic	Over continental slope	Common	Seasonal
White-beaked dolphin	*Lagenorhynchus albirostris*	N/	MMPA	536,016	W. North Atlantic	On and over continental shelf	Rare	Uncommon
Ziphiidae (Beaked whales)								
Blainville's beaked whale	*Mesoplodon densirostris*	N/A	MMPA	10,107 b/	W. North Atlantic	Deep ocean waters	Common	Seasonal
Cuvier's beaked whale	*Ziphius cavirostris*	N/A	MMPA	5,744	W. North Atlantic	Deep ocean waters	Common	Seasonal
Gervais' beaked whale	*Mesoplodon europaeus*	N/A	MMPA	10,107 b/	W. North Atlantic	Deep ocean waters	Rare	Uncommon
Sowerby's beaked whale	*Mesoplodon bidens*	N/A	MMPA	10,107 b/	W. North Atlantic	Deep ocean waters	Common	Seasonal
True's beaked whale	*Mesoplodon mirus*	N/A	MMPA	10,107 b/	W. North Atlantic	Deep ocean waters	Common	Seasonal
Sirenia (Sea cows)								
Trichechidae (Manatees)								
West Indian manatee	*Trichechus manatus*	N/A	T	3,802	Florida	Freshwater, estuarine, and extremely nearshore coastal areas	Extralimital	Uncommon

Name	Species Name	NY Status a/	Federal Status a/	Estimated Population	Stock	Known Project Area (NY and NJ) Distribution	Likelihood of Occurrence in the Project Area	Seasonal Occurrence
Pinnipeds (eared and earless seals)								
Phocidae (earless seals)								
Gray seal	*Halichoerus grypus*	N/A	MMPA	27,131	W. North Atlantic	Coastal and continental shelf waters	Common	Seasonal
Harbor seal	*Phoca vitulina*	N/A	MMPA	75,834	W. North Atlantic	Coastal, bays, estuaries, inlets	Common	Seasonal
Harp seal	*Cystophora cristata*	N/A	MMPA	Unknown	W. North Atlantic	Continental shelf with pack ice	Rare	Uncommon
Hooded seal	*Phoca groenlandica*	N/A	MMPA	Unknown	W. North Atlantic	Deep ocean water at edge of continental shelf with pack ice	Rare	Uncommon

Notes:
a/ SC = Species of Concern; E = Endangered; T = Threatened; MMPA = Marine Mammal Protection Act; N/A = not applicable
b/ This is a total estimate for all Mesoplodon spp.

Sources: Hayes et al. 2018, 2019, 2020; Draft NOAA Fisheries 2021 SAR Report used at request and provided directly by NOAA Fisheries.

4. AFFECTED SPECIES STATUS AND DISTRIBUTION

As described in Section 3, there are 38 marine mammal species that are known to be present (some year-round, and some seasonally or incidentally) in the Mid-Atlantic OCS region. The following subsections provide additional information on the biology, habitat use, abundance, distribution, and existing threats to the non-endangered or threatened and endangered marine mammals that are considered common in the waters of the New York Bight and which also have been determined to be likely to occur in the Project Area. NOAA Fisheries uses Marine Species Density Data Gap Assessments as developed by Roberts et al. (2018), which built upon models originally developed by the U.S. Department of the Navy to estimate marine mammal abundance (U.S. Navy 2007). The current estimates are supplemented by data from other sources to update the species Stock Assessment Reports (SARs; Hayes et al. 2021 [supplemented with Draft NOAA Fisheries 2021 SAR Report at request of NOAA Fisheries]). These reports suggest that marine mammal density in the Mid-Atlantic region is patchy and seasonally variable. Currently, there are a number of Unusual Mortality Events (UMEs) that NOAA Fisheries has evaluated and declared (NOAA Fisheries 2021). Under the MMPA, a UME is defined as "a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response." Current UMEs include several of the species found in New York (minke whale, right whale, humpback whale, and harbor or grey seals [seal UME is currently nonactive, closure pending]). Of these, the most relevant for this Project are UMEs affecting the minke whale, North Atlantic right whale, and humpback whale.

Most of the large whales generally found in the Project Area are baleen whales (a whale that has plates of whalebone in the mouth for straining plankton from the water). The sperm whale is the only large odontocete whale (whales with teeth) known to occur. ESA-listed large whales that may occur in the region are the sei, blue (*Balaenoptera musculus*), and sperm whale (*Physeter macrocephalus*); however, these whales are highly unlikely to occur in the Project Area. The sei whale has been acoustically detected in all seasons (WHOI 2018; WCS Ocean Giants 2020, Davis et al. 2020), and is only uncommonly observed. The blue whale has been seen in the Project Area in fall and winter including just off Sandy Hook, New Jersey, but not in the Lease Area. They have also been acoustically detected in fall, winter and spring, but not localized to the Lease Area. Sperm whales would not be expected to occur in the shallower water depths of the Project Area, though they are commonly found in all seasons in the deeper offshore waters of the OCS on the shelf break (Tetra Tech and SES 2018; Tetra Tech and LGL 2019 and 2020). While rare occurrences of these three ESA-listed whales have been reported in the Project Area, these species are considered to be rare and are not expected.

Of the large whales commonly present in the Project Area, almost all studies noted that humpback whales and fin whales are present year-round and have been sighted or acoustically detected in all months (Davis et al. 2020). Humpback whale and fin whale abundance in the Project Area is considered increasing as compared to previous years. In year-round acoustic studies conducted using permanent buoys in the New York Bight, the sei, fin, right, and humpback whales were the most commonly detected large whales (WHOI 2018). The right whale, fin whale, humpback whale, and bottlenose dolphin were detected during all seasons in previous acoustic studies from New Jersey (NJDEP 2010). Interannual shifts were noted by the WCS/WHOI buoys (WCS Ocean Giants 2020), with peaks in fin whale and humpback whale (and sei whale) detections shifting by a month in 2019 as compared to previous years, though not in the same directions (i.e., fin whale peaks shifted forward a month and both humpback and sei whale shifted backwards). Spatial differences were noted by the real time analyses between the NW and SE buoy locations from January through April with all four species being detected, albeit sei whales at less than one percent of the days. Fin whales and humpback whales were detected in greater numbers at both the SE and NW buoys. Right whales were detected by the Blue York buoy, roughly 22 mi (35.4 km) south of Fire Island, in the winter with occasional detections in July (WHOI 2018) and by the SE WCS/WHOI buoy from November through April predominantly. The right whale occurs seasonally in

Project Area waters and has been sighted in all seasons except summer; it is acoustically detected year-round, albeit rarely in summer.

Historically, the Gowanus Canal (near the EW 1 landfall) has been known for a multitude of whale and dolphin sightings. Dating back to 1928, whale hunts would occur in the canal, and records even show evidence of a sperm whale in the canal (New York Times 1928). Over the course of the last century, there have been other recorded whale and dolphin sightings, including the sighting of "Sludgie," the juvenile minke whale that stranded and eventually died in 2007 in the Gowanus Canal (Albrecht 2017). Additional historical references indicate that whales were plentiful in the area in the 1600-1800s, and a large decline was experienced due to increased water pollution from the early 1900s to the 1980s. As efforts to clean up the Hudson River and the waters surrounding Manhattan have been undertaken, there has been an increase in the number of whale sightings over the last 10 years. Two hundred and seventy-two whales have been documented in New York City waters in 2018 alone (The Guardian 2019), with a "boom" in large whales noted (National Geographic 2019). When characterizing mobile marine wildlife species, it is important to recognize that occurrences can vary from year to year and from season to season. The presence and/or absence of marine mammals within the Project Area waters can be affected by a variety of parameters, including water temperature, movements or availability of prey, and human presence or disturbance. The waters associated with the Project Area are used by marine mammals for foraging, transiting, or migrating, and some individuals may remain year-round. Some cetacean species prefer offshore, continental shelf waters during feeding seasons due to the abundance of their prey species. However, at alternate times of the year, these same species occur in shallower depths closer to shore. It should also be noted that in addition to the variable movement of marine mammals due to the factors listed, environmental changes stemming from climate change factors are affecting many marine mammals' typical foraging and migrating boundaries. Any such data, if available, is referenced within this Section under the species-specific descriptions. It is important to note that as more information becomes available on these changing trends, long-understood distributions and occurrences for various marine mammal species in these waters could change. The following species discussions are therefore based on both recent survey data and historic behavioral trends.

Marine mammal hearing, when noted, is based on the NOAA Fisheries (2018a) categories for low-, mid-, and high-frequency cetacean hearing groups. As part of an effort to assess impacts from anthropogenic sound sources, marine mammal species have been arranged into functional hearing groups based on their generalized hearing sensitivities: high-frequency cetaceans (harbor porpoise), mid-frequency cetaceans (dolphins, toothed whales, beaked whales), low-frequency cetaceans (Mysticetes; i.e., baleen whales), otariid pinnipeds (sea lions and fur seals), and phocid pinnipeds (true seals).

Human-induced impacts such as underwater noise, vessel collisions, entanglements, and other human disturbances are a threat to multiple marine mammal species. Other disturbances include habitat loss, pollution, and commercial fishing (Kenney 2002). Underwater noise generated from a variety of human activities is a known stressor for marine wildlife. Noise sources include noise from vessels associated with wind farm development or operation; from construction equipment such as multi-beam echosounders or other bottom survey equipment. Noise in the marine environment may cause injury and displacement and is known to affect marine mammal behavior. Stress from noise may reduce reproductive fitness by increasing energy expenditures, reducing foraging success, or by masking vocalizations, which can also have other indirect effects. Noise mitigations are planned as part of the Project-related avoidance, minimization, and mitigation measures. Increases in ship numbers and changes in vessel traffic associated with pre-construction surveys, wind farm construction, and post-construction operation and maintenance also increase the risk of vessel collisions with marine wildlife.

4.1 Mysticetes

4.1.1 Fin Whale (*Balaenoptera physalus*)–Endangered

The fin whale was listed as federally endangered in 1970 and is state listed as endangered in New York. The western North Atlantic stock is designated as strategic under the MMPA (Hayes et al. 2021).

The fin whale has a sleek, streamlined body with a V-shaped head. Fin whales have distinctive coloration: black or dark brownish gray on the back and sides, and white on the underside (NOAA Fisheries 2010b). Head coloring is asymmetrical: dark on the left side of the lower jaw, white on the right-side of the lower jaw. Many fin whales have several light-gray V-shaped chevrons behind their heads, and the underside of the tail flukes is often white with a gray border; these markings are unique and can be used to identify individuals (NOAA Fisheries 2010b). Fin whales are the second largest living whale species on the planet (Kenney and Vigness-Raposa 2010). Their gestation period is approximately 11 months, with females giving birth every two to three years, typically between late fall and winter. Fin whales hearing is in the low-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

The species' range in the North Atlantic extends from the Gulf of Mexico, Caribbean Sea, and Mediterranean Sea in the south to Greenland, Iceland, and Norway in the north (Jonsgård 1966; Gambell 1985). They are the most commonly sighted large whales in continental shelf waters from the Mid-Atlantic Coast of the United States to Nova Scotia (Sergeant 1977; Sutcliffe and Brodie 1977; CETAP 1982; Hain et al. 1992). The overall pattern of fin whale movement is complex, consisting of a less obvious north-south pattern of migration than that of right and humpback whales. Fin whales, much like humpback whales, seem to exhibit habitat fidelity; however, their habitat use has shifted in the southern Gulf of Maine (Kenney and Vigness-Raposa 2010; Hayes et al. 2021). This is most likely due to changes in the abundance of sand lance and herring, both of which are major prey species along with squid, krill, and copepods (Kenney and Vigness-Raposa 2010). While fin whales typically feed from Maine to Virginia in the summer, mating and calving (and general wintering) areas are still largely unknown (Hayes et al. 2021). Based on acoustic recordings from hydrophone arrays, Clark (1995) reported a general southward flow pattern of fin whales in the fall from the Labrador/Newfoundland region, past Bermuda, and into the West Indies. The overall distribution may be based on prey availability, as this species preys opportunistically on both invertebrates and fish (Watkins et al. 1984).

Fin whale abundance off the coast of the northeastern United States has historically been highest between spring and fall, with some individuals remaining during the winter (Hain et al. 1992). The best abundance estimate available for the western North Atlantic fin whale stock is 6,802 (Hayes et al. 2021). Fin whales were acoustically detected year-round in the New York Bight (Davis et al. 2020).

Present threats to fin whales are similar to other whale species, namely anthropogenic noise, fishery entanglements, and vessel strikes. Fin whales seem less likely to become entangled than other whale species. Glass et al. (2010) reported that between 2004 and 2008, fin whales belonging to the Gulf of Maine population were involved in only eight confirmed entanglements with fishery equipment. Furthermore, Nelson et al. (2007) reported that fin whales exhibited a low proportion of entanglements during their 2001 to 2005 study along the western Atlantic, with only eight reported events. Vessel strikes, however, may be a more serious threat to fin whales, with eight and 10 confirmed vessel strikes reported by Glass et al. (2010) and Nelson et al. (2007), respectively. This level of incidence was similar to that exhibited by the other whales studied. Conversely, a study compiling whale/vessel strike reports from historical accounts, recent whale strandings, and anecdotal records by Laist et al. (2001) reported that of the 11 great whale species studied, fin whales were involved in collisions most frequently (31 in the United States and 16 in France). From 2008 to 2012, the minimum annual rate of mortality for the North Atlantic stock from anthropogenic causes was approximately 3.35 per year (Waring et al. 2015). From 2014 to 2018, this number has decreased to 2.35 per year, including incidental fishery interaction records totaling 1.55 individuals, and records of vessel collisions totaling 0.8 whales (Hayes et al. 2021). An increase in ambient noise has also impacted fin whales, for whales in the Mediterranean have demonstrated at least two different avoidance strategies after being disturbed by tracking vessels (Jahoda et al. 2003).

4.1.2 Humpback Whale (*Megaptera novaeangliae*)–Not ESA-listed (West Indies Distinct Population Segment)/ Non-Strategic under MMPA

The humpback whale was listed as endangered in 1970 due to population decrease resulting from overharvesting; however, this species was delisted as threatened or endangered as of September 8, 2016 (81 Federal Register 62259). In September 2016, NOAA Fisheries revised the ESA listing for the humpback whale to identify 14 Distinct Population Segments based on breeding populations. Under this new final rule, humpback whales along the East Coast of the United States are part of the West Indies Distinct Population Segment, which is not listed as threatened or endangered (81 Federal Register 62259). The West Indies Distinct Population segment is considered non-strategic under the MMPA (Hayes et al. 2020).

North Atlantic humpback whale body coloration is primarily dark grey or black, but they can have a variable amount of white on their pectoral fins, flukes, and bellies. Their tail variation is so distinctive that the pigmentation patterns on the undersides of their flukes are used to identify individual whales (Katona et al. 1981). Humpback whales feed on small prey that is often found in large concentrations, including krill and fish such as herring and sand lance (Hain et al. 1982; Kenney and Vigness-Raposa 2010). Humpback whales are thought to feed mainly while migrating and in summer feeding areas; little feeding is known to occur in their wintering grounds. Humpbacks consume roughly 95 percent small schooling fish and 5 percent zooplankton (i.e., krill), and they will migrate throughout their summer habitat to locate prey (Kenney and Winn 1986). They swim below the thermocline to pursue their prey, so even though the surface temperatures might be warm, they are frequently swimming in cold water (NOAA Fisheries 1991b). Their hearing is in the low-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

Humpback whales from all of the North Atlantic migrate to the Caribbean in winter, where calves are born between January and March (Blaylock et al. 1995). In winter, whales from waters off New England, Canada, Greenland, Iceland, and Norway migrate to mate and calve primarily in the West Indies (including the Antilles, the Dominican Republic, the Virgin Islands and Puerto Rico), where spatial and genetic mixing among these groups occurs (Hayes et al. 2020). This species exhibits consistent fidelity to feeding areas within the northern hemisphere and feeds over the continental shelf in the North Atlantic between New Jersey and Greenland (Stevick et al. 2006).

The humpback whale population within the North Atlantic, and more specifically the stock associated with waters surrounding New York, is known as the Gulf of Maine stock, and has been estimated to include approximately 1,396 individuals (Hayes et a. 2020). This stock is part of a larger North Atlantic population estimated to be approximately 11,570 individuals (Waring et al. 2016). Humpback whales were acoustically detected in the New York Bight winter through summer, with a decrease in the fall, likely corresponding to their yearly migration to breeding grounds in the Caribbean (Davis et al. 2020).

Humpback whales were hunted as early as the seventeenth century, with most whaling operations having occurred in the nineteenth century (Kenney and Vigness-Raposa 2010). Before whaling activities began, it was thought that the abundance of whales in the North Atlantic stock was in excess of 15,000 (Nowak 2002). By 1932, commercial hunting within the North Atlantic may have reduced the humpback whale population to as little as 700 individuals (Breiwick et al. 1983). Humpback whales were commercially exploited by whalers throughout their whole range until they were protected in the North Atlantic in 1955 by the International

Whaling Commission. Contemporary anthropogenic threats to humpback whales include anthropogenic noise, fishery entanglements, and vessel strikes. Glass et al. (2010) reported that between 2002 and 2006, humpback whales belonging to the Gulf of Maine population were involved in 77 confirmed entanglements with fishery equipment and nine confirmed ship strikes. Humpback whales that were entangled exhibited the highest number of serious injury events of the six species of whale studied by Glass et al. (2010). A whale mortality and serious injury study conducted by Nelson et al. (2007) reported that the minimum annual rate of anthropogenic mortality and serious injury to humpback whales occupying the Gulf of Maine was 4.2 individuals per year. During this study period, humpback whales were involved in 70 reported entanglements and 12 vessel strikes and were the most common species reported dead. This number has increased to 12.15 animals per year between 2013 and 2017 (Hayes et al. 2020). In addition to ship strike impacts, humpback whales were confirmed in a recent National Report on Large Whale Entanglements to be among the five most frequently entangled large whale species (NOAA Fisheries 2017b). They are the most frequently reported entangled large whales, representing 68 percent of all confirmed entanglements since 2007 (NOAA Fisheries 2017b). In 2017 alone, there were 49 confirmed entanglements, 23 of which were off of the Northeast Atlantic Coast. Once entangled, they can swim for long distances dragging the attached gear, which can result in fatigue, compromised feeding ability, or severe injury or death. Additionally, impacts associated with entanglements may result indirectly in reduced reproductive success or death. Unusual Mortality Events are documented when there are a larger number of strandings than typical in one or more locations of the same species. There has been a documented UME for humpback whales since 2016, with a much larger number of strandings reported compared to prior years. For a variety of reasons, including ship strike, illness, entanglement, and other unknown causes, 155 whales have stranded since this UME was established. Off of New Jersey, 16 whales stranded during this time and off of New York 32 whales stranded (NOAA Fisheries 2022a).

4.1.3 Minke Whale (*Balaenoptera acutorostrata acutorostrata*)–Non-Strategic

The minke whale is not ESA-listed, and the Canadian East Coast stock is listed by NOAA Fisheries as non-strategic under the MMPA (Hayes et al. 2021).

Common minke whales range between 20 and 30 ft (6 and 9 m), with maximum lengths of 30 to 33 ft (9 to 10 m), and are the smallest of the North Atlantic baleen whales (Jefferson et al. 1993; Wynne and Schwartz 1999; Kenney and Vigness-Raposa 2010). The minke whale has a fairly tall sickle-shaped dorsal fin located about two-thirds down its back, and its body is black to dark grayish/brownish, with a white underside and a pale chevron on the back behind the head and above the flippers. The primary prey species for minke whales are most likely sand lance, clupeids, gadoids, and mackerel (Kenney and Vigness-Raposa 2010). These whales feed below the surface of the water, and calves are usually not seen in adult feeding areas. As is typical of the baleen whales, minke whales are usually seen either alone or in small groups, although large aggregations sometimes occur in feeding areas (Reeves et al. 2002). Minke whale hearing is in the low-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

Minke whales are among the most widely distributed of all the baleen whales. They occur in the North Atlantic and North Pacific, from tropical to polar waters. Generally, they inhabit warmer waters during winter and travel north to colder regions in summer, while some animals migrate as far as the ice edge.

Minke populations are often segregated by sex, age, or reproductive condition. In the 2015 stock assessment report, the estimate for minke whales in the Canadian East Coast stock was 20,741 (Waring et al. 2015). The population estimate of 20,741 was then substantially decreased to 2,591 individuals because estimates older than eight years were excluded from the newest estimate (Hayes et al. 2019). This downward estimate should not be interpreted as a decline in abundance of this stock, as previous estimates were not directly comparable

(Hayes et al. 2020). The population estimate has increased to 21,968 due to the availability of more recent survey data (Hayes et al. 2021).

Minke whales are impacted by anthropogenic noise, ship strikes, entanglement, and bycatch from bottom trawls, lobster trap/pot, gillnet, and purse seine fisheries. From 2008 to 2012, the minimum annual rate of reported mortality for the North Atlantic stock from anthropogenic causes was approximately 9.9 per year (Waring et al. 2015). From 2014 to 2018 this decreased to 10.55 per year (Hayes et al. 2021). Outside of U.S. waters, hunting for minke whales continues, by Norwegian whalers in the northeastern North Atlantic and by Japanese whalers in the North Pacific and Antarctic (Reeves et al. 2002). International trade of the species is currently banned. The best abundance estimate for this stock is 21,968 (Hayes et al. 2021). Minke whales were confirmed in a recent National Report on Large Whale Entanglements to be among the five most frequently entangled large whale species (NOAA Fisheries 2017b). There was a notable increase in minke whale strandings and entanglements in 2017 and 2018, with numbers higher than in all years ranging from 2007 to 2016 (NOAA Fisheries 2017b; NOAA Fisheries 2018c). Many of these entanglements involved line and pot gear (NOAA Fisheries 2017b). Over the last few years, NOAA Fisheries determined that there is a UME for minke whales along the Atlantic coast between Maine and South Carolina from 2017–present: a total of 122 whales have been stranded since 2017 (NOAA Fisheries 2022a). Previous minke whale UMEs occurred in 2003 and 2005 (NOAA Fisheries 2018c).

4.1.4 North Atlantic Right Whale (*Eubalaena glacialis*)–Endangered

The North Atlantic right whale is a strongly migratory species that moves annually between high-latitude feeding grounds and low-latitude calving and breeding grounds. This species was listed as a federally endangered species in 1970 and is one of the most endangered large whale species in the world. It is considered critically endangered under the ESA and is state listed as endangered in New York. The Western Atlantic stock is considered strategic under the MMPA (Hayes et al. 2021). The right whale saw a nominal 2.8 percent recovery rate between 1990 and 2011 (Hayes et al. 2021).

Distinguishing features for right whales include a stocky body, black coloration (although some have white patches on their undersides), lack of a dorsal fin, a large head (about one quarter of the body length), strongly bowed margin of the lower lip, and callosities on the head region. The tail is broad, deeply notched, and all black with smooth trailing edge (Jefferson et al. 2015). Right whales feed mostly on copepods belonging to the Calanus and Pseudocalanus genus (McKinstry et al. 2013) and are considered “grazers” as they swim slowly with their mouths open when feeding. They are the slowest swimming whales, only reaching speeds up to 10 mi (16 km) per hour. They can dive at least 1,000 ft (300 m) and typically stay submerged for 10 to 15 minutes, feeding on their prey below the surface (Jefferson et al. 2015). Right whales’ hearing is in the low-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

The historic range of right whales reached its southern terminus between Florida and northwestern Africa and its northern terminus between Labrador and Norway (Kenney 2002). The present range of the right whale population extends from the wintering and calving grounds in the southeastern United States between Florida and Cape Fear, North Carolina (Hayes et al. 2021) to summer feeding and nursery grounds between New England and the Bay of Fundy and the Gulf of St. Lawrence (Kenney 2002; Hayes et al. 2021). A few documented events of right whale calving have occurred in shallow coastal areas and bays (Kenney 2002). The winter distribution of right whales is largely unknown, although offshore surveys have reported between 1 and 13 sightings annually in northeastern Florida and southeastern Georgia (Hayes et al. 2021). Observations in December 2008 noted congregations of more than 40 individual right whales in the Jordan Basin area of the Gulf of Maine, leading researchers to believe this may be a wintering ground (NOAA Fisheries 2008). A right whale satellite tracking study within the northeast Atlantic (Baumgartner and Mate 2005) reported that this species often visited waters exhibiting low bottom water temperatures, high surface salinity, and high surface stratification, most likely due to higher food densities. North Atlantic right whales are typically found in feeding grounds within New England waters and waters of the New York Bight between February and May, with peak abundance in late March (Hayes et al. 2021).

The North Atlantic right whale was the first species targeted during commercial whaling operations and was the first species to be greatly depleted as a result of these activities (Kenney 2002). North Atlantic right whales were hunted in southern New England until the early twentieth century. Shore-based whaling in New York involved catches of right whales year-round, with peak catches in spring during the northbound migration from calving grounds off the southeastern United States to feeding grounds in the Gulf of Maine (Kenney and Vigness-Raposa 2010). Based on back calculations using the present population size and growth rate, the population may have numbered fewer than 100 individuals by 1935 when international protection for right whales came into effect (Hain 1975; Reeves et al. 1992; Kenney et al. 1995). This is a tremendous difference from pre-exploitation numbers, estimated at between 9,075 and 21,328 based on extrapolation of spatially explicit models of carrying capacity in the North Pacific (Monserrat et al. 2015). Abundance estimates for the North Atlantic right whale population vary. The 2003 United States Atlantic and Gulf of Mexico Marine Mammal Stock Assessment Report (SAR) indicated a population abundance of 291, which is less than what was reported in the Northern Right Whale Recovery Plan written in 1991 (NOAA Fisheries 1991a). Examination of abundance estimates for the years 1990–2011 suggests that abundance increased at about 2.8 percent per year from posterior median point estimates of 270 individuals in 1990 to 481 in 2011, but abundance declined at a rate of 14.35 percent from 2011 to 2018 when the abundance estimate was 412 individuals (NOAA Fisheries 2022b). The population size estimate decreased to 368 individuals in 2021 (Draft NOAA Fisheries 2021 SAR used at request and provided directly by NOAA Fisheries).

Contemporary anthropogenic threats to right whale populations include fishery entanglements and vessel strikes, although habitat loss, pollution, anthropogenic noise, and intense commercial fishing have the potential to negatively impact their populations (Kenney 2002). Entanglements can represent a significant trauma, and result in vast energy expenditure for large whales either from dragging gear or from trying to get released, leading to injury or death if disentanglement efforts are not successful within a critical time period (van der Hoop et al. 2017; van der Hoop et al. 2016). Such energy expenditures can have significant sub-lethal indirect and ongoing impacts to right whales, particularly reproductive females where time for reproduction could be delayed for months or years (van der Hoop et al. 2016). Recovery from entanglements and subsequent energy losses resulting in physiological stress could limit reproductive success and contribute to fluctuations in population growth (van der Hoop et al. 2016). Unfortunately, evidence suggests that recent efforts to reduce entanglement through fishing gear modification have not resulted in a decline in frequencies of entanglement or serious injury due to entanglement (Pace et al. 2014).

Between 2002 and 2006, a study of marine mammal strandings and human-induced interactions reported that right whales in the western Atlantic were subject to the highest proportion of entanglements (25 of 145 confirmed events) and ship strikes (16 of 43 confirmed occurrences) of any marine mammal studied (Glass et al. 2010). Bycatch of right whale has also been reported in pelagic drift gillnet operations by the Northeast Fisheries Observer Program; however, no mortalities have been reported (Glass et al. 2010). From 2014 through 2018, the minimum rate of annual human-caused mortality and serious injury to this species averaged 8.15 per year (Hayes et al. 2021). Records from 2014 through 2018 indicate there have been 43 confirmed injury events, including 18 mortalities (Hayes et al. 2021). From 2014 through 2018, the minimum rate of annual human-caused mortality and serious injury to this species from fishing entanglements averaged 6.85 per year, while ship strikes averaged 1.3 whales per year (Hayes et al. 2021). Environmental fluctuations and anthropogenic disturbance may be contributing to a decline in overall health of individual right whales that has been occurring for the last three decades (Rolland et al. 2016). The low annual reproductive rate of right whales, coupled with small population size, suggests anthropogenic mortality may have a greater impact on population growth rates for the species than for other whales (Hayes et al. 2021). In recent years there have been increased mortality rates coupled with decreasing calving rates. In 2017, five calves were observed; however, none were sighted in 2018, and from 2017 to 2018 there were 19 confirmed mortalities (NOAA Fisheries 2018b). Changes in prey availability affect right whale calving as do entanglements. Their health, in all demographic groups and in the overall population, has steadily declined over the last thirty years of observations (Rolland et al. 2016). Right whale calves have been sighted in 2019; the current count was seven as of March 2019.

Ship strikes are the second most frequently documented case of mortality in right whales (NOAA Fisheries 2018b) where most ship strikes are fatal to this species (Jensen and Silber 2004). Right whales have difficulty maneuvering around boats and spend most of their time at the surface, feeding, resting, mating, and nursing, increasing their vulnerability to collisions. Mariners should assume that North Atlantic right whales will not move out of their way nor will they be easy to detect from the bow of a ship as they are dark in color and typically do not surface with a high profile. To address potential for ship strike, NOAA Fisheries designated the nearshore waters of the Mid-Atlantic Bight as the Mid-Atlantic U.S. Seasonal Management Area (SMA) for right whales in December 2008. NOAA Fisheries requires that all vessels 65 ft (19.8 m) or longer must travel at 10 knots (18.5 km per hour [km/h]) or less within the right whale SMA from November 1 through April 30, when right whales are most likely to pass through these waters (NOAA Fisheries 2010; NYSDOS 2013). NOAA Fisheries also implements Slow Zones (based on presence of both visually and acoustically detected whales. Please see Section 11.1 for Project implementation of these zones). Studies by van der Hoop et al. (2015) have concluded large whale vessel strike mortalities decreased inside active SMAs but have increased outside of these protected areas.

Right whales are one of the five most frequently entangled large whales (NOAA Fisheries 2017b) with the odds of an entanglement event are now increasing by 6.3 percent per year (NOAA Fisheries 2018a). In addition, Dynamic Management Areas (DMAs) are areas of temporary protection established by NOAA Fisheries for particular marine mammal species, in an effort to respond to movements of high-risk whale species (such as right whale). These DMAs are determined by sighting reports made through vessel traffic in the larger Northern Atlantic and are communicated through marine communication systems and published on their website. The Right Whale Sighting Advisory System, a statutory requirement to reduce the risk of right whale collisions, is in place for any DMA. Lease stipulation 4.2.3 also requires that that all vessel operators must comply with a 10-knot or less speed restriction in DMAs or at all times between November 1 and April 30.

A UME for right whale strandings commenced in 2017 and remains active, with the current total at 50 whales (including both confirmed mortalities and seriously injured free-swimming whales; NOAA Fisheries 2022a). The UME was declared by NOAA Fisheries based on a high number of dead whales discovered in Canadian and U.S. waters (NOAA Fisheries 2019b).

4.1.5 Sei Whale (*Balaenoptera borealis borealis*)–Endangered

The sei whale (*Balaenoptera borealis borealis*) is listed as endangered under the ESA and is designated as strategic under the MMPA (Hayes et al. 2021). A final recovery plan for the sei whale was published in 2011 (NOAA Fisheries 2011). A five-year review of the species was completed in 2012 (NOAA Fisheries 2012) with no change in status and another five-year review was initiated in 2018 (pending).

Sei whales are a blue-black-gray color with skin often marked by pits or wounds likely caused by ectoparasitic (i.e., parasites that live on the surface of the host body) copepods; after healing, the wounds become ovoid white scars. The sei whale can be distinguished from other baleen species by its dorsal fin, which is falcate, curves backward, and is set about two-thirds of the way back from the tip of the snout. Unlike fin whales, they tend not to roll high out of the water as they dive. The sei whale blowholes and dorsal fins are often exposed above the water surface simultaneously. Although sei whales may prey upon small schooling fish and squid, available information suggests that calanoid copepods and euphausiids are the primary prey of this species (Flinn et al. 2002). Sei whale hearing is in the low-frequency hearing range (Southall et al. 2007; NOAA Fisheries 2018a).

The sei whale is a widespread species in the world's temperate, subpolar, subtropical, and tropical marine waters. NOAA Fisheries considers sei whales occurring from the U.S. East Coast to Cape Breton, Nova Scotia, and east to 42°W, as belonging to the "Nova Scotia stock" of sei whales (Hayes et al. 2021). Sei whales occur in deep water characteristic of the continental shelf edge throughout their range (Hain et al. 1992; Hayes et al. 2021). Sei whales have been acoustically detected in the New York Bight in all seasons (Davis et al. 2020).

There is limited information on the stock identity of sei whales in the North Atlantic (Hayes et al. 2021). The best abundance estimate based on the most recent SAR for the Nova Scotia stock of sei whales is 6,292 (Hayes et al. 2021). Insufficient data are available to determine trends of the Nova Scotian sei whale population. From 2014 through 2018, the minimum annual rate of human-caused mortality and serious injury was 1.20 (Hayes et al. 2021). No confirmed fishery-related mortalities or serious injuries of sei whales have been reported in the NOAA Fisheries Sea Sampling bycatch database (Hayes et al. 2021).

4.2 Odontocetes

4.2.1 Atlantic Spotted Dolphin (*Stenella frontalis*) and Pantropical Spotted Dolphin (*Stenella attenuata*)–Non-Strategic

There are two species of spotted dolphin found in the western North Atlantic Ocean: the Atlantic spotted dolphin and the pantropical spotted dolphin (Perrin et al. 1987). The Atlantic and pantropical spotted dolphins are not ESA-listed, and the stocks are not considered strategic under the MMPA (Hayes et al. 2020). Where they co-occur, the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate (Hayes et al. 2020). The pantropical spotted dolphin is found mostly in deeper offshore waters but does approach the coast in some areas (Jefferson et al. 2015).

Atlantic spotted dolphins have a robust body with a tall, curved dorsal fin located midway down their back (Jefferson et al. 2015). Individuals can reach 5 to 7.5 ft (1.5 to 2.3 m) in length (Herzing 1997). They have moderately long, slender beaks and their color patterns vary with age and location. In addition, two forms of the Atlantic spotted dolphin exist, one that is large and heavily spotted and another that is smaller in size with fewer spots (Hayes et al. 2020). Pantropical spotted dolphins are typically 6 to 7 ft (1.8 to 2.2 m) in length at adulthood (Jefferson et al. 2015). Pantropical dolphins have long, slender beaks like the Atlantic spotted dolphin, but are also distinguished by a dark cape or coloration on their backs, which stretches from their head to almost midway between the dorsal fin and the tail flukes, and by a white-tipped beak (Herzing 1997; Jefferson et al. 2015). Hearing for both dolphin species is in the mid-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

The Atlantic spotted dolphin prefers tropical to warm temperate waters along the continental shelf, 33 to 650 ft (10 to 200 m) deep to slope waters greater than 1,640 ft (500 m) deep. The pantropical spotted dolphin is distributed in offshore tropical and subtropical waters of the Atlantic Ocean. It has been suggested that these species may move inshore seasonally during the spring, but data to support this theory are limited (Caldwell and Caldwell 1966; Fritts et al. 1983). The Atlantic spotted dolphin diet consists of a wide variety of fish and squid, as well as benthic invertebrates (Herzing 1997). Similarly, pantropical spotted dolphins prey on near-surface fishes, squid, and crustaceans and on some mid-water species.

The best population estimate for the Atlantic spotted dolphin is approximately 39,921 individuals and for the pantropical spotted is 6,593 (Hayes et al. 2020).

Threats to dolphin species include fisheries interactions, bycatch (accidental or indirect catch), entanglement, ship strikes, anthropogenic noise, chemical pollution, and general habitat deterioration or destruction. The total annual estimated human-caused mortality and serious injury to spotted dolphin was zero; there were no reported deaths from U.S. fisheries observer data (Hayes et al. 2020).

4.2.2 Atlantic White-Sided Dolphin (*Lagenorhynchus actus*)–Non-strategic

Atlantic white-sided dolphins are not ESA-listed, and the stocks are not considered strategic under the MMPA (Hayes et al. 2020).

Atlantic white-sided dolphins range between 8.2 and 9.2 ft (2.5 m and 2.8 m) in length, with females being approximately 7.9 in (20 cm) shorter than males (Kenney and Vigness-Raposa 2010). This species is highly social and is commonly seen feeding with larger whales. White-sided dolphins feed on a variety of small species, such as herring, hake, smelt, capelin, cod, and squid, with regional and seasonal changes in the species consumed (Kenney and Vigness-Raposa 2010). Sand lance is an important prey species for these dolphins in the Gulf of Maine during the spring. Other fish prey include mackerel, silver hake, herring, smelt, and several other varieties of gadoids (Kenney and Vigness-Raposa 2010). Their hearing is in the mid-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

While the range of the Atlantic white-sided dolphin includes waters surrounding New York, they are typically found in water depths of 330 ft (100 m) in the cool temperate and subpolar waters of the North Atlantic, generally along the continental shelf between the Gulf Stream and the Labrador current to as far south as North Carolina (Reeves et al. 2002; Jefferson et al. 2015). They are the most abundant dolphin in the Gulf of Maine and the Gulf of St. Lawrence, but seem relatively rare along the North Atlantic coast of Nova Scotia (Kenney and Vigness-Raposa 2010). There are seasonal shifts in the distribution of Atlantic white-sided dolphins off the northeastern U.S. Coast, with low abundance in winter between Georges Basin and Jeffrey's Ledge and very high abundance in the Gulf of Maine during spring. Atlantic white-sided dolphins are most abundant during the summer. During the fall, the distribution of Atlantic white-sided dolphins is similar to that in the summer, although they are less abundant (Hayes et al. 2020).

Recent population estimates for Atlantic white-sided dolphins in the Western North Atlantic Ocean places this species at 93,233 individuals (Hayes et al. 2020).

The biggest human-induced threat to the Atlantic white-sided dolphin is bycatch, because they are occasionally caught in fishing gillnets and trawling equipment. An estimated average of 328 dolphins each year were killed by fishery-related activities from 2003 to 2007 (Waring et al. 2010). From 2013 through 2017, the total annual average fishery-related mortality or serious injury to this stock was 26 individuals (Hayes et al. 2020).

4.2.3 Bottlenose Dolphin (*Tursiops truncatus*)–Non-Strategic Western North Atlantic Offshore Stock; Non-Endangered / Strategic Western North Atlantic Northern Migratory Coastal Stock

The population of bottlenose dolphins in the North Atlantic consists of a complex mosaic of dolphin stocks (Waring et al. 2010). There are two distinct bottlenose dolphin morphotypes: migratory coastal and offshore.

The migratory coastal morphotype resides in waters typically less than 20 m deep, along the inner continental shelf (within 7.5 km of shore) and around islands; it is continuously distributed south of Long Island, New York into the Gulf of Mexico (Hayes et al. 2021). This migratory coastal population is subdivided into seven stocks, based largely upon spatial distribution (Waring et al. 2016). There are two stocks that may be found in the vicinity of the Project Area: the Western North Atlantic Offshore Stock (WNAOS) and the Western North Atlantic Northern Migratory Coastal Stock (WNANMCS).

Bottlenose dolphins feed on a large variety of organisms, depending on their habitat. The coastal, shallow population tends to feed on benthic fish and invertebrates, while deep water populations consume pelagic or mesopelagic fish such as croakers, sea trout, mackerel, mullet, and squid (Reeves et al. 2002). Bottlenose dolphins appear to be active both during the day and night. Their activities are influenced by the seasons, time of day, tidal state, and physiological factors such as reproductive seasonality (Wells and Scott 2002). They are light- to slate-gray in color, roughly 2.4 to 3.7 m long, and have short, stubby beaks. They show sexual dimorphism between males and females, with males being larger and heavier. The species' hearing is in the mid-frequency range (NOAA Fisheries 2018a; Southall et al. 2007).

In general, the species occupies a wide variety of habitats, thus is regarded as possibly the most adaptable cetacean (Reeves et al. 2002). It occurs in oceans and peripheral seas at both tropical and temperate latitudes. In North America, bottlenose dolphins are found in surface waters with temperatures ranging from 10°C to 32°C.

The WNANMCS is the coastal stock found from Long Island, New York to Assateague, Virginia, and is the stock most likely to be encountered in the vicinity of the Project Area. Seasonally, WNANMCS movements indicate they are mostly found in Long Island during warm water months. They migrate south to Cape Lookout, North Carolina, during winter months. These animals often move into or reside in bays, estuaries, the lower reaches of rivers, and coastal waters within the approximate 20-m depth isobath north of Cape Hatteras (Waring et al. 2016; Reeves et al. 2002). The offshore population consists of one stock (WNAOS) in the western North Atlantic, distributed primarily along the OCS and continental slope. WNAOS dolphins are distributed widely during the spring and summer from Georges Bank to the Florida Keys, with late summer and fall incursions as far north as the Gulf of Maine, depending on water temperatures (Hayes et al. 2017; Kenney 1990). This morphotype is most expected in waters north of Long Island, New York (Hayes et al. 2017). The range of the WNAOS morphotype south of Cape Hatteras has recently been found to overlap with that of the WNASMCS morphotype, found as close as 7.3 km from the shore in water depths of 13 m (Hayes et al. 2017). The WNAOS is found seaward of 34 km and in waters deeper than 34 m.

The NOAA Fisheries species SAR estimates the population of WNAOS bottlenose dolphin stock at 62,851 individuals and the WNANMCS stock at 6,639 individuals. From 1995 to 2001, NOAA Fisheries recognized only the western North Atlantic Coastal Stock of common bottlenose dolphins in the western North Atlantic. This stock was listed as depleted due to a UME from 1988 to 1989 (64 Federal Register 17789, 06 Apr 1993). The estimated mean annual fishery-related mortality and serious injury of WNAOS from 2013 through 2017 was 28 per year. This is less than ten percent of the calculated potential biological removal, and therefore is not significant and approaches the zero mortality and serious injury rate (Hayes et al. 2020). However, the estimated mean annual fishery-related mortality and serious injury of the WNANMCS from 2014 to 2018 is estimated to be 12.2 to 21.5 individuals (Hayes et al. 2021). This number is concerning in light of the Wells et al. (2015) estimation that only one-third of common bottlenose carcasses in estuarine environments are recovered, suggesting that annual human-caused mortality may approach ten percent of the potential biological removal for this stock based on the best available abundance estimate. Therefore, NOAA Fisheries considers the WNANMCS as strategic and the WNAOS as non-strategic (Hayes et al. 2020, 2021).

Common bottlenose dolphins are among the most frequently stranded small cetaceans along the U.S. Atlantic Coast. Many of the animals show signs of human interaction (i.e., net marks, mutilation, etc.). However, it is unclear what proportion of these stranded animals are from which stock, because most strandings are not identified to morphotype (Hayes et al. 2021). The biggest threat to the population is bycatch, as they are frequently caught in fishing gear, gillnets, purse seines, and shrimp trawls (Waring et al. 2016). They have also been adversely impacted by pollution, habitat alteration, boat collisions, human disturbance, and are subject to bioaccumulation of toxins. Scientists have found a strong correlation between dolphins with elevated levels of polychlorinated biphenyls and illness, indicating certain pollutants may weaken their immune system (ACS 2004). Two UMEs for western Atlantic bottlenose dolphins, from 1987 to 1988 and 2013 to 2015, were attributed to morbillivirus (Morris et al. 2015). When the impacts of the 1987-1988 UME were being assessed, only a single coastal stock of common bottlenose dolphin was thought to exist along the western Atlantic from New York to Florida, so impacts to the WNANMCS alone are not known (Scott et al. 1988). However, it was estimated that between 10 and 50 percent of the coast-wide stock died as a result of this UME (Eguchi 2002; Scott et al. 1988).

4.2.4 Common Dolphin (*Delphinus delphis delphis*)–Non-Strategic

The common dolphin is not ESA listed and the western North Atlantic stock is not considered strategic under the MMPA (Hayes et al. 2021). Historically, the short-beaked and long-beaked common dolphin were considered one species. In 1994 they were separated into two species (short- and long-beaked); however, advances in taxonomic studies suggest the initial classification was correct and the common dolphin is one species that shows considerable variation throughout its large range.

All common dolphins are slender and have a long beak, sharply demarcated from the melon. They are distinguished from other dolphins by a unique crisscross color pattern formed by the interaction of the dorsal overlay and cape (Perrin 2009), resulting in distinctive color bands on their sides. The species exhibits significant sexual dimorphism, with males being on average about nine percent larger in body length (Hayes et al. 2021). Common dolphins feed on squids and small fish, including species that school in proximity to surface waters, as well as mesopelagic species found near the surface at night (Jefferson et al. 2015). These dolphins can gather in schools of hundreds or thousands, although the schools generally consist of smaller groups of 30 or fewer. They are eager bow riders and are active at the surface (Reeves et al. 2002). The species' hearing is in the mid-frequency range (NOAA Fisheries 2018a; Southall et al. 2007).

The species is one of the most widely distributed cetaceans and occurs in temperate, tropical, and subtropical regions (Jefferson et al. 2015). Common dolphins can be found either along the 650- to 6,500-ft (200- to 2,000-m) isobaths over the continental shelf, or in pelagic waters of the Atlantic and Pacific Oceans. They are present in the western Atlantic from Newfoundland to Florida. This species is found between Cape Hatteras and Georges Bank from mid-January to May, although they migrate onto Georges Bank and the Scotian Shelf between mid-summer and fall, where large aggregations occur on Georges Bank in fall (Hayes et al. 2021). The common dolphin is especially common along shelf edges and in areas with sharp bottom relief such as seamounts and escarpments (Reeves et al. 2002). They show a strong affinity for areas with warm, saline surface waters. Off the coast of the eastern United States, they are particularly abundant in continental slope waters from Georges Bank southward to about 35 degrees north and usually inhabit tropical, subtropical, and warm-temperate waters (Hayes et al. 2021).

According to the species stock report, the best population estimate for the Western North Atlantic Stock, relevant to the Project Area, is approximately 172,974 individuals (Hayes et al. 2021).

The common dolphin worldwide population is also subject to bycatch. It has been caught in gillnets, pelagic trawls, and during longline fishery activities. From 2008 to 2012, it was estimated that on average approximately 289 total dolphins were killed each year by human activities (Waring et al. 2015). Average annual estimated fishery-related mortality or serious injury to this stock during 2014 to 2018 was 399 individuals (Hayes et al. 2021). This species is commonly seen stranded (Kenney and Vigness-Raposa 2010). From 2014 to 2018, 499 common dolphins strandings were reported between Maine and Florida (Hayes et al. 2021).

4.2.5 Harbor Porpoise (*Phocoena phocoena*)–Non-Strategic

Harbor porpoises in the Gulf of Maine/Bay of Fundy stock are not ESA-listed and this stock is not considered strategic under the MMPA (Hayes et al. 2021). In 2001, the harbor porpoise was removed from the candidate species list for the ESA, as a review of the biological status of the stock indicated that a classification of "Threatened" was not warranted (Waring et al. 2009b).

They are the smallest North Atlantic cetacean, measuring at only 4.6 to 6.2 ft (1.4 to 1.9 m), and feed primarily on pelagic schooling fish, bottom fish, squid, and crustaceans (Reeves and Read 2003; Kenney and Vigness-Raposa 20010). The species' hearing is in the high-frequency range (NOAA Fisheries 2018a; Southall et al. 2007).

They are likely to occur frequently in Mid-Atlantic waters where they are considered abundant from fall through spring, reaching their highest densities in spring when migration brings them toward the Gulf of Maine feeding grounds from their wintering areas offshore (Kenney and Vigness-Raposa 2010; DoN 2007; NYSDOS 2013). After April, they migrate north towards the Gulf of Maine and Bay of Fundy. They are frequently found in shallow, nearshore waters though they sometimes move into deeper offshore waters. In the western Atlantic, they are found from Cape Hatteras north to Greenland.

The current population estimate for harbor porpoise for the Gulf of Maine/Bay of Fundy stock is 95,543 (Hayes et al. 2021). It has been noted that harbor porpoises display avoidance behavior to sound greater than 140 dB re 1 µPa and tend to avoid vessels at sea (Barlow 1988; Palka and Hammond, 2001; Dyndo et al. 2015).

Harbor porpoise are subject to ship strike, with the most common threat to the harbor porpoise from incidental mortality from fishing activities, especially from bottom-set gillnets (Fenton et al. 2017). It has been demonstrated that the porpoise echolocation system is capable of detecting net fibers, but they either must not have the "system activated" or else they fail to recognize the nets (Reeves et al. 2002). The total annual estimated average human-caused mortality and serious injury to harbor porpoises is 150 per year from U.S. fisheries observer data (Hayes et al. 2021) and strandings have been reported in the Project Area. The most common threat to the harbor porpoise is incidental mortality from fishing activities, especially from bottom-set gillnets. A UME event in 2005 involved the stranding of 38 animals along the North Carolina coast from January 1 to March 28 (Waring et al. 2012). Most strandings of harbor porpoise from 2012 to 2018 occurred in Massachusetts. During this time, a total of 315 harbor porpoises were stranded along the U.S. and Canadian Atlantic coast (Hayes et al. 2021).

4.2.6 Long-Finned (*Globicephala melas*) and Short-Finned (*Globicephala macrorhynchus*) Pilot Whale–Non-Endangered / Non-Strategic Western North Atlantic Stocks

The two species of pilot whales in the western Atlantic, the long-finned pilot whales and short-finned pilot whales, are difficult to differentiate. Therefore, both species are presented together since much of the data is generalized for *Globicephala* species. The species considered most likely to occur in the New York waters is the long-finned (Hayes et al. 2019); the short-finned pilot whales could occur this far north, they are known from stranding records, but are uncommon in New York water. Neither species are ESA listed and both are considered non-strategic under the MMPA by NOAA Fisheries (Hayes et al. 2020).

Pilot whales are mid-sized odontocetes with sizes ranging up to 19 ft (5.7 m) for females and 22 ft (6.7 m) for the larger males. The long-finned pilot whale is a medium-sized animal with a stocky body, large bulbous or squarish forehead, and a thick dorsal fin located about a third of the body length behind the head. The short-finned pilot whale also has a bulbous forehead, but with no obvious beak (Jefferson et al. 2015). Long-finned pilot whales are dark black, dark gray, or brownish in color. They have pale grayish or whitish marks, such as a diagonal eye-stripe, or a blaze, that extend from behind the eye and up towards the dorsal fin. The long-finned pilot whale also has a large saddle behind the dorsal fin and a whitish anchor-shaped patch that starts at the throat and extends down its underside (Jefferson et al. 2015). The short-finned pilot whale's dorsal fin is far forward on its body and has a relatively long base (Jefferson et al. 2015). The body color of the short-finned pilot whale tends to be black or dark brown with a large gray saddle behind the dorsal fin. Pilot whales feed preferentially on squid but will eat fish (e.g., herring) and invertebrates (e.g., octopus, cuttlefish) if squid are not available. They also ingest shrimp (particularly younger whales) and various other fish species occasionally. These whales probably take most of their prey at depths of 600 to 1,650 ft (200 to 500 m), although they can forage deeper if necessary (Reeves et al. 2002). Their hearing is in the mid-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

Both species of pilot whale are more generally found along the edge of the continental shelf (a depth of 330 to 3,300 ft [100 to 1,000 m]), choosing areas of high relief or submerged banks. Long-finned pilot whales are pelagic, occurring in especially high densities in winter and spring over the continental slope, then moving inshore and onto the shelf in summer and fall to follow squid and mackerel populations (Reeves et al. 2002). They frequently travel into the central and northern Georges Bank, Great South Channel, and Gulf of Maine areas during the summer and early fall (May to October; Hayes et al. 2020).

The best population estimate for long-finned pilot whales is 39,215 individuals and for short-finned, 28,924 (Hayes et al. 2020).

Pilot whales are subject to bycatch in gillnet fishing, pelagic trawling, longline fishing, and purse seine fishing. The total observed average annual fishery-related mortality and serious injury from 2013 through 2017 was 21 long-finned pilot whales and 160 for short-finned pilot whales (Hayes et al. 2020). Strandings involving hundreds of individuals are not unusual and demonstrate that these large pods have a high degree of social cohesion (Reeves et al. 2002).

4.2.7 Risso's Dolphin (*Grampus griseus*)–Non-Strategic

The status of Risso's dolphins is unknown but is not considered strategic under the MMPA (Hayes et al. 2020).

The species' anterior body is extremely robust, tapering to a relatively narrow tail stock. It has one of the tallest dorsal fins in proportion to body length of any cetacean (Baird 2009). Color patterns change dramatically with age. Infants are gray to brown dorsally and creamy-white ventrally, with a white, anchor-shaped patch between the pectoral flippers and white around the mouth (Jefferson et al. 2015). Calves darken to nearly black, while retaining the ventral white patch. Older animals can appear almost completely white on the dorsal surface or when swimming just beneath the surface (Jefferson et al. 2015). Risso's dolphins range in size from 8.5 to 13 ft (2.5 to 4 m) and are typically an offshore dolphin; this species is considered uncommon in waters nearer to the coast (near shore; Reeves et al. 2002). Risso's dolphins are usually seen in mid-sized groups with roughly 10 to 40 individuals, although groups of 100 to 200 or even several thousand can occur. Cephalopods and crustaceans are the primary prey for the Risso's dolphins, which feed mainly at night. Their hearing is in the mid-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

Risso's dolphins are commonly found in the deeper waters of the U.S. East Coast continental shelf edge and oceanic waters ranging from Cape Hatteras to Georges Bank, mainly during spring, summer, and fall (Hayes et al. 2020). There is currently no information on stock structure of this species for western North Atlantic, therefore, it is not possible to determine if separate stocks exist in the Gulf of Mexico and Atlantic (Hayes et al. 2020).

The best estimate of abundance for the stock of Risso's dolphins is 35,215 animals (Draft NOAA Fisheries 2021 SAR Report used at request and provided directly by NOAA Fisheries). There are insufficient data to determine the population trend for this stock.

Risso's dolphins have been subject to bycatch during squid and mackerel trawl activities, pelagic drift gillnet activities, pelagic pair trawl fishery, and Mid-Atlantic gillnet fishery (Hayes et al. 2020). The average annual fishery related mortality and serious injury between 2007 and 2011 was 62 dolphins (Waring et al. 2014). From 2009 to 2013, the average annual fishery-related mortality and serious injury was 54 dolphins (Waring et al. 2016). From 2013 to 2017, the estimated annual average fishery-related mortality or serious injury was 53.9 dolphins (Hayes et al. 2020). Risso's dolphin strandings have also been recorded along the U.S. Atlantic Coast, with 38 strandings recorded between 2012 and 2016 (Hayes et al. 2020).

4.2.8 Sperm Whale (*Physeter macrocephalus*)–Endangered

The sperm whale (*Physeter macrocephalus*) is listed as endangered under the ESA and the North Atlantic stock is designated as a strategic stock under the MMPA (Waring et al. 2015). A recovery plan for sperm whales was finalized in 2010 (NOAA Fisheries 2010a), and a five-year review of the species was completed in 2015 and yielded no change in status (NOAA Fisheries 2015). NOAA Fisheries announced the initiation of a five-year review in May 2021 (NOAA Fisheries 2021b).

The sperm whale has a disproportionately large head, one quarter to one third of its total body length, with a narrow, underslung jaw (Jefferson et al. 2015). Sperm whales are generally dark gray in color with white lips and stomachs patches (Jefferson et al. 2015). The dorsal fin is low in profile, thick, not pointed or curved, and followed by "knuckle" markings along the spine. Photographs of markings on the dorsal fins and flukes of sperm whales are distinctive and used in studies of life history and behavior (Jefferson et al. 2015). Sperm whales feed primarily on large- and medium-sized squid and other cephalopods (such as octopus), medium- and large-sized demersal elasmobranchs (such as rays and sharks) and many teleost (bony) fish species (Christensen et al. 1992). While foraging, the whales typically gather in small clusters. Between diving bouts, sperm whales are known to raft (i.e., rest in a loose grouping) together at the surface. Adult males often forage alone. Groups of females may spread out over distances greater than 0.5 nm when foraging (Jefferson et al. 2015). Sperm whales are highly social, with a basic social unit consisting of 20 to 40 adult females, calves, and some juveniles (Whitehead 2009). Male sperm whales are essentially solitary, though they rejoin or find nursery groups during prime breeding season. When socializing, they generally gather into larger surface-active groups (Jefferson et al. 2015; Whitehead 2003). In the Northern Hemisphere, the peak breeding season for sperm whales occurs between March and June, and in the Southern Hemisphere, the peak breeding season occurs between October and December (NOAA Fisheries 2018b). Sperm whale hearing is in the mid-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

The sperm whale is thought to have a more extensive distribution than any other marine mammal, except possibly the killer whale (Hayes et al. 2020). This species is found in polar to tropical waters in all oceans from approximately 70° N to 70° S (Whitehead 2003). It ranges widely throughout the world's oceans but shows a strong preference for deep ocean habitats from equatorial zones to the edges of the polar pack ice (Whitehead 2003). In the Atlantic, sperm whales are found throughout the Gulf Stream and North Central Atlantic Gyre (Hayes et al. 2020). Its distribution is typically associated with waters over the continental shelf break, the continental slope, and farther offshore, with higher concentrations near drop-offs and areas with strong currents and steep topography regardless of season (Whitehead et al. 1992; Jefferson et al. 2015; Hayes et al. 2020). The sperm whale, an odontocete whale, is migratory. However, their migrations are not as well known or as predictable as other baleen whale species. In the North Atlantic, there appears to be a general shift northward during the summer, but there is no clear migratory pattern in temperate areas (Whitehead 2003).

The current abundance estimate for this species in the North Atlantic stock based on the most recent SAR is 4,349 individuals (Hayes et al. 2021). From 2008 to 2012, annual average human-caused mortality was 0.8 due to reports of one sperm whale mortality in 2009 and one in 2010 in the Canadian Labrador halibut longline fishery, one entanglement mortality in Canadian pot/trap gear, and one vessel strike mortality (Waring et al. 2015). There are no documented reports of fishery-related mortality or serious injury to this stock in the U.S. Exclusive Economic Zone during from 2013 to 2017 (Hayes et al. 2020). Sperm whales have not been documented as bycatch in the observed U.S. Atlantic commercial fisheries. Historically, 424 sperm whales were harvested in the Newfoundland-Labrador area between 1904 and 1972, and 109 male sperm whales were taken near Nova Scotia in 1964 to 1972 in a Canadian whaling fishery before whaling moratoriums were implemented (Waring et al. 2015). From 2013 to 2017, 12 sperm whale strandings were documented along the U.S. Atlantic coast (Hayes et al. 2020). Ship strikes are another source of human-caused mortality, and four reported ship strikes occurred along the east coast of the U.S. and Canada from 1994 to 2006 (Hayes et al. 2020). No recent collisions have been reported from 2006 to 2019 (Hayes et al. 2020). For the North Atlantic, the minimum population size has been estimated at 3,451 individuals (Hayes et al. 2020).

4.3 Pinnipeds

4.3.1 Gray Seal (*Halichoerus grypus atlantica*)–Non-Strategic

The gray seal is not ESA-listed, and NOAA Fisheries considers the North Atlantic stock as non-strategic under the MMPA (Hayes et al. 2021).

Gray seals exhibit sexual dimorphism, with adult males reaching 7.5 ft (2.3 m) long and females reaching 6.6 ft (2.0 m) (Jefferson et al. 1993; Wynne and Schwartz 1999; Kenney and Vigness-Raposa 2010). Gray seals are gregarious, gathering to breed, molt, and rest in groups of several hundred or more at island coasts and beaches or on land-fast ice and pack-ice floes. They are thought to be solitary when feeding and telemetry data indicates that some seals may forage seasonally in waters close to colonies, while others may migrate long distances from their breeding areas to feed in pelagic waters between the breeding and molting seasons (Reeves et al. 2002). Gray seals molt in late spring or early summer and may spend several weeks ashore during this time. When feeding, most seals remain within 45 mi (72 km) of their haul-out sites, feeding on numerous fish species and cephalopods (Kenney and Vigness-Raposa 20010). Gray seal scat samples from Muskeget Island, Massachusetts, included species such as sand lance, skates, flounder, silver hake, and gadids (Kenney and Vigness-Raposa 20010). Gray seal hearing is in the phocid frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

The gray seal is primarily found in coastal waters and forages in OCS regions (Lesage and Hammill 2001). These seals are typically most abundant in coastal waters (Ecology and Environment Engineering 2017). Gray seals occur in cold temperate to sub-arctic waters in the North Atlantic and are partitioned into three major populations occurring in eastern Canada, northwestern Europe, and the Baltic Sea (Jefferson et al. 2015; Kenney and Vigness-Raposa 2010). The western North Atlantic stock is considered to be the same population as the one found in eastern Canada, and ranges between Mid-Atlantic waters and Labrador (Hayes et al. 2021). As exhibited in harbor seal populations, gray seals occur most often in the waters off Maine during winter and spring and spend summer and fall off northern Maine and in Canadian waters (Hayes et al. 2021).

Gray seals form colonies on rocky island or mainland beaches, though some seals give birth in sea caves or on sea ice in areas where no rocky shores are available. Gray seals prefer haul out and breeding sites that are surrounded by rough seas and riptides. There are no pupping colonies or known haul-out sites in the Project Area. The nearest known pupping sites are greater than 250 nm (463 km) away, at Muskeget Island (Nantucket Sound), Monomoy National Wildlife Refuge, and in eastern Maine (Rough 1995). Similarly, the only known and consistently used haul out locations are along the sandy shoals located closer to Monomoy Refuge and on Nantucket, both in Massachusetts (Kenney and Vigness-Raposa 2010).

The total western Atlantic gray seal population estimates is 27,131 (Hayes et al. 2021). This species has been reported with greater frequency in waters south of Cape Cod in recent years, likely due to a population rebound in the Mid-Atlantic, however, most gray seals present are juveniles dispersing in the spring (Kenney and Vigness-Raposa 2010).

The biggest threats to gray seals are entanglements in gillnets or plastic debris (Hayes et al. 2021). From 2014 to 2018, the average annual estimated human-caused mortality and serious injury to gray seals in the U.S. and Canada was approximately 4,729 per year, which includes the removal of nuisance animals in Canada (Hayes et al. 2021).

4.3.2 Harbor Seal (*Phoca vitulina vitulina*)–Non-Strategic

The harbor seal is not ESA-listed, and NOAA Fisheries considers the North Atlantic stock as non-strategic under the MMPA (Hayes et al. 2021).

Harbor seals have short, dog-like snouts. Coloration varies by individual, but has two basic patterns: light tan, silver, or blue-gray with dark speckling or spots, or a dark background with light rings (Jefferson et al. 2015). Male harbor seals are 5.6 and 6.2 ft (1.7 and 1.9 m) in length, with females being slightly smaller than males (Wynne and Schwartz 2014; Kenney and Vigness-Raposa 2010; Jefferson et al. 2015). Harbor seals prey upon small to medium-sized fish, octopus and squid, and sometimes shrimp and crabs (Kenney and Vigness-Raposa 2010). Fish eaten by harbor seals include commercially important species such as mackerel, herring, cod, hake, smelt, shad, sardines, anchovy, capelin, salmon, rockfish, sculpins, sand lance, trout, and flounders (Jefferson et al. 2015). They spend about 85 percent of the day diving, with much of the diving presumed to be active foraging in the water column or on the seabed. They dive to depths of about 30 to 500 ft (10 to 150 m), depending on location. Harbor seals forage in a variety of marine habitats, including deep fjords, coastal lagoons and estuaries, and high-energy, rocky coastal areas. They may also forage at the mouths of freshwater rivers and streams, occasionally traveling several hundred miles upstream (Reeves et al. 2002). They haul out on sandy and pebble beaches, intertidal rocks and ledges, and sandbars, and occasionally on ice floes. Harbor seal hearing is in the phocid frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

Harbor seals are the most abundant seals in the waters of the eastern United States and are commonly found in all nearshore waters of the Atlantic Ocean and adjoining seas above northern Florida. Harbor seals occur year-round north of Cape Cod and historically were considered less common south of Cape Cod. However, they are increasingly common southward to the Carolinas (Hayes et al. 2021). During the summer, most harbor seals can be found north of New York, within the coastal waters of central and northern Maine, as well as the

Bay of Fundy (DoN 2005). Seals are typically most abundant in coastal waters (Ecology and Environment Engineering 2017).

Except for a strong bond between mothers and pups, harbor seals are generally intolerant of close contact with other seals. Nonetheless, they are gregarious, especially during the molting season, which occurs between spring and fall, depending on geographic location. They may haul out to molt at a tide bar, sandy or cobble beach, or exposed intertidal reef. During this haul out period, they spend most of their time sleeping, scratching, yawning, and scanning for potential predators such as humans, foxes, coyotes, bears, and raptors (Reeves et al. 2002). In late fall and winter, harbor seals may be continuously at sea for several weeks or more, presumably feeding to recover body mass lost during the reproductive and molting seasons and to fatten up for the next breeding season (Reeves et al. 2002).

Harbor seals are expected to occur year-round in and around New York waters, both in the offshore and nearshore waters. This species also has the potential to be found onshore in areas adjacent to the submarine export cable siting corridors and the export cable landfall sites. There are several seal haul-out sites in New York. Harbor seals generally predominate in the onshore haul-out sites but gray seals intermix and are present as well. In New York, CRESLI (2019) reports 26 haul-out sites occur on Long Island with 18,321 harbor seals documented occurring (cumulatively) from surveys completed since 2004. While there are no known haul-out sites directly at or near the proposed export cable landfall sites, it should be noted that harbor seals will occur throughout the New York coastline and have potential to haul out at many beach sites.

The current western North Atlantic stock based on the most recent SAR is estimated to consist of 75,834 individuals, which is from a 2012 survey (Hayes et al. 2021).

Historically, these seals have been hunted for several hundred to several thousand years. Harbor seals are still legally killed in Canada, Norway, and the United Kingdom to protect fish farms or local fisheries (Reeves et al. 2002). From 2014 to 2018, the average rate of mortality for the western North Atlantic harbor seal stock from anthropogenic causes was approximately 365.2 per year (Hayes et al. 2021). From 2014 to 2018, a total of 2,156 harbor seal stranding mortalities were reported between Maine and South Carolina: 3.9 percent showing signs of human interaction including fisheries entanglement (13 individuals), shooting (1 individuals), and vessel strike (13 individuals) and the remainder of unknown causes (57 individuals) (Hayes et al. 2021). Average annual fisheries-related mortality and serious injury does not exceed the potential biological removal (PBR) for this species (Hayes et al. 2021). From July to December 2018, 1,100 harbor seal mortalities occurred across Maine, New Hampshire, and Massachusetts, and as a result NOAA Fisheries declared a UME (NOAA Fisheries 2020b). The UME was expanded to cover all seal strandings from Maine to Virginia and included gray, harp, and hooded seals. The main cause was determined to be illness as a result of phocine distemper virus (Hayes et al. 2021). The UME is currently inactive and pending closure (NOAA Fisheries 2021b). Currently, the best abundance estimate for harbor seals is approximately 75,834 for the Western North Atlantic stock (Hayes et al. 2021).

5. TYPE OF INCIDENTAL TAKING AUTHORIZATION REQUESTED

The Applicant is requesting the authorization for potential non-lethal "taking" of small numbers of marine mammals to allow for incidental harassment resulting from the marine survey and construction activities. The request is based upon projected construction activities during the anticipated schedule as described in Section 2.1.

The potential underwater noise impacts of anticipated construction activities were evaluated against the criteria prescribed in the revised NOAA Fisheries (2018a) Technical Guidance. To ensure that the potential for take by Level A and B harassment is avoided and/or minimized to the maximum extent possible, the Applicant has committed to the mitigation measures as outlined in Sections 11.0, Mitigation Measures to Protect Marine Mammals and Their Habitat, and 13.0, Monitoring and Reporting.

As detailed in Section 1.2, Proposed Activity, construction activities would generate underwater noise with sounds exceeding the 120 dB RMS re 1 µPa and 160 dB RMS re 1 µPa threshold values for Level B harassment for non-impulsive and impulsive sound (respectively) and the injury thresholds for Level A harassment for certain hearing groups and pieces of equipment. The Applicant is requesting the authorization for the incidental take by Level B harassment and Level A harassment, of small numbers of marine mammals pursuant to Section 101 (a) (5) of the MMPA and in accordance with 50 CFR § 216 Subpart I, in support of the Applicant's survey activities. This request is being submitted to specifically address construction activities in support of the Applicant's development of an offshore wind farm as further detailed in Section 6, Take Estimates for Marine Mammals. The Proposed Activity is not reasonably expected to, and is not reasonably likely to, adversely affect the subject species or stocks through effects on annual rates of recruitment or survival. As such, the Applicant believes the Proposed Activity will have a negligible impact on the species and stocks of marine mammals outlined below in Section 6.

6. TAKE ESTIMATES FOR MARINE MAMMALS

The Applicant seeks authorization for potential "taking" of small numbers of marine mammals under the jurisdiction of NOAA Fisheries in the proposed Project Area. Anticipated impacts to marine mammals from the proposed survey activities will be associated with noise propagation from construction activities. It should be noted that the estimates of exposure for marine mammals as presented in this section are conservative.

Most marine animals can perceive underwater sounds over a broad range of frequencies from about 7 Hz to more than 160,000 Hz (160 kHz) (**Table 13**). Many of the dolphins and porpoises use even higher frequency sound for echolocation and perceive these high frequency sounds with high acuity. Marine mammals respond to low-frequency sounds with broadband intensities of more than about 120 dB re 1 µPa, or about 10 to 20 dB above natural ambient noise at the same frequencies (Richardson et al. 2013).

Table 13 Marine Mammal Hearing Groups

Hearing Group	Generalized Hearing Range a/
Low Frequency (LF) Cetaceans (baleen whales)	7 Hz to 35 Hz
Mid-Frequency (MF) Cetaceans (dolphins, toothed whales, beaked whales)	150 Hz to 160 Hz
High-Frequency (HF) Cetaceans (harbor) porpoise)	275 Hz to 160 kHz
Otariid Pinnipeds (sea lions and fur seals)	50 Hz to 86 kHz
Phocid Pinnipeds (true seals)	60 Hz to 39 kHz

Source: NOAA Fisheries 2018a

Note:
a/ These hearing ranges are generalized for species included in the entire group as a composite.

Sound is important to marine mammals for communication, individual recognition, predator avoidance, prey capture, orientation, navigation, mate selection, and mother-offspring bonding. Potential effects of anthropogenic sounds to marine mammals can include physical injury (e.g., temporary or permanent loss of hearing sensitivity), behavioral modification (e.g., changes in foraging or habitat-use patterns), and masking (the prevention of marine mammals from hearing important sounds).

6.1 Foundation Installation

6.1.1 Basis for Estimating Numbers of Marine Mammals that Might be Taken by Harassment from Impact Pile Driving

6.1.1.1 Acoustic Modeling

Modeling was performed by JASCO and is summarized here. For full details, please see the report provided in **Appendix A**.

Piles deform when driven with impact hammers, creating a bulge that travels down the pile and radiates sound into the surrounding air, water, and seabed. This sound may be received as a direct transmission from the sound source to biological receivers (such as marine mammals, sea turtles, and fish) through the water or as the result of reflected paths from the surface or re-radiated into the water from the seabed. Sound transmission depends on many environmental parameters, such as the sound speeds in water and substrates. It also depends on the sound production parameters of the pile and how it is driven, including the pile material, size (length, diameter, and thickness) and the make and energy of the hammer.

JASCO's physical model of pile vibration and near-field sound radiation (MacGillivray 2014) was used in conjunction with the GRLWEAP 2010 wave equation model (GRLWEAP, Pile Dynamics, Inc. 2010) to predict source levels associated with impact pile driving activities. Piles are modeled with a vertical installation using a finite-difference structural model of pile vibration based on thin-shell theory. The sound radiating from the pile itself was simulated using a vertical array of discrete point sources. These models account for several parameters that describe the operation—pile type, material, size, and length—the pile driving equipment, and approximate pile penetration depth. See **Appendix A** for a more detailed description.

Forcing functions were computed for the monopile and jacket foundations, using GRLWEAP 2010 (GRLWEAP, Pile Dynamics Inc. 2010). The model assumed direct contact between the representative hammers, helmets, and piles (i.e., no cushion material, which results in a more conservative estimate). The forcing functions serve as the inputs to the pile driving source models (PDSM) used to estimate equivalent acoustic source characteristics (see **Appendix A**). Decidecade spectral source levels for each pile type, hammer energy and modeled location, using an average summer sound speed profile are provided in **Appendix A**.

Acoustic propagation modeling used JASCO's Marine Operations Noise Model (MONM) and Full Wave Range Dependent Acoustic Model (FWRAM) that combine the outputs of the source model with the spatial and temporal environmental context (e.g., location, oceanographic conditions, and seabed type) to estimate sound fields. The lower frequency bands were modeled using MONM and FWRAM, which are based on the parabolic equation method of acoustic propagation modeling. For higher frequencies, additional losses resulting from absorption were added to the propagation loss model.

6.1.1.2 Model Input Parameters

Impact pile driving would occur in a continental shelf environment characterized by predominantly fine to coarse grained sandy seabed sediments, with some clay content. Water depths vary between approximately 24-41 m. From June to September, the average temperature of the upper (10–15 m) water column is higher, which can lead to a surface layer of increased sound speeds. This creates a downward refracting environment in which propagating sound interacts with the seafloor more than in a well-mixed environment. Increased wind mixing combined with a decrease in solar energy during winter, from December through March, results in a sound speed profile that is more uniform with depth. Average summer and winter sound speed profiles were used in the Project acoustic propagation modeling. See **Appendix A** for more details on the environmental parameters used in acoustic propagation and exposure modeling.

Empire has committed to noise attenuation applied during all wind turbine foundation pile driving (see section 11.2.9). Typical performance of 10 dB broadband attenuation was chosen for this analysis as an achievable reduction of sound levels produced during pile driving, noting that a 10 dB decrease means the sound energy level is reduced by 90%. For exposure modeling, several levels of attenuation were included for comparison purposes (please see **Appendix A**, Section 4.4 for exposure ranges to all modeled attenuation levels).

Forcing functions were computed for the monopile and pin pile using GRLWEAP 2010 (GRLWEAP, Pile Dynamics Inc. 2010). The forcing functions serve as the inputs to JASCO's pile driving source models used to estimate equivalent acoustic source characteristics detailed in **Appendix A**. Note that a 2-dB post piling shift increase applies to pin piles.

Hammer energy schedules, including the hammer energies and number of strikes predicted at various embedment depths during the pile driving process, were developed for the range of monopile and OSS jacket pin pile driving scenarios (see Section 1.2.1, **Table 2** through **Table 8**). A range of potential monopile diameters remains under consideration, as described in the Construction and Operations Plan (COP); as such, hammer energy schedules were developed for two different monopile diameters (9.6 m and 11 m). In addition, hammer energy schedules were generated for three different seabed penetration depths for the 11 m diameter scenario to represent the various soil conditions that may be encountered in the Lease Area (i.e., normal soil conditions (identified as "T1"), harder soil conditions [identified as "R3"], and outlier softer soil conditions [identified as "U3"]) (**Table 14** and **Table 15**). An additional hammer energy schedule was generated for "difficult to drive" monopiles (the difficult to drive hammer energy schedule was generated only for the 9.6 m diameter scenario as larger diameter monopiles could not be driven in difficult to drive conditions). Finally, hammer energy schedules were generated for pin piles at the two OSS locations (OSS 1 at EW 1 and OSS 2 at EW 2).

Each of the three 11 m monopile scenarios was modeled at two separate locations in the Lease Area (one in EW 1 and one in EW 2) to capture the range of water depths in the Lease Area, while the 9.6 m monopile scenarios (typical and difficult to drive) were modeled at three separate locations in the Lease Area to capture the range of water depths in the Lease Area (two locations were originally modeled, but Empire identified that the originally modeled "deeper" location did not represent the deepest water depth in the Lease Area and determined that remodeling an additional deeper location was warranted). Thus, a total of five monopile scenarios (9.6 m diameter typical and difficult to drive scenarios, and three different 11 m diameter typical scenarios) at a total of nine locations were modeled (identified as locations L01 through L09; **Table 14**). As planned offshore substation locations are known, sound fields from 2.5 m pin piles were modeled at the two planned offshore substation piled jacket foundation locations, one in EW 1 (OSS 1) and the other in EW 2 (OSS 2). Modeling assumptions are summarized in **Table 15**.

Table 14 Acoustic Modeling Locations for the Monopile and Jacket Foundations

Modeling Site	Foundation Type	Latitude	Longitude
L01	Monopile a/	40.3263	-73.4332
L02	Monopile a/	40.2645	-73.2337
L03	Monopile a/	40.2262	-73.1773
R3-L04	Monopile	40.3010	-73.3620
T1-L05	Monopile	40.3209	-73.2897
U3-L06	Monopile	40.3012	-73.3045

Modeling Site	Foundation Type	Latitude	Longitude
R3-L07	Monopile	40.2392	-73.2200
T1-L08	Monopile	40.2155	-73.1919
U3-L09	Monopile	40.2335	-73.1914
OSS 1	Jacket	40.3404	-73.4473
OSS 2	Jacket	40.2871	-73.2331

Note:
a/ Both typical and difficult to drive monopiles were modeled at these locations.

Table 15 Piling Assumptions Used in Underwater Acoustic Modeling

Foundation Type	Modeled Maximum Impact Hammer Energy (kJ)	Pile Length	Pile Diameter (m)	Pile Wall Thickness (mm)	Seabed Penetration (m)	Number of Piles per Day
Monopile	2300/5225 a/	78.5	9.6	73–101	38	1–2
Monopile R3	2000	75.3	11	85	35	1-2
Monopile T1	2500	84.1	11	85	40	1-2
Monopile U3	1300	97.5	11	85	55	1-2
Jacket	3200	57–66	2.5	50	47 and 56	2–3

Note:
The maximum seabed penetration depth for pin piles in the COP PDE of 60-m was also modeled; however, the penetration depths shown are considered the more likely scenario, and modeled acoustic ranges (ER95%) for the penetration depths shown were greater than those for the 60-m pile penetration depth, and were therefore carried forward to the exposure analysis to be conservative.
a/ Typical 2300, difficult to drive 5225

6.1.1.3 Calculation of Ranges to Regulatory Thresholds

Acoustic ranges (R95%) to thresholds corresponding to Level A harassment and Level B harassment for all marine mammal functional hearing groups were calculated separately for all five monopile scenarios described above (9.6 m diameter typical and difficult to drive scenarios, and three different 11 m diameter typical scenarios), as well as for the two OSS pin pile scenarios, at all modeling locations (locations L01 through L09, OSS1 and OSS2).

The modeled SEL acoustic ranges to thresholds corresponding to Level A harassment are summarized in **Table 16**, **Table 17**, and **Table 18** for monopile and jacket foundations, assuming 10 dB broadband attenuation and a summer acoustic propagation environment (which applies to the majority of months when pile driving may occur; results for the winter acoustic propagation environment, and for other attenuation levels, were also modeled and can be found in Appendix A Tables H-513 through H-526; (note summer applies to May through September while winter applies to December through March). Single strike acoustic ranges (Peak and SELcum) can be found in Appendix A.

Table 16 Monopile Foundation SEL acoustic ranges ($R_{95\%}$) to thresholds corresponding to Level A harassment in km with 10 dB attenuation for a typical pile (1 pile/day) (summer)

	L01 (9.6m)	L02 (9.6m)	L03 (9.6m)	L04 (R3)(11m)	L05 (T1)(11m)	L06 (U3)(11m)	L07 (R3) (11m)	L08 (U3)(11m)	L09 (T1)(11m)
LF	1.82	2.09	2.2	1.65	1.74	1.77	1.8	1.96	1.96
MF	0	0	0	0	0	0	0	0	0
HF	0.14	0.05	0.1	0.01	0	0	0.03	0	0.01
PW	0.14	0.13	0.13	0.11	0.11	0.11	0.12	0.12	0.12

Table 17 Monopile Foundation SEL acoustic ranges ($R_{95\%}$) to thresholds corresponding to Level A harassment in km with 10 dB attenuation for a difficult-to-drive pile (1 pile/day)(summer)

	L01 (9.6m)	L02 (9.6m)	L03 (9.6m)
LF	2.79	3.21	3.44
MF	0	0	0
HF	0.17	0.09	0.10
PW	0.36	0.37	0.38

Table 18 Jacket Foundation SEL acoustic ranges (R95%) to thresholds corresponding to Level A harassment in km with 10 dB attenuation for OSS pin piles, 1-3 piles per day (summer)

	OSS1 - 1 pin pile	OSS2 - 1 pin pile	OSS1 - 2 pin piles	OSS2 - 2 pin piles	OSS1 - 3 pin piles	OSS2 - 3 pin piles
LF	0.67	0.58	1.01	0.92	1.26	1.190
MF	0	0	0	0	0	0
HF	0.07	0.04	0.10	0.10	0.12	0.11
PW	0.03	0.03	0.05	0.05	0.08	0.06

As shown in **Table 16**, modeling results indicated that acoustic ranges (R95%) associated with the 9.6 m diameter typical monopile scenario were predominantly greater than for the 11 m diameter monopile scenarios. As such, the 9.6 m diameter monopile scenario was carried forward to the exposure analysis to be conservative, for all "typical" monopiles (i.e., 130 out of 147 total monopiles; the remining 17 monopiles assumed to be difficult to drive are also carried forward to the exposure analysis). While larger diameter monopiles can be associated with greater resulting sound fields, it has been demonstrated that the relationship between diameter and resulting rate of sound level increase is likely to diminish with increasing diameter (Bellman et al., 2020); the fact that the 11 m diameter monopile scenarios resulted in smaller modeled acoustic ranges than the 9.6 m diameter monopile scenarios is likely a product of the fact that the larger diameter monopile would only be installed in softer sediments which would require less hammer energy and/or number of hammer strikes for installation.

It should be noted that acoustic ranges (R95%) to marine mammal threshold criteria (**Table 16**, **Table 17**, and **Table 18**), especially those for the Level A harassment threshold based on the SEL_{cum} metric, are considered overly conservative as the accumulation of acoustic energy does not account for animal movement and behavior and therefore assumes that animals are essentially stationary within the zone of influence for impact pile driving noise for the entire duration of the pile installation, a scenario that does not reflect realistic animal behavior, based on the best available information. For this reason, animal movement modeling is performed to determine more realistic exposure estimates (see Section 6.1.2.1).

6.1.1.4 Calculation of Exposure Ranges (ER95)

In addition to acoustic ranges, exposure ranges (ER95%) that account for animal movement are calculated separately; animal movement and exposure modeling can be used to account for the movement of receivers when estimating distances for monitoring zones. The closest point of approach (CPA) for each of the species-specific simulated animals ("animats") during a simulation is recorded and then the CPA distance that accounts for 95% of the animats that exceed an acoustic impact threshold is determined. The $ER_{95\%}$ (95% exposure radial distance) is the horizontal distance that includes 95% of the CPAs of animats exceeding a given impact threshold (see Appendix A Section 2.6 for further detail). These exposure ranges are considered useful for estimating appropriate zones for mitigation-based monitoring as they more realistically account for animal movement (see Section 6.1.2.1). Exposure ranges (ER95%) are shown in **Table 19**, **Table 20**, **Table 21**, and **Table 22**).

Table 19 Monopile Foundation: Exposure ranges (ER95%) in km to marine mammal threshold criteria with 10 dB attenuation for a typical pile (summer)

	Species	One pile per day			Two piles per day		
		Injury		Behavior	Injury		Behavior
		LE	*Lpk*	*Lp a/*	*LE*	*Lpk*	*Lp a/*
LF	Fin whale b/	0.86	0	3.18	0.94	0	3.09
	Minke whale	0.22	0	3.13	0.54	0	3.02
	Humpback whale	0.24	0	3.15	0.33	0	3.01
	North Atlantic right whale b/	0.33	0	2.89	0.47	0	2.87
	Sei whale b/	0.43	0	3.09	0.54	0	3.07
MF	Atlantic white-sided dolphin	0	0	2.98	0	0	2.94
	Atlantic spotted dolphin	0	0	0	0	0	0
	Short-beaked common dolphin	0	0	3.07	0	0	2.92

	Species	One pile per day			Two piles per day		
		Injury		Behavior	Injury		Behavior
		LE	L_{pk}	*Lp a/*	*LE*	L_{pk}	*Lp a/*
	Bottlenose dolphin	0	0	2.46	0	0	2.41
	Risso's dolphin	0	0	3.07	0	0	2.93
	Long-finned pilot whale	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0
	Sperm whale b/	0	0	3.25	0	0	2.96
HF	Harbor porpoise	0	0	3.07	0	<0.01	3.05
PW	Gray seal	0	0	3.33	<0.01	0	3.26
	Harbor seal	0	0	3.02	0	0	2.97

Notes:
a/ NOAA
b/ Listed as Endangered under the ESA
LE = unweighted sound exposure level (dB re 1 µPa^2·s); Lp= unweighted sound pressure (dB re 1 µPa).

Table 20 Jacket Foundation OSS 1: Exposure ranges (ER95%) in km to marine mammal threshold criteria with 10 dB attenuation for a typical pile (summer)

	Species	Two pin piles per day			Three pin piles per day		
		Injury		Behavior	Injury		Behavior
		LE	L_{pk}	*Lp a/*	*LE*	L_{pk}	*Lp a/*
LF	Fin whale b/	0	0	0.90	0	0	0.79
	Minke whale	0	0	0.89	0	0	0.87
	Humpback whale	0	0	0.73	0	0	0.77
	North Atlantic right whale b /	0	0	0.78	0	0	0.80
	Sei whale b/	0	0	0.83	0	0	0.81
MF	Atlantic white-sided dolphin	0	0	0.75	0	0	0.87
	Atlantic spotted dolphin	0	0	0	0	0	0
	Short-beaked common dolphin	0	0	0.74	0	0	0.78
	Bottlenose dolphin	0	0	0.80	0	0	0.80
	Risso's dolphin	0	0	0.78	0	0	0.76
	Long-finned pilot whale	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0
	Sperm whale b/	0	0	0.88	0	0	0.82
HF	Harbor porpoise	0	0	0.86	0	0	0.79
PW	Gray seal	0	0	0.99	0	0	0.99
	Harbor seal	0	0	0.78	0	0	0.91

Notes:
a/ NOAA
b/ Listed as Endangered under the ESA
LE = unweighted sound exposure level (dB re 1 µPa2·s); Lp= unweighted sound pressure (dB re 1 µPa).

Table 21 Jacket Foundation OSS 2: Exposure ranges (ER95%) in km to marine mammal threshold criteria with 10 dB attenuation for a typical pile (summer)

	Species	Two pin piles per day			Three pin piles per day		
		Injury		Behavior	Injury		Behavior
		LE	*L_{pk}*	*Lp a/*	*LE*	*L_{pk}*	*Lp a/*
LF	Fin whale b/	0	0	0.84	0	0	0.84
	Minke whale	0	0	0.75	0	0	0.73
	Humpback whale	0	0	0.62	0	0	0.68
	North Atlantic right whale b /	0	0	0.66	0	0	0.66
	Sei whale b/	0	0	0.60	0	0	0.58
MF	Atlantic white-sided dolphin	0	0	0.77	0	0	0.75
	Atlantic spotted dolphin	0	0	0	0	0	0
	Short-beaked common dolphin	0	0	0.74	0	0	0.74
	Bottlenose dolphin	0	0	0.45	0	0	0.56
	Risso's dolphin	0	0	0.77	0	0	0.74
	Long-finned pilot whale	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0
	Sperm whale b/	0	0	0.54	0	0	0.57
HF	Harbor porpoise	0	0	0.60	0	0	0.67
PW	Gray seal	0	0	0.79	0	0	0.78
	Harbor seal	0	0	0.74	0	0	0.71

Notes:
a/ NOAA
b/ Listed as Endangered under the ESA
LE = unweighted sound exposure level (dB re 1 μPa2·s); Lp= unweighted sound pressure (dB re 1 μPa).

Table 22 Monopile Foundation: Exposure ranges (ER95%) in km to marine mammal threshold criteria with 10 dB attenuation for a difficult to drive pile (summer)

	Species	One pile per day			Two piles per day		
		Injury		Behavior	Injury		Behavior
		LE	L_{pk}	*Lp a/*	*LE*	L_{pk}	*Lp a/*
LF	Fin whale b/	1.35	0	4.74	1.84	0	4.51
	Minke whale	0.89	0	4.46	0.90	0	4.45
	Humpback whale	0.74	<0.01	4.47	0.69	0	4.53
	North Atlantic right whale b/	1.09	0	4.33	1.13	0	4.30
	Sei whale b/	1.04	<0.01	4.47	1.21	0	4.52
MF	Atlantic white-sided dolphin	0	0	4.24	0	0	4.30
	Atlantic spotted dolphin	0	0	0	0	0	0
	Short-beaked common dolphin	0	0	4.48	0	0	4.42
	Bottlenose dolphin	0	0	3.77	0	0	3.83
	Risso's dolphin	0	0	4.73	0	0	4.41
	Long-finned pilot whale	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0
	Sperm whale b/	0	0	4.59	0	0	4.47
HF	Harbor porpoise	0	0.08	4.52	0	0.04	4.37
PW	Gray seal	<0.01	0	4.91	<0.01	0	4.87
	Harbor seal	0	0	4.68	0	0	4.38

Notes:
a/ NOAA
b/ Listed as Endangered under the ESA
LE = unweighted sound exposure level (dB re 1 μPa2·s); Lp= unweighted sound pressure (dB re 1 μPa).

6.1.2 Estimate of Potential Project Impact Pile Driving Takes by Harassment

6.1.2.1 Animal Movement Modeling

Animal movement modeling was performed using the JASMINE model to estimate the probability of exposure of animals to sound arising from pile driving operations during construction of the Project. Sound exposure models such as JASMINE use simulated animals (animats) to sample the predicted 3D sound fields with movement rules derived from animal observations (**Appendix A**). The parameters used for forecasting realistic behaviors (e.g. diving, foraging, and surface times) were determined and interpreted from marine species studies (e.g., tagging studies) where available, or reasonably extrapolated from related species (**Appendix A**). The predicted sound fields were sampled by the model receiver moving in a way that real animals are expected to by programming animats to behave like marine mammal species that may be present near the Project. The output of the simulation is the exposure history for each animat within the simulation. An individual animats' sound exposure levels are summed over a specified duration, i.e., 24 h (**Appendix A**), to determine its total received acoustic energy (SEL) and maximum received PK and SPL. These received levels are then compared to the threshold criteria described in Section 2.4 within each analysis period.

The exposure criteria for impulsive sounds were used to determine the number of animats that were exposed to sound levels above the threshold values. To generate statistically reliable probability density functions, all simulations were seeded with an animat density of 0.5 animats/km² over the entire simulation area. Some species have depth preference restrictions, e.g., sperm whales prefer water greater than 1000 m (Aoki et al. 2007), and the simulation location contained a relatively high portion of shallow water areas. Results were then scaled by actual density of the respective species.

Appendix A provides a complete description of animal movement modeling and the parameters used in the JASMINE simulations, including a schematic overview of the exposure modeling process.

6.1.2.2 Mean Monthly Marine Mammal Density Estimates

Mean monthly marine mammal density estimates (animals per 100 square kilometers [animals/100 km²]) for all species are provided in **Table 23**. These were obtained using the Duke University Marine Geospatial Ecology Laboratory model results (Roberts et al. 2016a, 2016b, 2017, 2018, 2021a, 2021b) and include recently updated model results for North Atlantic right whale (NARW). The updated model predictions are summarized over three eras, 2003-2018, 2003-2009 and 2010-2018, to reflect the apparent shift in NARW distribution. The modeling conducted in this report relied on the 2010-2018 density predictions, which reflect the highest NARW densities over the three eras described above.

Densities were calculated within a 5.5 km buffered polygon around the lease area perimeter. The buffer size was selected as the largest 10 dB-attenuated exposure range over all species, scenarios, and threshold criteria (with the exception of the Wood et al. [2012] thresholds, which were not included in this estimate because they include a small subset of very long ranges for migrating mysticetes and harbor porpoise) rounded up to the nearest 0.5 km. The mean density for each month was determined by calculating the unweighted mean of all 10 × 10 km (5 × 5 km for NARW) grid cells partially or fully within the analysis polygon (**Figure 4**). For the May-December period, densities were computed monthly and, annually, and for the May–December period to coincide with proposed pile driving activities. For long- and short-finned pilot whales (Globicephala melas and Globicephala macrorhynchus, respectively), monthly densities are unavailable from Roberts et al. (2016a, 2016b, 2017), so annual mean densities were used. Additionally, Roberts et al. (2016a, 2016b, 2017) provide density for pilot whales as a guild that includes both species. To obtain density estimates for long-finned and short-finned pilot whales, the guild density from Roberts et al. (2016a, 2016b, 2017) was scaled by the relative stock sizes based on the best available abundance estimate from NOAA Fisheries SARs (Hayes et al. 2021). Equation 1 shows an example of how abundance scaling is applied to compute density for short-finned pilot whales.

$$D_{short\text{-}finned} = D_{both} \times N_{coastal} / (N_{short\text{-}finned} + N_{long\text{-}finned}) \quad (1)$$

where D represents density and N represents abundance.

Similarly, densities are provided for seals as a guild consisting primarily of harbor and gray seals (Roberts et al. 2016a, 2018). Gray and harbor seal densities were scaled by relative NOAA Fisheries SARs (Hayes et al. 2021) abundance.

Table 23 Mean Monthly Marine Mammal Density Estimates Within a 5.5 km Buffer Around OCS-A 0512 Lease Area

Species of Interest	Monthly densities (animals/100 km^2) a/												Annual Mean	May to Dec Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Fin whale b/	0.099	0.095	0.115	0.189	0.236	0.258	0.232	0.172	0.163	0.189	0.105	0.084	0.161	0.180
Minke whale	0.036	0.044	0.045	0.148	0.148	0.080	0.012	0.007	0.013	0.035	0.018	0.026	0.051	0.042
Humpback whale	0.061	0.031	0.020	0.044	0.042	0.048	0.020	0.013	0.062	0.129	0.054	0.065	0.049	0.054
North Atlantic right whale b/	0.479	0.548	0.645	0.726	0.122	0.007	0.002	0.002	0.002	0.005	0.031	0.230	0.233	0.050
Sei whale b/	0.001	0.001	0.001	0.021	0.018	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.004	0.003
Atlantic white sided dolphin	0.755	0.501	0.588	1.537	2.533	2.111	0.741	0.260	0.495	1.158	1.012	1.254	1.079	1.196
Atlantic spotted dolphin	0.005	0.002	0.003	0.011	0.027	0.114	0.283	0.148	0.263	0.146	0.145	0.015	0.097	0.143
Short-beaked common dolphin	7.494	1.434	0.573	0.947	1.038	0.930	0.863	2.235	3.413	5.013	4.336	11.713	3.332	3.693
Bottlenose dolphin	0.629	0.045	0.018	0.305	0.705	2.442	2.679	2.941	2.240	1.318	1.284	0.651	1.271	1.783
Risso's dolphin	0.006	0.003	0.001	0.001	0.003	0.003	0.014	0.030	0.012	0.003	0.006	0.014	0.008	0.011

Species of Interest	Monthly densities (animals/100 km^2) a/												Annual Mean	May to Dec Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Long-finned pilot whale	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098
Short-finned pilot whale	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072
Sperm whale b/	0.001	0.001	0.001	0.001	0.006	0.027	0.042	0.029	0.027	0.009	0.007	0.001	0.013	0.019
Harbor porpoise (sensitive)	7.573	11.683	11.252	6.946	2.059	0.037	0.051	0.079	0.072	0.157	2.874	6.549	4.111	1.485
Gray seals	1.830	3.661	3.129	2.713	1.981	0.082	0.005	0.002	0.007	0.029	0.098	1.227	1.230	0.429
Harbor seals	4.111	8.225	7.029	6.095	4.450	0.184	0.012	0.006	0.015	0.066	0.220	2.757	2.764	0.964

Notes:
a/ Density estimates are from habitat-based density modeling of the entire Atlantic Exclusive Economic Zone (EEZ) (Roberts et al. 2016a, 2016b, 2017, 2018, 2021a, 2021b).
b/ Listed as Endangered under the ESA.

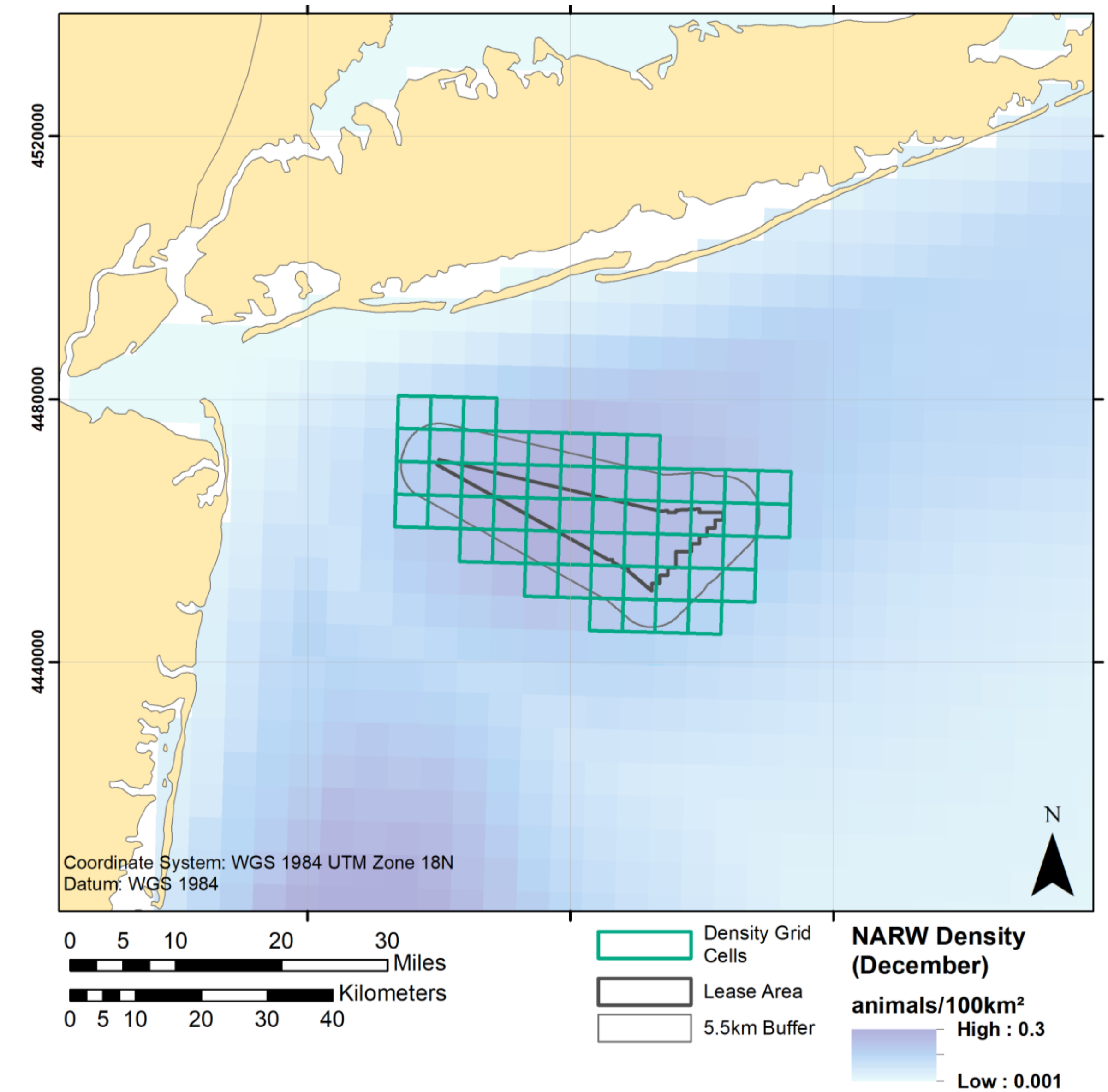


Figure 4 **Marine mammal (e.g., NARW) density map showing highlighted grid cells used to calculate mean monthly species estimates within a 5.5 km buffer around Lease Area OCS-A 0520 (Roberts et al. 2016a, 2021a, 2021b).**

6.1.2.3 Incorporation of Construction Scenario

Exposure estimates were calculated for marine mammals based on proposed construction schedules. As described above, Empire anticipates 96 monopile foundations and 24 pin piles will be installed in 2025 and 51 monopile foundations (zero pin piles) will be installed in 2026 (it is possible but not anticipated that monopile foundations and pin piles could be installed outside of the years described above due to schedule delays). As it is possible that either one or two monopile foundations may be installed per day, and either two or three pin piles may be installed per day, exposure estimates for all possible scenarios were modeled (i.e., one or two monopile foundations installed per day, and two or three pin piles installed per day).

The overall construction schedule assumed for exposure modeling purposes is detailed in **Table 24**. Note that all possible construction scenarios were modeled (i.e., one monopile/two pin piles per day, one monopile/three pin piles per day, two monopiles/two pin piles per day, two monopiles/three pin piles per day; Appendix A) to ensure the most conservative scenario was carried forward in the application. The resulting exposure estimates for Level A harassment were very similar across all modeled construction scenarios, with minimal differences (see Appendix A). Therefore, the most conservative scenario was driven by the exposure estimates for Level B harassment. Due to the nature of these calculations, the activities with the least piles installed per day had the longer overall durations in terms of total days, and therefore, the greatest resulting modeled exposures by Level B harassment. Consequently, the construction scenario with one monopile and two pin piles installed per day was carried forward for purposes of the exposure analysis presented in this application.

Table 24 Construction Schedule (one monopile per day/two pin piles per day) a/

Foundation type	Year 1				Year 2			
	Monthly Density				Monthly Density			
	Highest	Second	Third	Fourth	Highest	Second	Third	Fourth
Monopile – typical – 1 per day	19	20	20	20	24	24	3	0
Monopile – difficult – 1 per day	5	4	4	4	0	0	0	0
Pin pile – OSS1 – 2 per day	0	6	0	0	0	0	0	0
Pin pile – OSS2 – 2 per day	6	0	0	0	0	0	0	0
Total # of days	**30**	**30**	**24**	**24**	**24**	**24**	**3**	**0**

Note:
a/ Total days of piling per month for each foundation type in each of the four highest density months during May to December for each species, used to estimate the number of marine mammal and sea turtle acoustic exposures for Empire Wind.

Empire estimates that a maximum of 24 monopiles may be installed in any month, and that a maximum of 96 monopiles would be installed per year. Therefore, take estimates were generated for up to 24 monopiles per month (maximum 96 monopiles per year) in all possible months of construction (i.e., May through December); to be conservative, the scenario resulting in the greatest potential number of takes of each species was carried forward for the take request. Take estimates accounted for the maximum impact for all species (i.e., the maximum of 24 monopiles would be installed in highest density months for each species (excluding January through April)). Empire estimates that both offshore substation jack foundations will be constructed in summer of 2025.A maximum of 147 total monopile foundations may be driven over the course of the Project.

As described above, an estimated maximum of 17 foundations may be difficult-to-drive (including as many as 7 difficult-to-drive foundations for EW 1 and as many as 10 difficult-to-drive foundations for EW 2). This number represents a conservative estimate; the actual number will be informed by analysis of geotechnical data that will occur prior to construction. It is expected that difficult-to-drive foundation locations will be known in advance, and efforts will be made to avoid pile installation at those locations where possible. However, to be conservative, exposure estimates were calculated based on an assumption that pile driving would occur at the maximum 17 potential difficult-to-drive foundation locations. Empire expects that all difficult-to-drive foundations would be installed in 2025. It is possible but not anticipated that some difficult to drive foundations could be installed in 2026; however, to be conservative it was assumed all difficult to drive foundations would occur in 2025 as this scenario results in the most conservative exposure estimates for any single year of construction. To be conservative it was assumed that driving of difficult-to-drive foundations would occur in the months of highest density for each species, spread evenly among those months (i.e., of the 24 monopiles driven in the four months of highest density for each species, it was assumed four of those 24 would be considered difficult-to-drive in three months and five of those 24 would be difficult-to-drive in the remaining one month).

Thus, the construction schedule that was carried forward for the exposure estimate is considered conservative in terms of the modeled number of takes by Level A and Level B harassment for all species.

Estimates include the mean number of animals predicted to receive sound levels above exposure criteria for metric (SEL, PK, and SPL), assuming 10 dB attenuation (**Table 25**, **Table 26**, and **Table 27**). For full results, including all modeled attenuation levels and both summer and winter sound speed profiles, see **Appendix A**.

Table 25 Calculated Exposures by Level A and Level B Harassment Resulting from Wind Turbine and Offshore Substation Foundation Installation Impact Pile Driving (Year 1: 2025)

	Species	Injury		Behavior
		LE	L_{pk}	*Lp a/*
LF	Fin whale b/	1.63	0	12.19
	Minke whale	0.42	0	7.10
	Humpback whale	0.23	<0.01	5.10
	North Atlantic right whale b/	0.38	0	9.27
	Sei whale b/	0.04	<0.01	0.41
MF	Atlantic white-sided dolphin	0	0	179.81
	Atlantic spotted dolphin	0	0	0
	Short-beaked common dolphin	0	0	937.74
	Bottlenose dolphin	0	0	182.59
	Risso’s dolphin	0	0	1.30
	Long-finned pilot whale	0	0	0
	Short-finned pilot whale	0	0	0
	Sperm whale b/	0	0	1.55
HF	Harbor porpoise	0	0.15	220.61
PW	Gray seal	0.04	0	42.26
	Harbor seal	0	0	92.53

Notes:
NOAA Fisheries estimates were used as the basis of the requested take.
a/ NOAA Fisheries 2005
b/ Listed as Endangered under the ESA.

Table 26 Calculated Exposures by Level A and Level B Harassment Resulting from Wind Turbine and Offshore Substation Foundation Impact Pile Driving Installation (Year 2: 2026)

Species		Injury		Behavior
		LE	*L_{pk}*	*Lp a/*
LF	Fin whale c/	0.74	0	5.75
	Minke whale	0.22	0	4.79
	Humpback whale	0.10	0	2.86
	North Atlantic right whale b/	0.24	0	7.23
	Sei whale b/	0.03	0	0.30
MF	Atlantic white-sided dolphin	0	0	103.87
	Atlantic spotted dolphin	0	0	0
	Short-beaked common dolphin	0	0	581.15
	Bottlenose dolphin	0	0	91.59
	Risso's dolphin	0	0	0.71
	Long-finned pilot whale	0	0	0
	Short-finned pilot whale	0	0	0
	Sperm whale b/	0	0	0.78
HF	Harbor porpoise	0	0	153.84
PW	Gray seal	0	0	33.92
	Harbor seal	0	0	69.71

Notes:

NOAA Fisheries estimates were used as the basis of the requested take.
a/ NOAA Fisheries 2005
b/ Listed as Endangered under the ESA.

Table 27 Requested Takes by Level A and Level B Harassment Resulting from Wind Turbine and Offshore Substation Foundation Installation Impact Pile Driving (Total)

Species		Requested Takes			
		Injury		Behavior	
		Year 1	*Year 2*	*Year 1*	*Year 2*
LF	Fin whale b/	2	1	12	6
	Minke whale	0	0	7	5
	Humpback whale c/	0	0	60	26
	North Atlantic right whale b/	0	0	9	7
	Sei whale b/	0	0	0	0
MF	Atlantic white-sided dolphin	0	0	180	104
	Atlantic spotted dolphin	0	0	0	0
	Short-beaked common dolphin	0	0	938	581
	Bottlenose dolphin	0	0	183	92

	Species	Requested Takes			
		Injury		Behavior	
		Year 1	Year 2	Year 1	Year 2
	Risso's dolphin	0	0	1	1
	Long-finned pilot whale	0	0	0	0
	Short-finned pilot whale	0	0	0	0
	Sperm whale b/	0	0	2	1
HF	Harbor porpoise	0	0	221	154
PW	Gray seal	0	0	42	34
	Harbor seal	0	0	93	70

Notes:

NOAA Fisheries estimates were used as the basis of the requested take.
a/ NOAA Fisheries 2005
b/ Listed as Endangered under the ESA.
c/ Adjusted based on PSO sighting data from 2018-2021.

Note that upon review of the calculated exposure estimates based on the exposure modeling methodology described in Section 6.1.2 above and cross-comparisons to Empire Wind PSO sightings data ranging from 2018-2021 for the Project Area, it was determined that the calculated number of potential takes by Level B harassment of humpback whales based on the exposure modeling methodology described above was likely an underestimate (A.I.S. 2019; Gardline 2021a,b; Geoquip Marine 2021; Marine Ventures International 2021; RPS 2021; Smultea Environmental Sciences 2019, 2020, 2021). PSO sightings data was analyzed to determine the average number of humpback whales sighted per day during HRG surveys in the Project Area. Results indicated that the highest average sightings rate among PSO reports from 2018-2021 was 0.5 humpback whales sighted per day (Smultea Environmental Sciences 2019). The daily average of 0.5 humpback whales per day was then multiplied by the maximum potential number of days of pile driving associated with wind turbine and offshore substation foundation installation. In the event that one monopile or one pin pile is installed per day, up to 120 days of pile driving (i.e., 96 days of monopile installation and 24 days of pin pile installation) could occur in 2025 and up to 51 days of pile driving (i.e., 51 days of monopile installation) could occur in 2026. At a rate of 0.5 humpback whales per day, 120 days of pile driving in 2025 resulted in an estimated 60 takes by level B harassment in that year, and 51 days of pile driving in 2026 resulted in an estimated 25.5 (rounded to 26) takes by level B harassment in that year. As these alternate estimates of take by Level B harassment for humpback whales are higher than numbers calculated based on the exposure analysis method described in Section 6.1.2 (**Table 25** and **Table 26**), to be conservative the applicant has requested take by Level B harassment for humpback whales based on this alternate take calculation method (**Table 27**).

6.2 Cable Landfall and Marina Activities

6.2.1 Basis for Estimating Numbers of Marine Mammals that Might be Taken by Harassment from Pile Driving

6.2.1.1 Acoustic Modeling

Acoustic modeling of vibratory driving associated with cofferdam installation and removal, impact pile driving associated with goal post installation, and vibratory pile driving associated with berthing pile removal and bulkhead work at the marina at Onshore Substation C location are assessed in this section.

For vibratory pile driving of cofferdams, underwater sound propagation modeling was completed using dBSea, a powerful software developed by Marshall Day Acoustics for the prediction of underwater noise in a variety of environments. The 3D model is built by importing bathymetry data and placing noise sources in the environment. Each source can consist of equipment chosen from either the standard or user defined databases. Noise mitigation methods may also be included. The user has control over the seabed and water properties including SSP, temperature, salinity, and current.

Noise levels are calculated throughout the entire Project Area and displayed in 3D. To examine results in more detail, levels may be plotted in cross sections or a detailed spectrum may be extracted at any point in the 3D calculation area. Levels are calculated in third octave bands. For the purposes of the Project acoustic analysis, two different solvers for the low- and high-frequency ranges:

dBSeaPE (Parabolic Equation Method): The dBSeaPE solver makes use of the parabolic equation method, a versatile and robust method of marching the sound field out in range from the sound source. This method is one of the most widely used in the underwater acoustics community and offers excellent performance in terms of speed and accuracy in a range of challenging scenarios.

dBSeaRay (Ray Tracing Method): The dBSeaRay solver forms a solution by tracing rays from the source to the receiver. Many rays leave the source covering a range of angles, and the sound level at each point in the receiving field is calculated by coherently summing the components from each ray. This is currently the only computationally efficient method at high frequencies.

The underwater acoustic modeling analysis used a split solver, with dBSeaPE evaluating the 12.5 Hz to 800 Hz and dBSeaRay addressing 1,000 Hz to 20,000 Hz. The specific parameters used in the modeling are described in the following sections.

The modeling for goal posts, berthing piles, and bulkhead work relied on the formulaic spreadsheet provided by NOAA Fisheries.

6.2.1.2 Model Input Parameters

Cofferdam Vibratory Driving

As the vibratory installation and removal of cofferdams relied on dBSea, the accuracy of underwater noise modeling results is largely dependent on the sound source characteristics and the accuracy of the intrinsically dynamic data inputs and assumptions used to describe the medium between the path and receiver, including sea surface conditions, water column, and sea bottom. A point source was utilized to evaluate the vibratory pile driving.

For estimating source levels and frequency spectra, the vibratory pile driver was estimated assuming an 1,800 kilonewton (kN) vibratory force. Modeling was accomplished using adjusted one-third-octave band vibratory pile driving source levels cited for similar vibratory pile driving activities conducted during cofferdam installation for the Block Island Wind Farm (Tetra Tech 2012; Schultz-von Glahn et al. 2006). The assumed sound source level for vibratory pile driving corresponded to 195 dB SEL re 1 μPa. The frequency distribution of the vibratory pile driving sound source is displayed in **Figure 5**. The anticipated duration is 1 hour of active pile driving per day.

Figure 5 Vibratory Pile Driving Spectral Source Levels

For geometrically shallow water, sound propagation is dominated by boundary effects. Bathymetry data represent the 3D nature of the subaqueous land surface and were obtained from the National Geophysical Data Center (NGDC) and a U.S. Coastal Relief Model (NOAA 2005); the horizontal resolution of this dataset is 3 arc seconds (90 meters). NGDC's 3 arc-second U.S. Coastal Relief Model (CRM) provides the first comprehensive view of the U.S. coastal zone, integrating offshore bathymetry with land topography into a seamless representation of the coast. The CRM spans the U.S. East and West Coasts, the northern coast of the Gulf of Mexico, Puerto Rico, and Hawaii, reaching out to, and in places even beyond, the continental slope. The Geophysical Data System (GEODAS) is an interactive database management system developed by the NGDC for use in the assimilation, storage and retrieval of geophysical data. GEODAS software manages several types of data including marine trackline geophysical data, hydrographic survey data, aeromagnetic survey data, and gridded bathymetry/topography.

The bathymetric data were sampled by creating a fan of radials at a given angular spacing. This grid was then used to determine depth points along each modeling radial transect. The underwater acoustic modeling takes place over these radial planes in set increments depending on the acoustic wavelength and the sampled depth. These radials transects were used for modeling acoustic impacts during both the construction and operations of the Project, with each radial centered on the given Project sound source or activity.

Sediment type (e.g., hard rock, sand, mud, clay) directly impacts the speed of sound as it is a part of the medium in which the sound propagates. For the immediate Project Area encompassing the Lease Area, the seafloor is expected to be predominantly sand. The geoacoustic properties with information on the compositional data of the surficial sediments were informed by geotechnical studies performed by Empire in 2019. The sediment layers used in the modeling and the main geoacoustic properties are defined in **Table 28**. The term "compressional" refers to the fact that particle motion of the sound wave is in the same direction as propagation. The term "compressional sound speed" refers to the speed of sound in the sediment along the direction of acoustic propagation. The term "compressional attenuation" refers to how much sound (dB) is lost per wavelength (λ) of the signal. Finally, density is the physical density of the sediment. Ranges are provided for the different geoacoustic properties because the values vary depending on the location specifically being modeled for a given scenario.

Table 28 Geoacoustic Properties of Sub-bottom Sediments as a Function of Depth

Seabed Layer (m)	Material	Geoacoustic Properties
0 to 6	Sand and silt	Cp = 1,575 m/s αs (dB/λ) = 1.0 dB/ λ ρ = 1,700 kg/m^3
5 to 18.5	Sand (dense to very dense)	Cp = 1,650 m/s αs (dB/λ) = 0.8 dB/ λ ρ = 1,900 kg/m^3
18 to 50	Clay	Cp = 1,560 m/s αs (dB/λ) = 0.2 dB/ λ ρ = 1,560 kg/m^3

The speed of sound in sea water depends on the temperature T [°C], salinity S [parts per thousand (ppt)], and depth D [m] and can be described using SSPs. Oftentimes, a homogeneous or mixed layer of constant velocity is present in the first few meters. It corresponds to the mixing of superficial water through surface agitation. There can also be other features, such as a surface channel, which corresponds to sound velocity increasing from the surface down. This channel is often due to a shallow isothermal layer appearing in winter conditions, but can also be caused by water that is very cold at the surface. In a negative sound gradient, the sound speed decreases with depth, which results in sound refracting downwards which may result in increased bottom losses with distance from the source. In a positive sound gradient, as is predominantly present in the winter season, sound speed increases with depth and the sound is, therefore, refracted upwards, which can aid in long distance sound propagation. For the construction modeling scenarios, the December SSP was selected as it exhibited maximum case characteristics for long-range noise propagation effects. **Figure 6** displays the monthly SSPs for the Project Area.

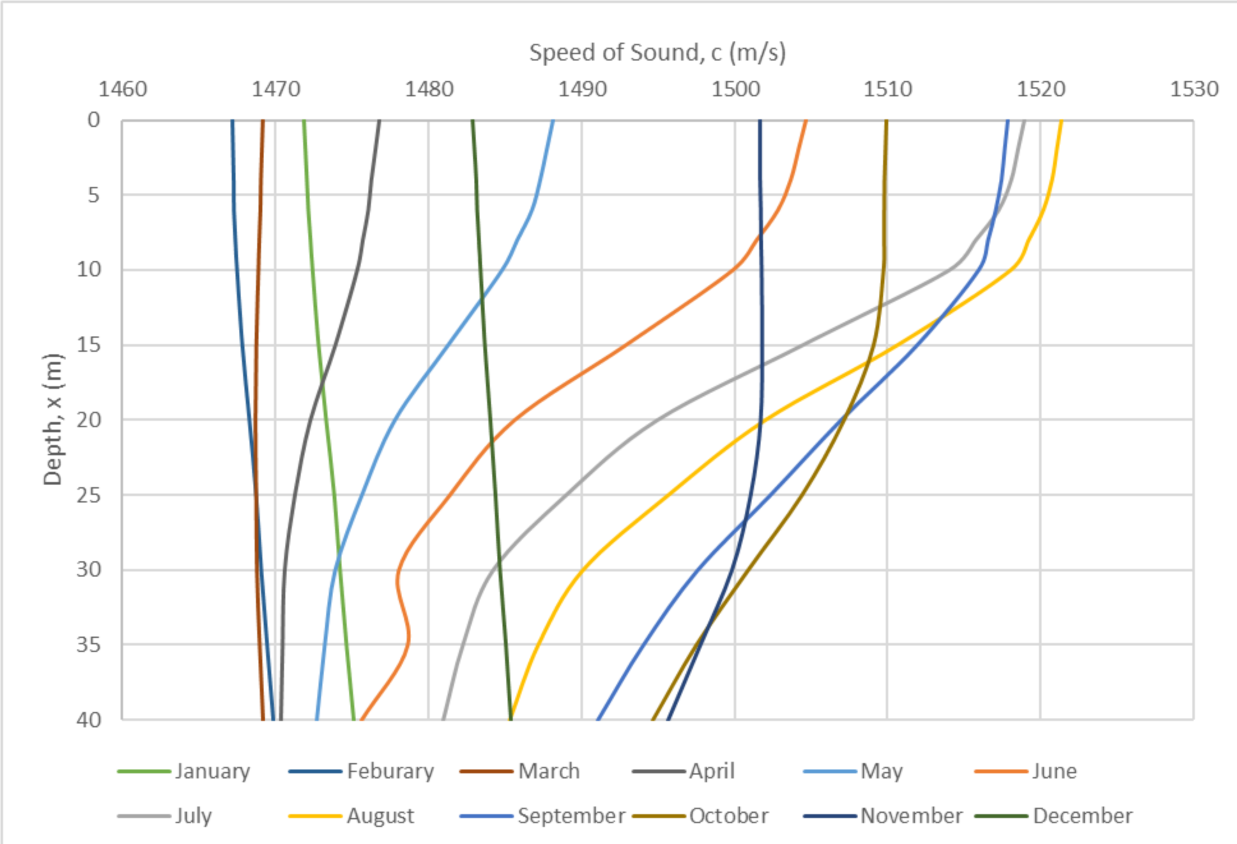


Figure 6 Monthly Sound Speed Profile as a Function of Depth

Goal Post Pile Driving and Marina Activities

Modeling of goal post pile driving and marina activities, berthing pile and the bulkhead, was conducted following prescriptive guidance provided by NOAA Fisheries. The Level A harassment cumulative PTS criteria were applied to the formulaic spreadsheet provided by NOAA Fisheries, which has been updated to reflect NOAA Fisheries' 2018 Revisions to Technical Guidance (NOAA Fisheries 2018a). PTS onset acoustic thresholds estimated in the NOAA Fisheries User Spreadsheets rely on overriding default values, calculating individual adjustment factors, and using the difference between levels with and without weighting functions for each of the five categories of hearing groups. The adjustment factors in the spreadsheets allow for the calculation of cumulative sound exposure level (SELcum) distances and peak sound exposure (PK) distances and account for the accumulation (Safe Distance Methodology) using the source characteristics (duty cycle and speed) after Silve et al. (2014). The impact pile driving evaluated was input using the impact pile driving specific tab within the NOAA Fisheries User Spreadsheet as appropriate.

The Level B harassment distance was calculated using a simple spread calculation to estimate the horizontal distance to the 160 dB re 1 µPa isopleth:

$$SPL(r) = SL - PL(r) \quad (2)$$

Where:

SPL = sound pressure level (dB re 1 µPa),
r = range (m),

SL = source level (dB re 1 µPa m), and
PL = propagation loss as a function of distance.

Propagation loss is calculated using:

$$PL(r)=20\mathrm{Log}_{10}(r)+\alpha(f)\cdot r/1000$$

Note the calculation methodologies do not allow for inclusion of site-specific environmental parameters

6.2.1.3 Calculation of Ranges to Regulatory Thresholds

To determine the ranges to the defined threshold isopleths a maximum received level-over-depth approach was used. This approach uses the maximum received level (Rmax) that occurs within the water column at each horizontal sampling point. Both the Rmax and the R95% ranges were calculated for each of the regulatory thresholds. The Rmax is the maximum range in the model at which the sound level calculated. The R95% is the maximum range at which a sound level was calculated excluding five percent of the Rmax. The R95% excludes major outliers or protruding areas associated with the underwater acoustic modeling environment. Regardless of shape of the calculated isopleths the predicted range encompasses at least 95 percent of the horizontal area that would be exposed to sound at or above the specified level. All ranges to injury thresholds presented in the Underwater Acoustic Assessment Report are presented in terms of the R95% range. Calculations were completed for the scenario described in **Table 29**.

Table 29 Underwater Acoustic Modeling Scenarios for Cofferdam Vibratory Pile Driving

Scenario	Description	Location (Lat/Long)	Apparent Source Level dB re: dB re 1 µPa²·s
EW 1	Vibratory Pile Driving	40.66261, -74.0127 (water depth 11.99 m)	195 SEL
EW 2	Vibratory Pile Driving	40.579, -73.6326 (water depth 7.02 m)	195 SEL

The results of the modeling for vibratory pile driving are presented in **Table 30**.

Table 30 Distances (meters) to the Level A and Level B Harassment Threshold Isopleth Distances for Cofferdam Vibratory Pile Driving

Location	PTS onset by Hearing Group a/				Behavioral Response
	LF cetaceans	MF cetaceans	HF cetaceans	Phocid pinnipeds	All
	199 $L_{E,\ 24hr}$	198 $L_{E,\ 24hr}$	173 $L_{E,\ 24hr}$	201 $L_{E,\ 24hr}$	120 SPL RMS
EW 1	122	0	44	62	1,985
EW 2	13	0	12	11	1,535

Source: NOAA Fisheries 2018a

Note:
a/ Injury

The estimated Level B harassment zone for each cofferdam location was determined by calculating the area of ensonified to the 120 SPL RMS threshold distance minus the area overlapping land. The resulting zones of influence (ZOI) are provided below in **Table 31**. Note that very shallow water depths (3-4 m) at the site of cofferdam pile driving is responsible for the limited acoustic propagation of vibratory driving noise.

Table 31 Estimated ZOIs (km^2) Ensonified to the Level B Harassment Threshold for Cofferdam Vibratory Pile Driving

Location	Calculated ZOI per day (km^2)
EW 1	2.679
EW 2	1.672

As described in Section 1.2, as many as two temporary cofferdams may be installed for EW 1 and as many as three temporary cofferdams may be installed for EW 2. The resulting ZOIs in **Table 31** were used to calculate marine mammal exposures resulting from vibratory pile driving for EW 1 and EW 2.

Results of acoustic modeling of goal post pile driving are detailed below in **Table 32**. Modeling assumed a single strike SEL of 174 dB with 2000 strikes per pile; no attenuation was assumed.

Table 32 Distances (meters) to the Level A and Level B Harassment Threshold Isopleth Distances for Goal Post Impact Pile Driving

	PTS onset by Hearing Group a/								Behavioral Response
	LF cetaceans		MF cetaceans		HF cetaceans		Phocid pinnipeds		All
Pile	219 $L_{p,pk}$	183 $L_{E,24hr}$	230 $L_{p,pk}$	185 $L_{E,24hr}$	202 $L_{p,pk}$	155 $L_{E,24hr}$	218 $L_{p,pk}$	185 $L_{E,24hr}$	160 SPL RMS
12 inch steel	0.0	632.1	0.0	22.5	7.4	752.9	0.0	338.3	398.1 (ZOI = 0.048 km^2)

Note:
a/ Injury

As described above, either cofferdams or goal post installation may occur as part of cable landfall activities, but not both. For goal post installation, two hours per goal post (two piles), for 3 goal posts (6 piles) per HDD, for a total of 18 piles and 36 total hours of pile driving are anticipated. For cofferdams, there is 1 hour per day for 6 days (installation and removal) per cofferdam for a total of 18 hours pile driving anticipated. While modeled distances to the Level A harassment threshold for goal post pile driving were larger than for cofferdam vibratory driving based on the SELcum metric, it should be noted that modeled distances based on the SELcum metric are based on the assumption that an individual animal remains within the modeled zone for the entire duration of pile driving in order to incur PTS. This is not considered realistic as marine mammals are highly mobile and it is extremely unlikely that an individual would remain in an ensonified zone for an extended period of time. As modeled distances to the Level B harassment threshold and zones of influence for Level B harassment were orders of magnitude larger for cofferdam vibratory driving compared to goal post pile driving (**Table 30**, **Table 31**, and **Table 32**), acoustic impacts from cofferdam vibratory driving activities were determined to be greater than that of the alternative goal post installation activity. Therefore, to be conservative the cofferdam scenario was carried forward for the analysis of potential takes by harassment from cable landfall activities. As such, goal post pile driving is not analyzed further in this application.

Results of acoustic modeling of marina work are detailed below in **Table 33**.

Table 33 Distances (meters) to the Level A and Level B Harassment Threshold Isopleth Distances for Vibratory Driving at Onshore Substation C Location Marina

Location	PTS onset by Hearing Group a/				Behavioral Response
	LF cetaceans	MF cetaceans	HF cetaceans	Phocid pinnipeds	All
	199 $L_{E,\ 24hr}$	198 $L_{E,\ 24hr}$	173 $L_{E,\ 24hr}$	201 $L_{E,\ 24hr}$	120 SPL RMS
Marina Bulkhead Work (Sheetpile installation)	43.2	3.8	63.8	26.2	1,000
Marina Berthing Pile Removal	43.5	3.9	64.3	26.5	1,600

6.2.2 Estimate of Potential Cofferdam Vibratory Pile Driving and Marina Activity Takes by Harassment

Cofferdam Vibratory Driving

Estimates of take are computed according to the following formula as provided by NOAA Fisheries (Personal Communication, November 24, 2015):

$$Estimated\ Take = D \times ZOI \times (d) \tag{3}$$

Where:

D = average highest species density (number per km²)

ZOI = maximum ensonified area to MMPA threshold for impulsive noise (160 dB RMS 90% re 1 µPa)

d = number of days

The area ensonified to the Level B harassment threshold, as well as the projected duration of cofferdam installation and removal at each respective vibratory pile driving location, was then used to produce the results of take calculations provided in **Table 34**. As described in Section 1.2, it is expected to take three days to install and three days to remove each cofferdam. Therefore six days of vibratory pile driving/removal at each location were included. It should be noted that calculations do not take into account whether a single animal is harassed multiple times or whether each exposure is a different animal. Therefore, the numbers in **Table 28** are the maximum number of animals that may be exposed to sound above relevant thresholds during vibratory pile driving (i.e., the Applicant assumes that each exposure event is a different animal).

The data used as the basis for estimating species density for the Project Area are derived from data provided by Duke University's Marine Geospatial Ecology Lab and the Marine-life Data and Analysis Team. This dataset is a compilation of the best available marine mammal data (1994-2018) and was prepared in a collaboration between Duke University, Northeast Regional Planning Body, University of North Carolina, the Virginia Aquarium and Marine Science Center, and NOAA Fisheries (Roberts et al. 2016a; Curtice et al. 2019).

Maximum monthly densities as reported by Roberts et al. (2016b, 2017, 2018, 2020, 2021a) were averaged by season over the duration of cofferdam installation/removal (spring [March through May], summer [June through August], fall [September through November], and winter [December through February]). To be conservative, the maximum average seasonal density for each species was then carried forward in the take calculations. Bottlenose dolphin density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020) are reported as "bottlenose" and not identified to stock. Given the noise from cofferdam installation would not extend beyond the 20 m isobath, where the coastal stock predominates, it is expected that all estimated takes by Level B harassment of bottlenose dolphins harassment from cofferdam installation will accrue to the coastal stock. As Roberts et al. does not account for group size, the estimated take was adjusted to account for one group size per day of each of bottlenose and common dolphins.

Due to the presence of several seal haul outs, it was determined the Roberts et al. density data underestimated potential seal occurrence, and ten Level B seal takes per day were estimated (Woo and Biolsi 2018). For pinnipeds, because the seasonality of and habitat use by gray seals roughly overlaps with harbor seals, and the density data as presented by Roberts et al. (2016b, 2017, 2018, 2020, 2021a) do not differentiate between pinniped species, the estimated takes were split evenly between harbor and gray seals.

Marina Activities

Since the acoustic impact of the marina work was minimal (**Table 33**) and densities are not available for the specific inshore region where the activity will occur, potential take by harassment for marine mammals could not be calculated. Instead, to be conservative, 10 takes by Level B harassment of seals per day were estimated (Woo and Biolsi 2018), which were split evenly between harbor and gray seals (**Table 35**).

Table 34 Average Marine Mammal Densities Used in Exposure Estimates and Estimates of Potential Takes by Level B Harassment from Cofferdam Vibratory Pile Driving

Species	EW 1 Cofferdams (2024)		EW 2 Cofferdams (2024-2025) Totals	
	Average Seasonal Density a/ (No./100 km²)	Calculated Take (Requested Take) by Level B Harassment	Average Seasonal Density a/ (No./100 km²)	Calculated Take (Requested Take) by Level B Harassment
North Atlantic Right Whale	0.29	0	0.029	0
Humpback Whale	0.07	0	0.07	0
Fin Whale	0.17	0	0.17	0
Sei Whale	0.01	0	0.01	0
Sperm Whale	0.02	0	0.02	0
Minke Whale	0.08	0	0.08	0
Bottlenose Dolphin (Western North Atlantic Northern Migratory Coastal Stock) b/	6.6	2.12 (180)	6.6	1.98 (270)
Atlantic Spotted Dolphin	0.14	0	0.14	0
Short-Beaked Common Dolphin c/	4.94	1.59 (360)	4.94	0.04 (540)
Atlantic White-sided Dolphin	1.02	0	1.02	1.49 (1)
Risso's Dolphin	0.01	0	0.01	0
Pilot Whale *spp.* d	0.11	0	0.11	0
Harbor Porpoise	9.07	2.92 (3)	9.07	0
Harbor Seal e/	8.2	1.32 (60)	8.2	2.73 (90)
Gray Seal e/	8.2	1.32 (60)	8.2	1.23 (90)

Notes:
a/ Cetacean density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020, 2021a).
b/ Bottlenose dolphin density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020) reported as "bottlenose" and not identified to stock. Given the noise from cofferdam installation would not extend beyond the 20 m isobath, where the coastal stock predominates, it is expected that all estimated takes by Level B harassment of bottlenose dolphins from cofferdam installation will accrue to the coastal stock. As Roberts et al. does not account for group size, the requested take was adjusted to account for one group size, 15 individual (Reeves et al. 2002) per day of bottlenose.
c/ As Roberts et al. does not account for group size, the estimated take was adjusted to account for one group size, 30 individuals (Reeves et al. 2002) per day of each common dolphins.
d/ Pilot whale density values from Duke University (Roberts et al. 2016, 2017, 2018, 2020, 2021a) reported as "Kogia *spp.*" and not species-specific. As the short-finned pilot whale is the smaller stock, take estimates have been assumed to be of this stock to be conservative. As described in Section 4.1.4, both the short-finned and long-finned pilot whale occur in the Mid-Atlantic, though the short-finned pilot whale tends to occur in more southern waters.
e/ Pinniped density values from Duke University (Roberts et al. 2016, 2017, 2018, 2020, 2021a) are reported as "seals" and are not species-specific, therefore, 50% of expected takes by Level B harassment are expected to accrue to harbor seals and 50% to gray seals.

Table 35 Average Marine Mammal Densities Used in Exposure Estimates and Estimates of Potential Takes by Level B Harassment from Marina Pile Driving

Species	Marina Work (2024)	
	Average Seasonal Density a/ (No./100 km²)	Requested Take by Level B Harassment
Bottlenose Dolphin (Western North Atlantic Northern Migratory Coastal Stock) b/	6.6	735
Harbor Seal c/	8.2	245
Gray Seal c/	8.2	245

Notes:
a/ Cetacean density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020, 2021a).
b/ Bottlenose dolphin density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020) reported as "bottlenose" and not identified to stock. Given the noise from cofferdam installation would not extend beyond the 20 m isobath, where the coastal stock predominates, it is expected that all estimated takes by Level B harassment of bottlenose dolphins from cofferdam installation will accrue to the coastal stock. As Roberts et al. does not account for group size, the requested take was adjusted to account for one group size, 15 individual (Reeves et al. 2002) per day of bottlenose.
c/ Pinniped density values from Duke University (Roberts et al. 2016, 2017, 2018, 2020, 2021a) are reported as "seals" and are not species-specific, therefore, 50% of expected takes by Level B harassment are expected to accrue to harbor seals and 50% to gray seals.

6.3 HRG Survey Activities

6.3.1 Basis for Estimating Numbers of Marine Mammals that Might be Taken by Harassment from HRG Survey Activities

6.3.1.1 Acoustic Modeling

Two separate calculation methodologies were used to calculate distances to Level A (PTS onset) and Level B acoustic harassment thresholds, both following prescriptive guidance provided by NOAA Fisheries. The Level A harassment cumulative PTS criteria were applied to the formulaic spreadsheet provided by NOAA Fisheries, which has been updated to reflect NOAA Fisheries' 2018 Revisions to Technical Guidance (NOAA Fisheries 2018a). PTS onset acoustic thresholds estimated in the NOAA Fisheries User Spreadsheets rely on overriding default values, calculating individual adjustment factors, and using the difference between levels with and without weighting functions for each of the five categories of hearing groups. The new adjustment factors in the spreadsheets allow for the calculation of cumulative sound exposure level (SEL_{cum}) distances and peak sound exposure (PK) distances and account for the accumulation (Safe Distance Methodology) using the source characteristics (duty cycle and speed) after Silve et al. (2014). The HRG systems evaluated were input as non-impulsive and impulsive mobile sources within the NOAA Fisheries User Spreadsheet as appropriate.

The Level B harassment distances for each piece of HRG equipment operating below 180 kHz were calculated per NOAA Fisheries' Interim Recommendation for Sound Source Level and Propagation Analysis for High Resolution Geophysical Sources (NOAA Fisheries 2019b). The methodology is new and is detailed within the referenced document. Methods used to estimate the horizontal distance to the 160 dB re 1 µPa isopleth include the in-beam distance at which 160 dB re 1 µPa is reached:

$$SPL(r)=SL-PL(r) \tag{4}$$

Where:

SPL = sound pressure level (dB re 1 µPa),
r = in-beam range (m),
SL = in-beam source level (dB re 1 µPa m), and
PL = propagation loss as a function of distance.

Propagation loss is calculated using:

$$PL(r)=20Log10(r)+\alpha(f)\cdot r/1000 \tag{5}$$

Where:

$\propto$ = absorption coefficient (dB/km), and
f = frequency (kHz).

The absorption coefficient is approximated using:

$$\alpha(f)\approx 0.000339f2 + 48.5(f2 / (f2 + 5715.36) \tag{6}$$

When a range of frequencies is produced by a source, the lowest frequency is used for determining the absorption coefficient.

For a downwards-pointing source with a beamwidth less than 180 degrees, the vertical impact distance (V) is calculated from the in-beam range using the following equation:

$$V = r \cdot cos(\theta/2) \tag{7}$$

Where:

θ = -3 dB beamwidth.

The horizontal impact distance (R) is calculated, accounting for the beamwidth and vertical sound propagation characteristics using the following equation:

$$R = v \cdot tan(\theta/2) \tag{8}$$

Therefore, the Level A harassment calculation methodology prescribed by NOAA Fisheries does not account for the influences of absorption, water depth, and/or beamwidth whereas the October 2019 guidance issued to evaluate distances to Level B thresholds does account for those factors.

6.3.1.2 Model Input Parameters

As indicated, prescriptive calculation methodologies provided by NOAA Fisheries were used to calculate maximum distances to the Level A and B harassment regulatory thresholds. The calculation methodologies do not allow for inclusion of site-specific environmental parameters but do incorporate Project-specific sound source characteristics including the following:

- Level A harassment:
    - Manufacturer sound source level
    - Source Velocity
    - Pulse Duration
    - Repetition Rate
    - Duty Cycle

- Level B harassment:
    - Manufacturer sound source level
    - Frequency
    - Beamwidth
    - Water depth

The majority of this information is identified or calculated based on HRG equipment data given in **Table 10**. In addition, absorption is included in the updated Level B harassment calculation methodology. The calculation of absorption coefficient varies with frequency, temperature, salinity, and pH, the largest factor driving the absorption coefficient is frequency. Therefore, to calculate the distances to the Level B harassment threshold, the lower end of the equipment operating frequency is used and other factors (temperature, salinity, and pH) are neglected.

6.3.1.3 Calculation of Range to Regulatory Thresholds

As outlined above, NOAA Fisheries' calculation methodologies were used to evaluate maximum distances to the Level A and Level B harassment thresholds. **Table 36** shows the maximum distances to the Level A harassment thresholds for each type of HRG equipment proposed. Results calculated using the NOAA

Fisheries 2018 guidance and the accompanying Optional User Spreadsheet for each type of survey equipment is provided in **Appendix B**.

Note that of the list of equipment proposed in **Table 10**, USBL, MBES, SSS, and the Innomar SBP were removed from further analysis due to either the extremely low likelihood of the equipment resulting in marine mammal harassment (i.e., USBL, MBES, select SSS) or due to negligible calculated isopleth distances corresponding to the Level B harassment threshold (<2m) (i.e., select SSS and Innomar SBP). Results for the remaining equipment are presented in **Table 36** and **Table 37**.

Table 36 Maximum Distances (meters) to Isopleth Distances Corresponding to Level A Harassment Thresholds for HRG Equipment

HRG System	Representative HRG Equipment	Marine Mammal Group PTS Onset (m)				
		LF cetaceans	MF cetaceans	HF cetaceans	Phocid pinnipeds	Otariid pinnipeds
		199 dB SEL_{cum}	198 dB SEL_{cum}	173 dB SEL_{cum}	201 dB SEL_{cum}	219 dB SEL_{cum}
SBP	EdgeTech DW106	0.3	0.1	7.7	0.2	0.0
SBP	EdgeTech 424	0.0	0.0	0.2	0.0	0.0
SBP	Teledyne Benthos Chirp III - TTV 170	138.0	1.8	113.2	54.0	1.1

Notes:
dB re 1 µPa m – decibels referenced to 1 microPascal at 1 meter.
RMS – root-mean-square
SBP – sub bottom profiler
SEL_{cum} – cumulative sound exposure level expressed as dB re 1 μPa^2

As shown in **Table 36**, the EdgeTech DW106 and 424 have estimated isopleth distances to the Level A harassment threshold for all marine mammal functional hearing groups that are considered de minimis. The Teledyne Benthos Chirp has a calculated isopleth distance to the Level A harassment threshold of up to a maximum of 138 m (for LF cetaceans). However, as indicated above, Level A harassment calculations using the NOAA Fisheries optional user spreadsheet tool does not take into account beamwidth and absorption, and therefore the resulting calculated distances to the Level A harassment threshold for equipment types that are not omni-directional do not reflect actual expected isopleth distances. These estimates are therefore considered unrealistic for purposes of analyzing the potential for these sources to result in marine mammal exposure above the Level A harassment threshold. The Applicant does not expect take by Level A harassment to occur from the Teledyne Benthos Chirp because both the source and marine mammal are mobile and thus the likelihood of a marine mammal remaining in the ensonified zone long enough to reach PTS is not anticipated and therefore authorization for take by Level A harassment resulting from HRG sources is not anticipated nor requested.

The isopleth distances corresponding to the Level B harassment threshold for each type of HRG equipment with the potential to result in harassment of marine mammals were calculated per NOAA Fisheries' Interim Recommendation for Sound Source Level and Propagation Analysis for High Resolution Geophysical Sources. The distances to the 160 dB RMS re 1 µPa isopleth for Level B harassment are presented in **Table 37**.

Table 37 Isopleth Distances (meters) Corresponding to the Level B Harassment Threshold for HRG Equipment

HRG Survey Equipment	Source Level (SL_{RMS}) (dB re 1µPa)	Lateral Distance (m) to Level B Harassment Threshold
EdgeTech DW106	194	50.00
EdgeTech 424	180	8.75
Teledyne Benthos Chirp III - TTV 170	219	50.05

Notes:
dB re 1 µPa m – decibels referenced to 1 microPascal at 1 meter (m)

The survey activities that have the potential to result in Level B harassment (160 $dB_{RMS90\%}$ re 1 µPa) include the noise produced by EdgeTech DW106, EdgeTech 424, or Teledyne Benthos Chip III (see **Table 37**), of which the Teledyne Benthos Chirp III results in the greatest calculated distance to the Level B harassment criteria at 50.05 (164 ft). Therefore, to be conservative, the Applicant has applied the estimated distance of 50.05 m (164 ft) to the 160 $dB_{RMS90\%}$ re 1 µPa Level B harassment criteria as the basis for determining potential take from all HRG sources.

The basis for the take estimate is the number of marine mammals that would be exposed to sound levels in excess of the Level B harassment criteria (160 $dB_{RMS90\%}$ re 1 µPa). Typically, this is determined by estimating an ensonified area for the activity, by calculating the ZOI (zone of influence) to the isopleth distance corresponding to the Level B harassment threshold. This area is then multiplied by marine mammal density estimates in the project area and then corrected for seasonal use by marine mammals, seasonal duration of Project-specific noise-generating activities, and estimated duration of individual activities when the maximum noise-generating activities are intermittent or occasional. In the absence of any part of this information, it becomes prudent to take a conservative approach to ensure the potential number of takes is not greatly underestimated.

The estimated distance of the daily vessel track line was determined using the estimated average speed of the vessel and the 24-hour operational period within each of the corresponding survey segments. All noise-producing survey equipment is assumed to be operated concurrently. Using the distance of 50.05 (164 ft)) to the 160 $dB_{RMS90\%}$ re 1 µPa Level B harassment isopleth (**Table 37**), the estimated daily vessel track of approximately 177.792 km (110.475 mi) for 24-hour operations, inclusive of an additional circular area to account for radial distance at the start and end of a 24-hour cycle, estimates of the total area ensonified to the Level B harassment threshold per day ("daily ensonified area") of HRG surveys were calculated (**Table 38**).

Table 38 Estimated Number of Survey Days, Estimated Survey Distance per Day, and Estimated Daily Ensonified Area for HRG surveys, from 2024 through 2028

Survey Segment	Number of Active Survey Vessel Days	Estimated distance per day (km)	Calculated daily ensonified area (km^2)
2024 Survey Effort	41	177.792	17.805
2025 Survey Effort	191		
2026 Survey Effort	150		
2027 Survey Effort	100		
2028 Survey Effort	100		

6.3.2 Estimate of Potential HRG Survey Takes by Level B Harassment

Estimates of take are computed according to the following formula as provided by NOAA Fisheries (Personal Communication, November 24, 2015):

$$Estimated\ Take = D \times ZOI \times (d) \qquad (9)$$

Where:

D = average highest species density (number per km^2)
ZOI = maximum ensonified area to MMPA threshold for continuous noise (120 $dB_{RMS90\%}$ re 1 µPa)
d = number of days

Per NOAA Fisheries guidance for mobile sound sources, the ZOI was calculated according to the following formula (Personal Communication, November 24, 2015):

$$ZOI = maximum\ ensonified\ area\ around\ the\ sound\ source \times the\ expected\ distance\ travelled\ over\ a\ 24\text{-}hr\ period. \qquad (10)$$

Refer to **Table 36** and **Table 37** for the calculated ZOI for each of the proposed HRG survey segments.

The data used as the basis for estimating species density for the Project Area are derived from data provided by Duke University's Marine Geospatial Ecology Lab and the Marine-life Data and Analysis Team. This dataset is a compilation of the best available marine mammal data (1994-2018) and was prepared in a collaboration between Duke University, Northeast Regional Planning Body, University of North Carolina, the Virginia Aquarium and Marine Science Center, and NOAA Fisheries (Roberts et al. 2016a; Curtice et al. 2019). Recently, these data have been updated with new modeling results and have included density estimates for pinnipeds in addition to revised estimates for right whales (Roberts et al. 2016b, 2017, 2018, 2021a). Seal density data (as presented in Roberts et al. 2016b, 2017, 2018, 2020, 2021a) were used to estimate pinniped densities for each survey segment; with 50 percent of take accrued to harbor seals and 50 percent accrued to gray seals.

HRG survey activities are not likely result in serious injury or death, even in the absence of proposed mitigation and monitoring measures; proposed mitigation and monitoring measures (as described in Section 11, Mitigation Measures to Protect Marine Mammals and Their Habitat) are expected to reduce the number of marine mammals potentially exposed to noise from HRG surveys; however, mitigation and monitoring measures have not been factored into estimated numbers of takes by harassment and the estimated numbers of takes by harassment are therefore considered conservative.

For this analysis of potential takes, the maximum range to the regulatory thresholds along each radial were combined to create a polygon that forms the impact area or ZOI surrounding the sound source along the daily track line distance for HRG survey activities. The parameters in **Table 38** were used to estimate Level B harassment for marine mammals for the entire HRG survey area utilizing the respective ZOI (daily ensonified area) and duration for each segment of the survey. Density data from Roberts et al. (2016b, 2017, 2018, 2020, 2021a) were mapped within the boundary of the Project Area (**Figure 1**) using geographic information systems. Maximum monthly densities as reported by Roberts et al. (2016b, 2017, 2018, 2020, 2021a) were averaged by season over the survey duration (for winter [December through February]), spring [March through May], summer [June through August], and fall [September through November]) for the entire HRG Project Area. To be conservative, the maximum average seasonal density within the HRG survey schedule, for each species, was then carried forward in the take calculations, **Table 39**.

All noise-producing survey equipment is assumed to be operated concurrently. The ensonified area to the Level B harassment threshold, as well as the anticipated duration of each respective survey segment, was then used to produce the results of take calculations provided in **Table 39**. It should be noted that calculations do not take into account whether a single animal is harassed multiple times or whether each exposure accrues to a different animal. Therefore, the numbers in **Table 39** are the maximum number of animals that may be harassed during the HRG surveys (i.e., the Applicant assumes that each exposure event is a different animal).

For pinnipeds, because the seasonality of and habitat use by gray seals roughly overlaps with harbor seals, the same estimated density estimate has been applied to both gray and harbor seals. Pinniped density data (as presented in Roberts et al. 2016b, 2017, 2018, 2020, 2021a) were used to estimate gray and harbor seal exposure numbers presented in **Table 39**. These data, as presented by Roberts et al. (2016b, 2017, 2018, 2020, 2021a) do not differentiate between pinniped species. Therefore, the calculated takes by Level B harassment calculated for "seals" were accrued 50 percent to harbor seals and 50 percent to gray seals.

As Roberts et al. does not account for group size, the requested pilot whale take was adjusted to account for one group size per year of each of pilot whales (Reeves et al. 2002). Bottlenose dolphin density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020, 2021a) are reported as "bottlenose dolphin" and are not identified to stock. HRG survey activities were not differentiated by region relative to the 20 m isopleth and therefore bottlenose takes are not identified to stock. As Roberts et al. does not account for group size, the requested bottlenose take was adjusted to account for one group size, 15 individual (Reeves et al. 2002) per day of bottlenose dolphins. The requested common dolphin take was adjusted to account for one group size, 30 (Reeves et al. 2002) individuals, per day of common dolphins.

Table 39 Marine Mammal Densities Used in Exposure Estimates and Estimated Takes by Level B Harassment from HRG Surveys

Species	Average Seasonal Density a/ (No./100 km²)	HRG Survey 2024 Calculated Take (No.)	HRG Survey 2025 Calculated Take (No.)	HRG Survey 2026 Calculated Take (No.)	HRG Survey 2027 Calculated Take (No.)	HRG Survey 2028 Calculated Take (No.)	Totals Requested Take (No.)	Stock
North Atlantic Right Whale	0.292	2.13	9.92	7.79	5.19	2.55	28	Western North Atlantic
Humpback Whale	0.073	0.53	2.47	1.94	1.293	0.84	8	Gulf of Maine
Fin Whale	0.165	1.21	5.62	4.41	2.94	2.29	17	Western North Atlantic
Sei Whale	0.011	0.08	0.36	0.28	0.19	0.06	1	Nova Scotia
Sperm Whale	0.022	0.16	0.76	0.60	0.407	0.16	3	North Atlantic
Minke Whale	0.077	0.56	2.60	2.04	1.36	0.61	8	Canadian east coast
Pilot Whale *spp.* b/	0.107	0.78	3.64	2.86	1.91	1.91	125	Western North Atlantic
Bottlenose Dolphin c/	6.596	48.15	224.33	176.17	117.45	48.93	8,730	Western North Atlantic, Offshore and Coastal
Atlantic White-sided Dolphin	1.016	7.42	34.54	27.13	18.09	12.41	100	Western North Atlantic
Short-Beaked Common Dolphin d/	4.944	36.10	168.12	132.03	88.02	43.82	17,460	Western North Atlantic
Atlantic Spotted Dolphin	0.144	1.05	4.88	3.84	2.56	1.29	14	Western North Atlantic
Risso's Dolphin	0.010	0.07	0.33	0.26	0.17	0.09	1	Western North Atlantic
Harbor Porpoise	9.073	66.23	308.536	242.31	161.54	68.48	848	Gulf of Maine/Bay of Fundy

Species	Average Seasonal Density a/ (No./100 km²)	HRG Survey 2024 Calculated Take (No.)	HRG Survey 2025 Calculated Take (No.)	HRG Survey 2026 Calculated Take (No.)	HRG Survey 2027 Calculated Take (No.)	HRG Survey 2028 Calculated Take (No.)	Totals Requested Take (No.)	Stock
Harbor Seal e/	8.200	59.86	278.86	219.00	146.00	70.77	388	Western North Atlantic
Gray Seal e/	8.200	59.86	278.86	219.00	146.00	70.77	388	Western North Atlantic

Notes:
a/ Cetacean density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020, 2021a).
b/ Pilot whale density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020, 2021a) reported as "Kogia spp" an d not species-specific. As the short-finned pilot whale is the smaller stock, take estimates have been assumed to be of this stock to be conservative. As described in Section 4.1.4, both the short-finned and long-finned pilot whale occur in the Mid-Atlantic, though the short-finned pilot whale tends to occur in more southern waters. As Roberts et al. does not account for group size, the estimated take was adjusted to account for one group size per year of each of pilot whales (Reeves et al. 2002)
c/ Bottlenose dolphin density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020, 2021a) reported as “bottlenose dolphin” and not identified to stock. HRG survey activities were not differentiated by region relative to the 20 m isopleth and therefore bottlenose takes are not identified to stock. As Roberts et al. does not account for group size, the estimated take was adjusted to account for one group size, 15 individual (Reeves et al. 2002) per day of bottlenose dolph ins.
c/ As Roberts et al. does not account for group size, the estimated take was adjusted to account for one group size, 30 individuals (Reeves et al. 2002), per day of common dolphins.
e/ Pinniped density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020, 2021a) reported as "seals" and not species-specific, therefore, 50% accrued to harbor seals and 50% accrued to gray seals.

6.4 Total Requested Harassment Take

6.4.1 Summary of Annual Totals of Requested Harassment Take

Table 40 summarizes the total Level B harassment take requested across all construction activities as described in Sections 6.1, 6.2, and 6.3, assuming the 10 dB reduction in source level will be achieved by the selected mitigation for pile driving. Please note that as impact pile driving is the only activity anticipated to result in potential Level A harassment takes, those estimates are only reported in Section 6.1.2.

6.4.2 Summary of Conservatism

Assumptions regarding construction parameters are conservative and additional conservatism is built into the modeling scenarios for both acoustic modeling and exposure estimates, including the potentially most impactful foundation scenario in terms of pile size and penetration depth. In addition, the maximum potential number of difficult-to-drive foundations were accounted for in the exposure estimation. For impact pile driving, the maximum impact for all species (i.e., an assumption that impact driving would occur in highest density months for each species) was carried forward to the exposure estimates. Of the cofferdam and goal post alternatives, the potentially most impactful activity, cofferdams, was carried forward for analysis. Therefore, the requested take numbers are considered conservative. Requested take across the entire LOA period is summarized in **Table 41**.

Table 40 Summary of Annual Estimated Takes Across All Project Activities by Level A and Level B Harassment

Species	2024 Requested Take (No.) Behavior	2024 %	2025 Requested Take (No.) Behavior	2025 Requested Take (No.) Injury	2025 %	2026 Requested Take (No.) Behavior	2026 Requested Take (No.) Injury	2026 %	2027 Requested Take (No.) Behavior	2027 %	2028 Requested Take (No.) Behavior	2028 %	Stock
North Atlantic Right Whale	2	0.54	19	0	5.16	15	0	4.08	5	1.36	3	0.82	Western North Atlantic
Humpback Whale	1	0.07	62	0	4.44	28	0	2.01	1	0.07	1	0.07	Gulf of Maine
Fin Whale	1	0.01	18	2	0.29	10	1	0.16	3	0.04	2	0.03	Western North Atlantic
Sei Whale	0	0.00	0	0	0.00	0	0	0.00	0	0.00	0	0.00	Nova Scotia
Sperm Whale	0	0.00	3	0	0.07	2	0	0.05	0	0.00	0	0.00	North Atlantic
Minke Whale	1	0.00	10	0	0.05	7	0	0.03	1	0.00	1	0.00	Canadian east coast
Pilot Whale *spp.* b/	1	0.00	4	0	0.01	3	0	0.01	2	0.01	2	0.01	Western North Atlantic
Bottlenose Dolphin c/	0	0.00	183	0	0.29	92	0	0.15	0	0.00	49	0.08	Western North Atlantic, Offshore
	735	11.07	0	0	0.00	0	0	0.00	0	0.00	0	0.00	Western North Atlantic, Coastal
	498	7.50	494	0	7.44	176	0	2.65	117	1.76	49	0.74	Western North Atlantic, Offshore and Coastal
Atlantic White-sided Dolphin	7	0.01	215	0	0.23	131	0	0.14	18	0.02	12	0.01	Western North Atlantic
Short-Beaked Common Dolphin	936	0.54	1646	0	0.95	713	0	0.41	88	0.05	44	0.03	Western North Atlantic

	2024		2025			2026			2027		2028		
Species	Requested Take (No.) Behavior	%	Requested Take (No.) Behavior	Requested Take (No.) Injury	%	Requested Take (No.) Behavior	Requested Take (No.) Injury	%	Requested Take (No.) Behavior	%	Requested Take (No.) Behavior	%	Stock
Atlantic Spotted Dolphin	1	0.00	5	0	0.01	4	0	0.01	3	0.01	1	0.00	Western North Atlantic
Risso's Dolphin	0	0.00	1	0	0.00	1	0	0.00	0	0.00	0	0.00	Western North Atlantic
Harbor Porpoise	66	0.07	530	1	0.56	396	1	0.42	162	0.17	68	0.07	Gulf of Maine/Bay of Fundy
Harbor Seal d/	455	0.60	411	0	0.54	289	0	0.38	146	0.19	71	0.09	Western North Atlantic
Gray Seal d/	455	1.68	462	0	1.70	253	0	0.93	146	0.54	71	0.26	Western North Atlantic
Harp Seal e/	4	UNK	4	0	UNK	4	0	UNK	4	UNK	4	UNK	Western North Atlantic

Notes:
a/ Cetacean density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020, 2021a).
b/ Pilot whale density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020, 2021a) reported as "Kogia *spp.*" and not species-specific. As the short-finned pilot whale is the smaller stock, take estimates have been assumed to be of this stock to be conservative. As described in Section 4.1.4, both the short-finned and long-finned pilot whale occur in the Mid-Atlantic, though the short-finned pilot whale tends to occur in more southern waters.
c/ Bottlenose dolphin density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020, 2021a) reported as “bottle nose dolphin” and not identified to stock. Given the noise from cofferdam installation would not extend beyond the 20 m isobath, where the coastal stock predominates, all estimated takes by Level B harassment of bottlenose dolphins from cofferdam installation were attributed to the coastal stock. Takes from impact pile driving were attributed to each stock (coastal and offshore) according to delineation along the 20 m isobath during the animat modeling process. Takes from HRG survey activities were not differentiated, per NOAA Fisheries recommendation.
d/ Pinniped density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020, 2021a) reported as "seals" and not species-specific.
e/ Harp seal occurrence is anticipated to be rare. Anecdotal stranding data indicate only a few harp seals are sighted within the vicinity of the Project each year. Therefore, 4 harp seal Level B takes have been requested per year of the Project.
f/ Since EW 2 cofferdam activities are planned for either 2024 or 2025, the requested take was included in both years in the yearly total.

Table 41 Summary of Potential Takes Across All Project Activities by Level A and Level B Harassment

Species	Requested Take		Stock
	Level B Harassment	Level A Harassment	
North Atlantic Right Whale	44	0	Western North Atlantic
Humpback Whale	93	0	Gulf of Maine
Fin Whale	34	3	Western North Atlantic
Sei Whale	0	0	Nova Scotia
Sperm Whale	5	0	North Atlantic
Minke Whale	20	0	Canadian east coast
Pilot Whale *spp.* b/	12	0	Western North Atlantic
Bottlenose Dolphin c/	324	0	Western North Atlantic, Offshore
	735	0	Western North Atlantic, Coastal
	1,334	0	Western North Atlantic, Offshore and Coastal
Atlantic White-sided Dolphin	383	0	Western North Atlantic
Short-Beaked Common Dolphin	3,427	0	Western North Atlantic
Atlantic Spotted Dolphin	14	0	Western North Atlantic
Risso's Dolphin	2	0	Western North Atlantic
Harbor Porpoise	1,222	2	Gulf of Maine/Bay of Fundy
Harbor Seal d/	1,372	0	Western North Atlantic
Gray Seal d/	1,387	0	Western North Atlantic
Harp Seal e/	20	0	Western North Atlantic

7. ANTICIPATED IMPACT OF THE ACTIVITY

Consideration of negligible impact is required for NOAA Fisheries to authorize the incidental take of marine mammals. In 50 CFR § 216.103, NOAA Fisheries defines negligible impact to be "an impact resulting from a specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stocks [of marine mammals] through effects on annual rates of recruitment or survival." Based upon best available data regarding the marine mammal species (including density, status, and distribution) that are likely to occur in the Project Area, the Applicant concludes that exposure to marine mammal species and stocks during marine site characterization surveys would result in short-term minimal effects and would not affect the overall annual recruitment or survival for the reasons detailed in the following subsections. As such, the Applicant believes the Proposed Activity will have a negligible impact on the species and stocks of marine mammals described above.

7.1 Foundation Installation

Impact pile driving will temporarily increase underwater noise in the Project Area; this increase in noise has the potential to impact marine mammals both behaviorally and physiologically. Underwater noise is an impact concern for marine wildlife, particularly marine mammals. All marine mammals use sound to forage, orient, socially interact with conspecifics, or detect and respond to predators. Sound is important to marine mammals for communication, individual recognition, predator avoidance, prey capture, orientation, navigation, mate selection, and mother-offspring bonding. The sound generated by impact pile installation during the Project would exceed the NOAA Fisheries in-water acoustic thresholds for both Level A and Level B. Therefore, these sound levels would be considered potentially injurious and behaviorally disturbing to marine mammals.

Most marine animals can perceive underwater sounds over a broad range of frequencies, from about 10 Hz to more than 10 kHz (Southall et al. 2019; Southall et al. 2007). Potential effects of anthropogenic noise to marine mammals can include behavioral modification (changes in foraging or habitat-use patterns), and masking (the prevention of marine mammals from hearing important sounds (Nowacek at al. 2007). Behavioral reactions can include avoidance of the sound source, avoidance of feeding habitat, and changes in breathing patterns (Malme et al. 1984; Richardson et al. 1995; Nowacek et al. 2007; Tyack 2009). Recent studies on behavioral responses to anthropogenic noise clearly indicate that animals will show variable responses to noise dependent on species, behavioral contexts, and likely the distance from animals to the sound source (Ellison et al. 2012).

7.2 Cable Landfall and Marina Activities

Vibratory and impact pile driving will also temporarily increase underwater noise in the Project Area. The sound generated by pile installation during the Project would exceed the NOAA Fisheries in-water acoustic thresholds Level B. Therefore, these sound levels would be considered potentially behaviorally disturbing to marine mammals, with potential effects similar to those discussed in Section 7.3. However, modeling indicates that pile driving associated with the cofferdam installation and removal and marina work is unlikely to result in PTS to marine mammals.

7.3 HRG Survey Activities

As detailed in Section 1.2, potential acoustic exposures from survey activities are within the non-injurious behavioral effects zone (Level B harassment). The potential for take as estimated in Section 6.3 represents a highly conservative estimate of harassment based upon typical HRG survey operations utilizing an overly conservative ZOI and without taking into consideration the effects of standard mitigation and monitoring measures. The protective measures as described in Section 11.0 are designed to avoid and/or minimize the potential for interactions with and exposure to marine mammals.

7.4 Summary

Marine mammals are mobile and are expected to quickly leave an area when noise-producing construction activities are initiated. While Project activities may disturb more than one individual, short-term construction activities are not expected to result in population-level effects and individuals would likely return to normal behavioral patterns after pile driving has ceased or after the animal has left the construction area. Acoustical disturbance of marine mammal species would therefore be temporary. Construction activities are not anticipated to have an impact on recruitment or survival of any of the marine mammal stocks discussed in this application. Therefore, based on the best available information and the information provided in this application, Project-related pile installation and removal activities are expected to have a negligible impact on the marine mammal species and stocks that could occur in the vicinity of the Project area during the in-water construction period.

8. ANTICIPATED IMPACTS ON SUBSISTENCE USES

There are no traditional subsistence hunting areas in the Project Area.

9. ANTICIPATED IMPACTS ON HABITAT

9.1 Foundation Installation

Installation of the monopile and piled jacket foundations via impact pile driving will result in the temporary disturbance the seafloor during the duration of construction activities. The actual area of disturbance at any one time is expected to be localized on the basis that foundations will be installed on a sequential basis. There is a large amount of similar quality available alternative suitable habitat in the vicinity of the Project Area indicating that temporary displacement will not necessarily result in a loss of available habitat and prey resource. Since marine mammals are mobile, they can move away from the temporary construction sites and return when construction is complete. Thus, no permanent disturbance to or displacement from suitable habitat is anticipated for marine mammal species in the Project Area. Furthermore, the localized disturbance to the seafloor is expected to return to pre-construction conditions within a relatively short time frame.

Impact pile driving may also temporarily disturb local prey species due to short-term disturbance of benthic habitat and increased water turbidity, as well as from underwater sound; this may therefore indirectly impact the ability for marine mammals to forage in these specific areas. Marine mammals feed throughout the water column from seafloor to surface, though preferences vary by species and prey availability. Project construction activities have the potential to impact species that feed primarily on invertebrates in the benthic (seafloor) habitat. Additionally, species that feed subsurface by grouping fish and then conducting surface lunges are likely to be impacted by prey species being impacted from pile driving activities. The marine mammals foraging in the Project Area primarily target copepods, small schooling fish such as capelin, mackerel, or herring; mesopelagic (intermediate depths below the surface) migrators such as squid; or benthic species including crustaceans, cephalopods, and all species of flounders. Primary production and availability of food resources for marine mammals is not expected to be impacted as a result of Project-related construction and installation activities. Underwater portions of foundations are expected to be newly colonized by encrusting and attaching organisms, creating an array of biogenic reefs in the Lease Area, which in turn will attract prey species for marine mammals. Therefore, it is possible that the foundations will provide a beneficial impact for marine mammals.

Copepods, right whale's preferred prey, are planktonic organisms that remain in the water column and are not likely to be impacted by impact pile driving activities. Localized Project related construction activities should only temporarily displace prey species. There is also alternative suitable habitat available for prey species both within the Project Area, in portions already constructed and recovered or yet to be disturbed, or outside of the Project Area and within New York Bight where marine mammals would likely find prey. The seafloor is expected to return to pre-construction conditions within a short time frame, meaning impacts to prey species will be temporary and localized

Any potential impacts on marine mammal habitat from these activities will be negligible.

9.2 Cable Landfall and Marina Activities

Benthic and pelagic habitat within the Project Area will be temporarily disturbed by pile driving used to install and remove cofferdam and complete the marina work. However, this pile driving will represent a localized area of disturbance in any given time period. Marine mammals that may be collocated with construction-related habitat disturbances are not expected to be impacted from loss of habitat. Marine habitats are expected to return to pre-construction conditions following localized disturbances within a relatively short timeframe. Additionally, due to local habitat uniformity, ample suitable habitat is available in the vicinity of the Project Area. Temporarily displaced marine mammals will still have access to similar-quality habitat in adjacent areas and are expected to return to the Project Area upon the completion of construction. No permanent habitat disturbance or long-term marine mammal displacement is anticipated in the Project Area.

Pile driving activities will temporarily impact prey species by increasing turbidity in the water column, disturbing benthic habitat, and generating underwater sound. Such impact-producing factors may provoke mobile prey species to leave the area of activity and/or cause injury or mortality in less mobile species. This may indirectly inhibit marine mammal foraging activities within the Project Area. However, just as marine mammals will have access to suitable habitat in the vicinity of the Project Area, their mobile prey base will have access to ample similar-quality habitat nearby. Mobile forage species will only be displaced temporarily by Project-related construction, as benthic and pelagic habitats are expected to return to pre-construction conditions within a short timeframe.

Any potential impacts on marine mammal habitat from these activities will be negligible.

9.3 HRG Survey Activities

Bottom disturbance associated with the HRG activities may include grab sampling to validate the seabed classification obtained from the multibeam echosounder/sidescan sonar data. This will typically be accomplished using a Mini-Harmon Grab with 0.1 m^2 sample area or the slightly larger Harmon Grab with a 0.2 m^2 sample area. The temporary and localized impact of the ZOI in relation to the comparatively vast area of surrounding open ocean would render any potential impacts to prey availability or potential avoidance by marine mammals insignificant and not likely to affect marine mammal species. The HRG survey equipment will not contact the seafloor and would not be a source of air or water pollution. Impact to prey species is expected to be limited to avoidance of the area around the HRG survey activities and short-term changes in behavior. Such impacts are not expected to result in population-level effects on prey species (BOEM 2016). Individuals disturbed by a survey would likely return to normal behavioral patterns after the survey has ceased or after the animal has left the Project Area.

Any potential impacts on marine mammal habitat from these activities will be negligible.

10. ANTICIPATED EFFECTS OF HABITAT IMPACTS ON MARINE MAMMALS

10.1 Foundation Installation

Impacts from loss of habitat from the pile and offshore substation installation will also be negligible and will only be associated with the physical footprint of the foundations and scour protection. Because of the small footprint of the foundations and scour protection relative to available habitat, the effects to marine mammals from loss or modification of habitat will be insignificant or de minimus.

10.2 Cable Landfall and Marina Activities

Impacts from loss of habitat from the cofferdam installation and removal and marina work will also be temporary and negligible and will only be associated with the physical footprint of the cofferdam. Because of the small footprint of the area impacted relative to available habitat, it is reasonable to conclude that effects to marine mammals from loss or modification of habitat will be insignificant or de minimus.

10.3 HRG Survey Activities

As stated in Section 9.0, the effects to marine mammals from loss or modification of habitat from the proposed survey activities will be negligible, insignificant, and discountable.

11. MITIGATION MEASURES TO PROTECT MARINE MAMMALS AND THEIR HABITAT

11.1 Vessel Strike Avoidance Procedures

The Applicant will ensure that vessel operators and crew maintain a vigilant watch for cetaceans and pinnipeds by slowing down or stopping their vessels to avoid striking these protected species. Vessel crew members responsible for navigation duties will receive site-specific training on marine mammal sighting/reporting and vessel strike avoidance measures. Vessel strike avoidance measures will include, but are not limited to, the following, except under extraordinary circumstances when complying with these measures would put the safety of the vessel or crew at risk:

a. All vessel operators and crew will maintain vigilant watch for cetaceans and pinnipeds, and slow down or stop their vessel to avoid striking these protected species;
b. All vessel operators will comply with 10 knot (18.5 km/hr) or less speed restrictions in any SMA, DMA or visually triggered Slow Zone;
c. All vessel operators will reduce vessel speed to 10 knots (18.5 km/hr) or less when any large whale, any mother/calf pairs, whale or dolphin pods, or larger assemblages of cetaceans are observed near (within 100 m [330 ft]) an underway vessel;
d. All vessels will maintain a separation distance of 500 m (1640 ft) or greater from any sighted North Atlantic right whale;
e. If underway, vessels must steer a course away from any sighted North Atlantic right whale at 10 knots (18.5 km/hr) or less until the 500 m (1640 ft) minimum separation distance has been established. If a North Atlantic right whale is sighted in a vessel's path, or within 100 m (330 ft) of an underway vessel, the underway vessel must reduce speed and shift the engine to neutral. Engines will not be engaged until the North Atlantic right whale has moved outside of the vessel's path and beyond 100 m. If stationary, the vessel must not engage engines until the North Atlantic right whale has moved beyond 100 m;

f. All vessels will maintain a separation distance of 100 m (330 ft) or greater from any sighted whales. If sighted, the vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the whale has moved outside of the vessel's path and beyond 100 m. If a vessel is stationary, the vessel will not engage engines until the whale has moved out of the vessel's path and beyond 100 m;
g. All vessels will maintain a separation distance of 50 m (164 ft) or greater from any sighted small cetaceans. Any vessel underway remain parallel to a sighted small cetacean's course whenever possible, and avoid excessive speed or abrupt changes in direction. Vessels may not adjust course and speed until the small cetaceans have moved beyond 50 m and/or the abeam of the underway vessel;
h. All vessels underway will not divert or alter course in order to approach any whale, small cetacean, or pinniped. Any vessel underway will avoid excessive speed or abrupt changes in direction to avoid injury to the sighted cetacean or pinniped; and
i. All vessels will maintain a separation distance of 50 m (164 ft) or greater from any sighted pinniped.

Vessels operators will use all available sources of information on North Atlantic right whale presence, including daily monitoring of the Right Whale Sightings Advisory System, WhaleAlert app, and monitoring of Coast Guard VHF Channel 16 to receive notifications of right whale detections to plan vessel routes to minimize the potential for co-occurrence with right whales. As part of vessel strike avoidance, a training program will be implemented. The training program will be provided to NOAA Fisheries for review and approval prior to the start of surveys. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet. Signing the log sheet will certify that the crew members understand and will comply with the necessary requirements throughout the survey event.

11.2 Foundation Installation

11.2.1 Seasonal Pile Driving Restrictions

Impact pile driving of foundations will not occur from January 1 through April 30. In addition, pile driving will not occur from December 1 through December 31, unless unanticipated delays due to weather or technical issues arise that necessitate extending pile driving into December in which case Empire would notify NOAA Fisheries and BOEM in writing by September 1 that circumstances are expected to necessitate pile driving in December.

11.2.2 Pile Driving Weather and Time Restrictions

Impact pile driving will commence only during daylight hours no earlier than one hour after (civil) sunrise. Impact pile driving will not be initiated later than 1.5 hours before (civil) sunset. Pile driving may continue after dark when the installation of the same pile began during daylight (1.5 hours before (civil) sunset), when clearance zones were fully visible for at least 30 minutes and must proceed for human safety or installation feasibility reasons. Impact pile driving will not be initiated in times of low visibility when the visual clearance zones (Section 11.2.5) cannot be visually monitored, as determined by the lead Protected Species Observer (PSO) on duty.

11.2.3 Visual Monitoring

During impact pile driving visual monitoring will occur as follows:

- A minimum of two PSOs must be on active duty at the impact pile driving vessel/platform from 60 minutes before, during, and for 30 minutes after all pile installation activity; and

- A minimum of two PSOs must be on active duty on a dedicated PSO vessel from 60 minutes before, during, and for 30 minutes after all monopile installation activity, or, an alternate monitoring technology (e.g., UAS) that has been demonstrated as having greater visual monitoring capability compared to two PSOs on a dedicated PSO vessel and is approved by NOAA Fisheries, will be employed from 60 minutes before, during, and for 30 minutes after all monopile installation activity. If a dedicated PSO vessel is selected, the vessel must be located at the best vantage point to observe and document marine mammal sightings in proximity to the Clearance/Shutdown zones.

11.2.4 Pre-start Clearance

For impact pile driving, the Applicant will implement a 60-minute pre-start clearance period of the Clearance zones prior to the initiation of soft-start (Section 11.2.7) to ensure no marine mammals are in the vicinity of the pile. During this period the Clearance zones (Section 11.2.5) will be monitored by both PSOs and passive acoustic monitoring (PAM). Pile driving will not be initiated if any marine mammal is observed within its respective Clearance zone (Section 11.2.5). If a marine mammal is observed within a Clearance zone during the pre-start clearance period, impact pile driving may not begin until the animal(s) has been observed exiting its respective zone, or, until an additional time period has elapsed with no further sightings (i.e., 15 minutes for dolphins and pinnipeds and 30 minutes for all other species). In addition, impact pile driving will be delayed upon a confirmed PAM detection of a North Atlantic right whale, if the PAM detection is confirmed to have been located within the 5 km North Atlantic right whale PAM Clearance zone. Any large whale sighted by a PSO within 1,000 m of the pile that cannot be identified to species must be treated as if it were a North Atlantic right whale.

Impact pile driving will not be initiated if the clearance zones cannot be adequately monitored (i.e., if they are obscured by fog, inclement weather, poor lighting conditions) for a 30-minute period prior to the commencement of soft start, as determined by the Lead PSO. If light is insufficient, the lead PSO will call for a delay until the Clearance zone is visible in all directions. If a soft start has been initiated before the onset of inclement weather, pile driving activities may continue through these periods if deemed necessary to ensure human safety and/or the integrity of the Project.

11.2.5 Clearance and Shutdown Zones

Clearance and Shutdown zones will be established and continuously monitored during impact pile driving to minimize impacts to marine mammals (**Table 42**). Empire proposes the following Clearance and Shutdown zones for impact pile driving:

Table 42 Clearance and Shutdown Zones (Impact)

Species	Typical Pile		Difficult-to-drive	
	Clearance zone (m)	Shutdown zone (m)	Clearance zone (m)	Shutdown zone (m)
North Atlantic right whale – PAM	5,000	1,500	5,000	1,500
North Atlantic right whale – visual detection	1,500	1,500	1,500	1,500
All other Mysticetes and sperm whales	1,500	1,500	1,500	1,500
Harbor porpoise	400	400	400	400
Dolphins and pilot whales	200	200	200	200
Seals	200	200	200	200

Proposed clearance and shutdown zones have been developed in consideration of modeled distances to relevant thresholds and are considered very conservative with respect to minimizing the potential for take by Level A harassment. All proposed clearance and shutdown zones for large whales are at least three times larger than the largest modeled exposure range (ER95%) distances to thresholds corresponding to Level A harassment (SEL and peak), with the exception of fin whales for which the proposed clearance and shutdown zones are over 50 percent larger than modeled exposure range (ER95%) distances to thresholds corresponding to Level A harassment (SEL and peak) (**Appendix A**). For dolphins, pilot whales, harbor porpoises and seals, the proposed clearance and shutdown zones are significantly more than the modeled ER95% and L_{pk} distances to thresholds corresponding to Level A harassment (**Appendix A**).

These zones will be monitored as described in Sections 11.2.3 (Visual Monitoring) and mitigation enacted as described in 11.2.8 (Shutdown and Power Down Procedures).

11.2.6 Passive Acoustic Monitoring

PAM will occur during all impact pile driving and will supplement the visual monitoring program. During impact pile driving, PAM will begin 60 minutes prior to the initiation of soft-start, throughout foundation installation, and for 30 minutes after impact pile driving has been completed. PAM will be conducted by a dedicated, qualified, and NOAA Fisheries-approved PAM operator.

The PAM operator will monitor the hydrophone signals in real time both aurally (using headphones) and visually (via the monitor screen displays). The PAM operator will communicate detections of any marine mammals to the Lead PSO on duty who will ensure the implementation of the appropriate mitigation measures (i.e., delay or shutdown of pile driving). PAM detection alone (i.e., in the absence of visual confirmation by a PSO of a marine mammal within a relevant Clearance/Shutdown zone) will not trigger mitigation measures (i.e., delay or shutdown of pile driving), with the exception of a confirmed PAM detection of a North Atlantic right whale within the relevant zone (Section 11.2.5).

The real-time PAM system will be designed and established such that detection capability extends to 5 km from the pile driving location, for all monopile installations. Real-time PAM will begin at least 60 minutes before pile driving begins. The real-time PAM system will be configured to ensure that the PAM operator is able to review acoustic detections within approximately 15 minutes of the original detection, in order to verify whether a right whale has been detected. Any possible right whale vocalization will be reported as a detection if the vocalization is determined by the PAM operator to be within the Clearance/Shutdown zones.

11.2.7 Soft Start

A soft start refers to initiating the pile driving process at reduced hammer energy to provide marine mammals a warning and an opportunity to vacate the area prior to pile driving at full hammer energy. Soft start will occur at the beginning of the driving of each pile and at any time following the cessation of impact pile driving of 30 minutes or longer. The soft start requires an initial 30 minutes using a reduced hammer energy for pile driving.

11.2.8 Shutdown and Power Down

The Clearance and Shutdown zones around the pile driving activities will be maintained, as previously described, by PSOs for the presence of marine mammals before, during, and after impact pile driving activity. If a marine mammal is observed entering or within the respective zones after pile driving has commenced, a shutdown of impact pile driving will occur when practicable as determined by the lead engineer on duty, who must evaluate the following to determine whether shutdown is safe and practicable:

a. Use of site-specific soil data and real-time hammer log information to judge whether a stoppage would risk causing piling refusal at re-start of piling;
b. Confirmation that pile penetration is deep enough to secure pile stability in the interim situation, taking into account weather statistics for the relevant season and the current weather forecast; and
c. Determination by the lead engineer on duty will be made for each pile as the installation progresses and not for the site as a whole.

If a shutdown is called for but the lead engineer determines shutdown is not practicable due to an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk of injury or loss of life for individuals, reduced hammer energy (power down) will be implemented, when the lead engineer determines it is practicable.

Subsequent restart/increased power of the equipment can be initiated if the animal has been observed exiting its respective zone within 30 minutes of the shutdown, or, after an additional time period has elapsed with no further sighting of the animal that triggered the shutdown (i.e., 15 minutes for small odontocetes and 30 minutes for all other species).

If pile driving shuts down for reasons other than mitigation (e.g., mechanical difficulty) for brief periods (i.e., less than 30 minutes), it may be activated again without ramp-up, if PSOs have maintained constant observation and no detections of any marine mammal have occurred within the respective zones.

11.2.9 Attenuation

The Applicant will employ noise mitigation techniques during all impact pile driving that will attenuate pile driving noise by a minimum of 10 dB, such that measured ranges to isopleth distances corresponding to relevant marine mammal harassment thresholds are consistent with those modeled based on 10 dB attenuation, determined via sound field verification (Section 13.3). The Applicant will employ a double bubble curtain or an attenuation technology that achieves noise reduction equivalent to or greater than that achieved by a double bubble curtain. Note that given the rapid advancement in technologies and potential for additional attenuation as technology evolves, the Applicant will review suitable technologies available at the time of installation before selecting a final device.

11.3 Cable Landfall and Marina Activities

11.3.1 Visual Monitoring

A minimum of two PSOs will be on active duty on the vibratory pile driving platform, or on a vessel nearby the construction vessel, from 30 minutes before, during, and 30 minutes after all pile driving.

11.3.2 Pre-start Clearance

For all pile driving, the Applicant will implement a 30-minute clearance period of the Clearance zones (Section 11.3.3) prior to the initiation of installation. During this period the Clearance zones will be monitored by the PSOs, using the appropriate visual technology for a 30-minute period. Installation may not be initiated if any marine mammal is observed within its respective Clearance zone. If a marine mammal is observed within a Clearance zone during the pre-start clearance period, installation may not begin until the animal(s) has been observed exiting its respective zone or until an additional time period has elapsed with no further sightings (i.e., 15 minutes for dolphins and pinnipeds and 30 minutes for all other species). Any large whale sighted by a PSO within 1,000 m of the pile that cannot be identified to species must be treated as if it were a North Atlantic right whale.

11.3.3 Clearance and Shutdown Zones

Clearance and Shutdown zones for vibratory driving would be as follows (**Table 43**):

Table 43 Clearance and Shutdown Zones (Cable Landfall and Marina Activities)

Species	Clearance Zone (m)	Shutdown Zone (m)
North Atlantic right whale, all other Mysticetes and sperm whale	1,600	1,600
Harbor porpoise	100	100
Dolphins and pilot whales	50	50
Seals	50	50

11.3.4 Shutdown and Power Down Procedures

The Clearance and Shutdown zones around pile driving activities will be maintained, as previously described, by PSOs for the presence of marine mammals before, during, and after pile driving activity. An immediate shutdown of the hammer will be required if a marine mammal is sighted within or approaching its respective Shutdown zone. The operator will comply immediately with any call for shutdown by the Lead PSO, except in cases where immediate shutdown would represent a human safety risk. Any disagreement between the Lead PSO and operator will be discussed only after shutdown has occurred. Subsequent restart of the equipment can be initiated if the animal has been observed exiting its respective Shutdown zone within 30 minutes of the shutdown, or, after an additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes and 30 minutes for all other species).

11.4 HRG Survey Activities

Note that mitigation for the HRG surveys will be updated to reflect the current best management practices as agreed to by NOAA Fisheries at the time the surveys are conducted. The measures outlined here are current as per the 2021 programmatic ESA section 7 consultation regarding offshore wind geophysical and geotechnical surveys (BOEM and NOAA Fisheries 2021).

11.4.1 Visual Monitoring

A PSO will be on active duty stationed aboard either the survey vessel or a dedicated PSO vessel when active acoustic sources that operate below 180 kHz and that have been determined by NOAA Fisheries as likely to result in harassment of marine mammals, are operated. The PSO must be on active duty from 30 minutes before, during, and 30 minutes after end of operation of such equipment.

11.4.2 Pre-start Clearance

For all HRG survey activities that operate below 180 kHz that have been determined by NOAA Fisheries as likely to result in harassment of marine mammals, the Applicant will implement a 30-minute clearance period of the Clearance zones (Section 11.4.4) prior to the initiation of ramp-up (Section 11.4.3). During this period the Clearance zones will be monitored by the PSO using the appropriate visual technology for a 30-minute period. Ramp-up may not be initiated if any marine mammal is observed within its respective Clearance zone. If a marine mammal is observed within a Clearance zone during the pre-start clearance period, ramp-up may not begin until the animal(s) has been observed exiting its respective zone or until an additional time period has elapsed with no further sightings (i.e., 15 minutes for dolphins and pinnipeds and 30 minutes for all other species). Any large whale sighted by a PSO within 500 m of the HRG source that cannot be identified to species must be treated as if it were a North Atlantic right whale.

11.4.3 Ramp Up

Where technically feasible, a ramp-up procedure will be used for HRG survey equipment that operates below 180 kHz that has been determined by NOAA Fisheries as likely to result in harassment of marine mammals, and that is capable of adjusting energy levels at the start or re-start of HRG survey activities. A ramp-up procedure will be used at the beginning of HRG survey activities in order to provide additional protection to marine mammals near the survey area by allowing them to vacate the area prior to the commencement of survey equipment use. The ramp-up procedure will not be initiated during periods of inclement conditions if the Clearance zones cannot be adequately monitored by the PSOs using the appropriate visual technology (e.g., reticulated binoculars, night vision equipment) for a 30-minute period. A ramp-up would begin with the power of the smallest acoustic equipment at its lowest practical power output appropriate for the survey. When technically feasible, the power would then be turned up and other acoustic sources added in way such that the source level would increase gradually.

Ramp-up activities will be delayed if a marine mammal(s) enters a relevant Clearance zone (Section 11.4.4). Ramp-up will continue if the animal has been observed exiting the Clearance zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for dolphins and pinnipeds and 30 minutes for all other species).

11.4.4 Clearance and Shutdown Zones

Clearance and Shutdown zones for HRG survey activities with equipment that operates below 180 kHz that has been determined by NOAA Fisheries as likely to result in harassment of marine mammals will be determined based on best management practices as agreed to by NOAA Fisheries at the time the surveys are conducted. Proposed Clearance and Shutdown zones are shown in **Table 44**.

Table 44 Clearance and Shutdown Zones (HRG Surveys)

Species	Clearance Zone (m)	Shutdown Zone (m)
North Atlantic right whale	500	500
All other ESA-listed marine mammals (e.g., fin, sei, sperm whale)	500	100
All other marine mammal species a/	100	100

Note:
a/ With the exception of seals and delphinid(s) from the genera Delphinus, Lagenorhynchus, Stenella or Tursiops, as described below.

11.4.5 Shutdown and Power Down Procedures

The Clearance and Shutdown zones will be maintained, as previously described, by a PSO for the presence of marine mammals before, during, and after HRG survey activities. The following outlines the shutdown procedures:

If a non-delphinid cetacean is sighted within or approaching the established Shutdown zone during operation of HRG equipment operating at or below 180 kHz that has been determined by NOAA Fisheries as likely to result in harassment of marine mammals, an immediate shutdown of that survey equipment is required. The vessel operator must comply immediately with any call for shutdown by the Lead PSO. Any disagreement should be discussed only after shutdown. Subsequent restart of that equipment must use the ramp-up procedures (Section 11.4.3) and may only occur following clearance of the Clearance zones of all non-delphinid cetaceans for at least 30 minutes, and all delphinid cetaceans and pinnipeds for at least 15 minutes.

If a seal or a delphinid(s) from the genera *Delphinus, Lagenorhynchus, Stenella,* or *Tursiops*, is visually detected approaching the survey vessel (e.g., to bow ride) or towed HRG survey equipment, shutdown is not required. If there is uncertainty regarding identification of a marine mammal species (i.e., whether the observed marine mammal(s) belongs to one of the delphinid genera for which shutdown is waived), PSOs must use best professional judgment in making the decision as to whether to call for a shutdown.

Following a shutdown for any reason, startup of the equipment may begin immediately (i.e., without pre-start clearance) only if: (a) the shutdown is less than 30 minutes, (b) visual monitoring of the shutdown zone(s) continued throughout the shutdown, (c) the animal(s) prompting the shutdown was visually followed and confirmed by PSOs to be outside of the shutdown zone(s) and heading away from the vessel, and (d) the shutdown zone(s) remains clear of all marine mammals. If these conditions (a, b, c, and d) are not met, the clearance zones must be monitored for 30 minutes of pre-start clearance observation before HRG equipment (operating <180 kHz) may be turned back on.

If the HRG equipment operating below 180 kHz that has been determined by NOAA Fisheries as likely to result in harassment of marine mammals shuts down for reasons other than encroachment into the relevant Shutdown zones by a non-delphinid cetacean, including but not limited to a mechanical or electronic failure, resulting in the cessation of the source for a period greater than 20 minutes, a restart for the HRG survey equipment is required using the full ramp-up procedures and clearance of the Clearance zones of all cetaceans and pinnipeds for 30 minutes. If the pause is less than less than 20 minutes, the equipment may be restarted as soon as practicable at its operational level as long as visual surveys were continued diligently throughout the silent period and the Clearance zones remained clear of cetaceans and pinnipeds. If the visual surveys were not continued diligently during the pause of 20 minutes or less, a restart for the HRG survey equipment is required using the full ramp-up procedures and clearance of the Clearance zones for all cetaceans and pinniped for 30 minutes.

12. MITIGATION MEASURES TO PROTECT SUBSISTENCE USES

Potential impacts to species or stocks of marine mammals will be limited to individuals of marine mammal species located in the northeast region of the United States, and will not affect Arctic marine mammals. Given that the Project is not located in Arctic waters, the activities associated with the Applicant's proposed activities will not have an adverse effect on the availability of marine mammals for subsistence uses allowable under the MMPA.

13. MONITORING AND REPORTING

13.1 Visual Monitoring Program

Visual monitoring of the established Clearance and Shutdown zones will be performed by qualified and NOAA Fisheries-approved PSOs.

Observer qualifications will include direct field experience on a marine mammal observation vessel and/or aerial surveys in the Atlantic Ocean/Gulf of Mexico. As described above, observer teams will be constituted as follows:

- Impact Pile Driving:
    - A minimum of two PSOs must be on active duty at the impact pile driving vessel/platform from 60 minutes before, during, and for 30 minutes after all pile installation activity.

  - A minimum of two PSOs must be on active duty on a dedicated PSO vessel from 60 minutes before, during, and for 30 minutes after all monopile installation activity (unless an alternative monitoring technology (e.g., UAS) that has been demonstrated as having greater visual monitoring capability relative to a dedicated PSO vessel and is approved by NOAA Fisheries is deployed instead of a PSO vessel). The dedicated PSO vessel, if used, must be located at the best vantage point in order to observe and document marine mammal sightings in proximity to the Clearance/Shutdown zones.

- Vibratory Pile Driving: A minimum of two PSOs must be on active duty on the vibratory pile driving platform, or nearby construction vessel, from 30 minutes before, during, and 30 minutes after all vibratory pile driving.
- HRG Survey Activities: A minimum of one PSO on active duty during the day and two PSOs on active duty at night will be stationed aboard either the survey vessel or a dedicated PSO vessel. The PSOs must be on active duty from 30 minutes before, during, and 30 minutes after end of operation of active acoustic sources that operate below 180 kHz.

PSOs will work in shifts such that no one monitor will work more than 4 consecutive hours without a 2-hour break or longer than 12 hours during any 24-hour period. Each PSO will monitor 360 degrees of the field of vision. The Applicant will provide resumes of all proposed PSOs and PAM operators (including alternates) for review and approval by NOAA Fisheries at least 45 days prior to the start of survey operations.

It will be the responsibility of the Lead PSO on duty to communicate the presence of marine mammals as well as to communicate and enforce the action(s) that are necessary to ensure mitigation and monitoring requirements are implemented as appropriate. As applicable, PAM operators will communicate detected vocalizations to the Lead PSO on duty, who will then be responsible for implementing the necessary mitigation procedures.

PSOs will be equipped with binoculars and have the ability to estimate distances to marine mammals located in proximity to the pile / HRG equipment (depending on activity) using range finders. Reticulated binoculars will also be available to PSOs for use as appropriate based on conditions and visibility to support the sighting and monitoring of marine species. Digital single-lens reflex camera equipment will be used to record sightings and verify species identification. During night operations and as required during the daytime, night-vision equipment, and infrared technology will be used. Specifications for the night-vision, and infrared equipment will be provided to NOAA Fisheries for review and acceptance prior to the start of surveys. Position data will be recorded using hand-held or vessel global positioning system (GPS) units for each sighting.

Observations will take place from the highest available vantage point on the pile driving platform, dedicated PSO vessel, or HRG survey vessel (depending on activity). General 360-degree scanning will occur during the monitoring periods, and target scanning by the PSO will occur when alerted of a marine mammal presence.

Data on all PAM/PSO observations will be recorded based on standard PSO collection requirements. This will include dates and locations of construction operations; time of observation, location and weather; details of the sightings (e.g., species, age classification [if known], numbers, behavior); and details of any observed "taking" (behavioral disturbances or injury/mortality). The data sheet will be provided to NOAA Fisheries for review and approval prior to the start of activities. In addition, prior to initiation of pile driving or survey work (depending on activity), all crew members will undergo environmental training, a component of which will focus on the procedures for sighting and protection of marine mammals. A briefing will also be conducted between the marine operations or survey supervisors (depending on activity) and crews, the PSOs, and the

Applicant. The purpose of the briefing will be to establish responsibilities of each party, define the chains of command, discuss communication procedures, provide an overview of monitoring purposes, and review operational procedures.

In addition, for all construction activities and survey operations, members of the monitoring team will consult NOAA Fisheries North Atlantic right whale reporting systems between watch shifts for the presence of North Atlantic right whales throughout operations. Reporting systems will be checked at least once daily.

13.2 Passive Acoustic Monitoring

Given the range of species that could occur in the Project Area, the PAM system used during impact pile driving will consist of an array of hydrophones with both broadband (sampling mid-range frequencies of 2 kHz to 200 kHz) and at least one low-frequency hydrophone (sampling range frequencies of 75 Hz to 30 kHz).

The real-time PAM system will be designed such that detection capability extends to 5 km from the pile driving location, for all monopile installations. Real-time PAM will begin at least 60 minutes prior to pile driving. The PAM operator responsible for determining if acoustic detections originated from a North Atlantic right whale will be trained in identification of mysticete vocalizations. Any possible North Atlantic right whale vocalization will be reported as a detection if the vocalization is determined by the PAM operator to be within the Clearance / Shutdown zones.

A PAM Plan will be submitted to NOAA Fisheries for review and approval at least 90 days prior to the planned start of pile driving. The Plan will describe all proposed PAM equipment, procedures, and protocols, including for real-time PAM implementation.

13.3 Sound Field Verification

Sound field measurements will be conducted during the driving of at least two monopiles and at least one jacket pile over the course of construction. The Applicant proposes that sound field measurements will be conducted during pile driving of the first monopile installed over the course of the Project to compare field measurements with modeled isopleth distances. If pile driving occurs across different seasons, sound field measurements will also be conducted during pile driving of a monopile in a season that differs from the season of the first monopile installation for comparison purposes (i.e., if the first monopile is driven in spring and pile driving also occurs in fall, sound field measurements will occur on a pile driven in the fall). In addition, if a foundation location is selected that is anticipated to be difficult-to-drive, sound field measurements will occur on the first difficult-to-drive pile location. If difficult-to-drive foundations are driven across different seasons (i.e., summer and winter), sound field measurements will also be conducted during installation of a difficult-to-drive monopile in a season that differs from the season of the first difficult-to-drive monopile installation for comparison purposes. Empire will provide initial results of the sound field measurements to NOAA Fisheries as soon as they are processed.

Sound field measurements will be conducted at distances of approximately 750 m, 2,500 m, and 5,000 m from the pile being driven, as well as at the extent of the modeled Level B harassment zones to verify the accuracy of those modeled zones. The recordings will be continuous throughout the duration of all impact hammering of each pile monitored. The measurement systems will have a sensitivity appropriate for the expected sound levels from pile driving received at the nominal ranges throughout the installation of the pile. The frequency range of the system will cover the range of at least 20 Hz to 20 kHz. The system will be designed to have omnidirectional sensitivity and will be designed so that the predicted broadband received level of all impact pile-driving strikes exceed the system noise floor by at least 10 dB. The dynamic range of the system will be sufficient such that at each location, pile driving signals are not clipped and are not masked by noise floor.

A Sound Field Verification Plan will be submitted to NOAA Fisheries for review and approval at least 90 days prior to planned start of pile driving. This plan will describe how Empire will ensure that the location selected is representative of the rest of the piles of that type to be installed and how the effectiveness of the sound attenuation methodology will be evaluated based on the results. The applicant will provide the initial results of the field measurements to NOAA Fisheries as soon as they are available.

13.4 Reporting

The Applicant will provide the following reporting as necessary during construction and survey activities:

a. The Applicant will contact NOAA Fisheries within 24 hours of the commencement of pile driving activities and again within 24 hours of the completion of the activity;
b. If a North Atlantic right whale is observed at any time by PSOs or personnel on any project vessels, during any project-related activity or during vessel transit, sighting information will be reported immediately to the NOAA Fisheries North Atlantic Right Whale Sighting Advisory System: (866) 755-6622.
c. If a North Atlantic right whale is detected via PAM, a report of the detection will be submitted to the NOAA Fisheries North Atlantic right whale Passive Acoustic Reporting System.
d. Any observed significant behavioral reactions (e.g., animals departing the area) or injury or mortality to any marine mammals will be reported to NOAA Fisheries within 24 hours of observation.
e. Any observed dead or injured marine mammal will be reported to NOAA Fisheries Northeast Region Stranding Hotline (800-900-3622) within 24 hours of the sighting, regardless of whether the injury is caused by a project-related vessel. In addition, if the injury or death was caused by a collision with a project-related vessel, the Applicant will ensure that NOAA Fisheries is notified of the strike immediately. If the Applicant is responsible or the injury or death, the vessel will assist with any salvage effort as requested by NOAA Fisheries.
f. Within 90 days after completion of the pile driving activities (vibratory and impact) for that year, a technical report will be provided to NOAA Fisheries that fully documents the methods and monitoring protocols, summarizes the data recorded during monitoring, estimates the number of listed marine mammals and sea turtles that may have been taken during pile driving activities, and provides an interpretation of the results and effectiveness of all monitoring tasks.

All PSO and PAM operators will use a standardized data entry format for reporting. Final reports will follow a standardized format for PSO reporting regarding activities requiring marine mammal mitigation and monitoring. An annual report will be provided to NOAA Fisheries and to BOEM summarizing the prior year's activities.

14. SUGGESTED MEANS OF COORDINATION

All marine mammal data collected by the Applicant during proposed marine activities will be provided to NOAA Fisheries, BOEM, and other interested government agencies, and be made available upon request to educational institutions and environmental groups. These organizations could use the data collected during this period to study ways to reduce incidental taking and evaluate its effects.

All hydroacoustic data and resulting transmission loss rates collected by the Applicant will be provided to NOAA Fisheries, BOEM, and other interested government agencies, and be made available upon request to educational institutions and environmental groups. These organizations could use the data collected during this period to study ways to reduce incidental taking from survey activities and evaluate its effects.

15. REFERENCES

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Appendix A: Empire Wind Acoustic and Exposure Modeling

Empire Wind Acoustic and Exposure Modeling

JASCO Applied Sciences (USA) Inc.

17 March 2023

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Executive Summary

Empire Offshore Wind LLC (Empire Wind) has submitted a Construction and Operations Plan to support the construction, operation, and decommissioning of the Empire Offshore Wind Farm (the Project). The Project is being proposed within the Bureau of Ocean Energy Management Renewable Energy Lease Area OCS-A 0512, an area covering approximately 32,112 hectares (ha; 79,350 acres [ac]). The Project will generate approximately 2,000 MW of offshore wind renewable energy and include two onshore locations in New York where the renewable electricity generated will be transmitted to the electric grid. The Empire Wind Offshore Wind Farm will consist of up to 147 wind turbine generators, up to 2 offshore substations, array and substation interconnection cables, and up to two export cables.

The wind turbine generators (WTGs) will be supported by tapered monopile foundations, and the Offshore Substations (OSS) will be supported by piled jacket foundations. Hammering of a 9.6-meter (m) diameter monopile and 2.5 m diameter pin pile were selected for quantitative analysis as this installation likely represents the primary underwater noise generated during Project installation considered within the Project Design Envelope (PDE).

Sound generated during pile driving was modeled by characterizing the sound produced at the pile and then calculating how the sound propagates within the surrounding water column. For impact pile driving sounds, time-domain representations of the acoustic pressure waves generated in the water are required to calculate the metrics – sound pressure level (SPL), sound exposure level (SEL), and zero-to-peak pressure (PK) – used to evaluate potential impacts. The goal of the study was to determine monitoring distances (exposure and acoustic ranges) for mitigation purposes. JASCO's animal movement modeling software, JASMINE, was used to integrate the computed sound fields with species-typical movement (e.g., dive patterns) to estimate received sound levels for the modeled marine mammals and sea turtles that may occur near the construction area.

The potential acoustic exposure for marine species was estimated by finding the accumulated sound energy (SEL) and maximum SPL and PK pressure level that each animat received over the course of the simulation. Exposure criteria are based on relevant regulatory-defined marine mammal injurious and behavioral thresholds (NMFS 2018(Stadler and Woodbury 2009, GARFO 2020a), available relevant scientific understanding for marine mammal behavioral thresholds (Wood et al. 2012), and the best available science for fish and sea turtles (Popper et al. 2014). The projected number of animals exposed to sound levels above threshold values was determined by scaling the number of animats exposed to a criterion in the model to reflect local populations using density estimates from the 2022 Duke University Habitat-based Marine Mammal Density Models (Roberts et al. 2016, 2022) for the US Atlantic for each species.

Using the time history of the received levels, exposure ranges accounting for 95% of exposures above regulatory-defined injury and behavioral disruption thresholds (NMFS 2018, McCauley et al. 2000, Finneran et al. 2017) were calculated. Fish were considered static receivers, so the acoustic distance to their regulatory thresholds (FHWG Andersson et al. 2007, Wysocki et al. 2007, 2008, Stadler and Woodbury 2009, Mueller-Blenkle et al. 2010, Purser and Radford 2011) were calculated. Exposure ranges (marine mammals) and acoustic ranges (fish) are reported for various levels (0, 6, 10, and 15 dB) of broadband attenuation that could be expected from the use of mitigation systems such as a bubble curtain.

Acronyms and Abbreviations

BOEM	Bureau of Ocean Energy Management
CalTrans	California Department of Transportation
dB	decibels
DP	Dynamic Positioning
EEZ	Exclusive Economic Zone
$ER_{95\%}$	95% exposure ranges
ESA	Endangered Species Act
ft	feet
FWRAM	Full Wave Range Dependent Acoustic Model
GARFO	Greater Atlantic Regional Fisheries Office
h	hour
HF	high frequency (cetacean hearing group)
HSD	Hydro Sound Damper
Hz	Hertz
IAC	Inter-Array Cables
in	inch
JASMINE	JASCO Animal Simulation Model Including Noise Exposure
kHz	kilohertz
kJ	kilojoule
km	kilometer
SEL	sound exposure level
LF	low frequency (cetacean hearing group)
SPL	sound pressure level
PK	peak pressure level
m	meter
MF	mid-frequency (cetacean hearing group)
mi	mile
MA WEA	Massachusetts Wind Energy Area
MMPA	Marine Mammal Protection Act
MONM	Marine Operations Noise Model
μPa	micro-Pascal
m/s	meters per second
NARW	North Atlantic right whale
NAS	noise abatement system
NEFSC	Northeast Fisheries Science Center
NOAA	National Oceanic and Atmospheric Administration
nm	nautical mile
NMFS	National Marine Fisheries Service also known as NOAA Fisheries
NMS	Noise Mitigation System
NY	New York

NY OPA	New York Offshore Planning Area
NYSERDA	New York State Energy Research and Development Authority
OCS	Outer Continental Shelf
OSS	Offshore Substation
OPA	offshore planning area
PDE	Project Design Envelope
PDSM	Pile Driving Source Model
PK	zero-to-peak sound pressure
Project	Empire Wind Offshore Wind Farm Project
PTS	permanent threshold shift
PA	phocid pinniped in air (hearing group)
PW	phocid pinniped in water (hearing group)
RI/MA WEA	Rhode Island/Massachusetts Wind Energy Area
SEFSC	Southeast Fisheries Science Center
SEL	sound exposure level
SEL_{cum}	cumulative sound exposure level
SPL	sound pressure level
rms	root mean square
TTS	temporary threshold shift
WEA	Wind Energy Area
WTG	wind turbine generator

1. Introduction

1.1. Project Background and Overview of Assessed Activity

Empire Offshore Wind LLC (Empire Wind), a 50/50 joint venture between Equinor and BP, proposes to construct, own, and operate the Empire Offshore Wind Farm (the Project). The wind farm portion of the Project will be located on the Outer Continental Shelf (OCS) in the designated Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS-A 0512 (Lease Area). The wind turbine generators (WTGs) and offshore substations, array cables, and substation interconnector cables will be located in Federal waters approximately located 22 kilometers (km) south of Long Island, New York. The location of the WTGs, Offshore Substations (OSS), Inter-Array Cables (IAC) and Export Cables (ECs) are collectively referred to as the Empire Offshore Wind Farm or the Project.

Underwater noise may be generated by several activities associated with the Project. Impacts of noise on marine fauna for most of these anthropogenic sound sources is expected to be low or very low. Only pile driving for the installation of WTGs and OSS foundations could be expected to have greater impacts. A quantitative assessment of pile driving activities is undertaken here as the primary source of noise associated with the Project. A qualitative assessment of secondary sound sources associated with other construction and operational activities that contribute non-impulsive (aircraft, dredging, drilling, dynamic positioning [DP] thrusters) and continuous (vessel propulsion, turbine operation) sound to the environment can be found in Appendix C.

For the quantitative acoustic analysis, the potential underwater acoustic impacts resulting from the installation of tapered monopile foundations and jacket foundations were modeled. A range of potential monopile diameters remains under consideration; a monopile diameter of 9.6 meters (m) was selected for modeling as representative of the most likely scenario based on currently available data. The jacket foundations use 2.5 m diameter pin piles. This underwater noise assessment considers the currently available information; the precise locations, noise sources, and schedule of the construction and operation scenarios is subject to change as the engineering design progresses.

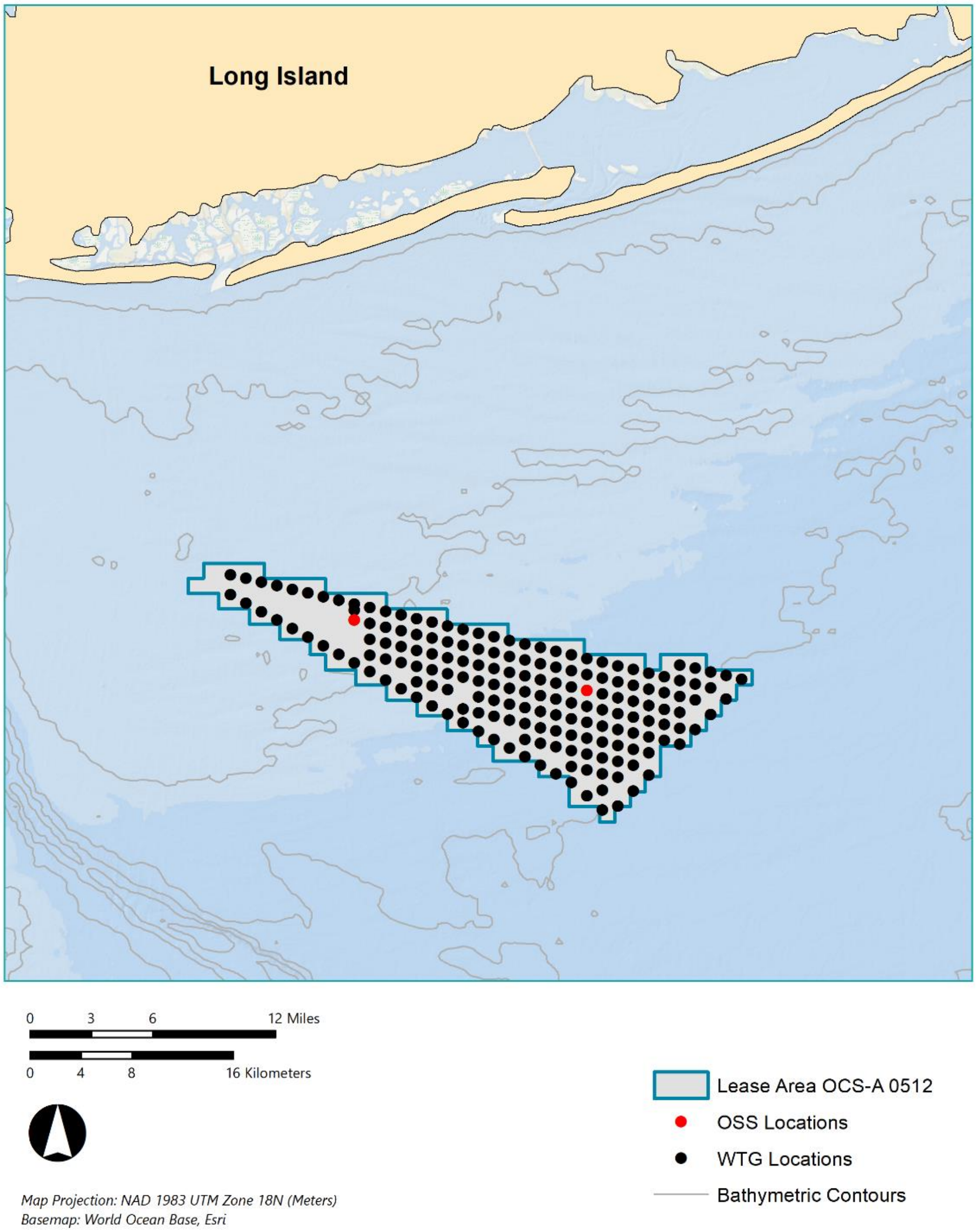

Figure 1. Location of the Empire Offshore Wind Farm in relation to Long Island, New York.

1.2. The Modeling Scope and Assumptions

The objectives of this modeling study were to predict the acoustic ranges to regulatory-defined acoustic thresholds associated with injury and behavioral disturbance for various marine fauna, including fish, marine mammals, and sea turtles that may occur near the Project during pile driving in the construction stage of the Project. JASCO also used the results of animal movement and exposure modeling to estimate potential exposure ranges ($ER_{95\%}$) and exposure numbers for marine mammals and sea turtles.

There are several potential anthropogenic sound sources associated with the Project; however, the primary sound source is impact (impulsive) pile driving during foundation installation in the construction stage.

1.2.1. Foundations

A monopile used as a foundation in a wind farm is a single hollow cylinder fabricated from steel that is installed by driving (hammering) it into the seabed. The monopiles proposed for the Project represent the monopile foundation that will be installed within the Project Design Envelope (PDE) as WTG foundations. Jacket foundations used for OSSs consist of a large lattice structure supported/secured by pin piles. Up to three pin piles are expected to be installed per day. The pin piles to secure the jacket structure for the Project are 2.5 m diameter straight piles.

The amount of sound generated during pile driving varies with the energy required to drive piles to a desired depth and depends on the sediment resistance encountered. Sediment types with greater resistance require hammers that deliver higher energy strikes and/or an increased number of strikes relative to installations in softer sediment. Maximum sound levels usually occur during the last stage of impact pile driving where the greatest resistance is encountered (Betke 2008). The make and model of impact hammer (IHC S-5500 and IHC S-4000) and conservative, though representative, hammering schedules used in the acoustic modeling effort were provided by Empire Wind in coordination with potential hammer suppliers. The hammering schedules, number of strikes at each hammer energy level, needed to drive the monopiles at typical locations and at difficult to drive locations are listed in Tables 1 and 2, respectively, and the hammering schedules needed to drive the jacket foundation pin piles are listed in Tables 6 and 7.

Sound fields from the monopiles were modeled at nine representative locations in the Project: L01, L02, L03, L04, L05, L06, L07, L08, and L09. L01 through L03 were used to model the 9.6 m monopile typical and difficult to drive cases, and L04 through L09 were used to model the 11 m monopile. Sound fields from pin piles were modeled at the two planned jacket foundation locations, OSS1 and OSS2. Modeling locations are shown in Figure 2 and described in Table 8. The modeling locations were selected as they represent the range of water depths in the Project. The monopiles were assumed to be vertical and driven to a maximum expected penetration depth of 38 m (125 ft) for 9.6 m piles and 55 m (180 ft) for 11 m piles. Jacket pin piles were assumed to be vertical and driven to a maximum expected penetration depth of 56 m (184 ft).

Key modeling assumptions for the monopiles and pin piles are listed in Table 9, with additional modeling details and input parameters shown in Appendix B.

Table 1. Typical Monopile Foundations: The hammer energy schedule and number of strikes for 9.6 m monopiles with an IHC S-5500 hammer.

Energy level (kJ)	Strike count	Pile penetration depth (m)
Initial sink depth		2
450	1607	12
800	731	5
1400	690	4
1700	1050	6
2300	1419	9
Total	**5497**	**38**
Strike rate (strikes/min)	30	

Table 2. Difficult to Drive Monopile Foundations: The hammer energy schedule and number of strikes for 9.6 m monopiles with an IHC S-5500 hammer.

Energy level (kJ)	Strike count	Pile penetration depth (m)
Initial sink depth		2
450	1607	12
800	731	5
1400	690	4
1700	1050	6
2300	1087	4
5500	2000	5
Total	**7165**	**38**
Strike rate (strikes/min)	30	

Table 3. Typical Monopile Foundations: The hammer energy schedule and number of strikes for 11 m R3 monopiles with an IHC S-5500 hammer.

Energy level (kJ)	Strike count	Pile penetration depth (m)
Initial sink depth		1
500	1168	14
750	433	3
1100	265	2
2000	2159	15
Total	**4025**	**35**
Strike rate (strikes/min)	30	

Table 4. Typical Monopile Foundations: The hammer energy schedule and number of strikes for 11 m T1 monopiles with an IHC S-5500 hammer.

Energy level (kJ)	Strike count	Pile penetration depth (m)
Initial sink depth		3
500	1339	14
750	857	6
1000	632	4
1500	1109	7
2000	326	2
2500	656	4
Total	**4919**	**40**
Strike rate (strikes/min)	30	

Table 5. Typical Monopile Foundations: The hammer energy schedule and number of strikes for 11 m U3 monopiles with an IHC S-5500 hammer.

Energy level (kJ)	Strike count	Pile penetration depth (m)
Initial sink depth		5
450	622	6
750	2781	20
1000	1913	12
1300	2019	12
Total	**7335**	**55**
Strike rate (strikes/min)	30	

Table 6. Jacket Foundations: The hammer energy schedule and number of strikes for pin piles supporting the jacket foundation located at OSS1, with an IHC S-4000 hammer.

Energy level (kJ)	Strike count	Pile penetration depth (m)
Initial sink depth		8
500	1799	30
750	1469	12
2000	577	4
3200	495	2
Total	**4340**	**56**
Strike rate (strikes/min)	30	

Table 7. Jacket Foundations: The hammer energy schedule and number of strikes for pin piles supporting the jacket foundation located at OSS2, with an IHC S-4000 hammer.

Energy level (kJ)	Strike count	Pile penetration depth (m)
Initial sink depth		5
500	1206	22
750	1153	9
1100	790	7
3200	562	4
Total	**3711**	**47**
Strike rate (strikes/min)	30	

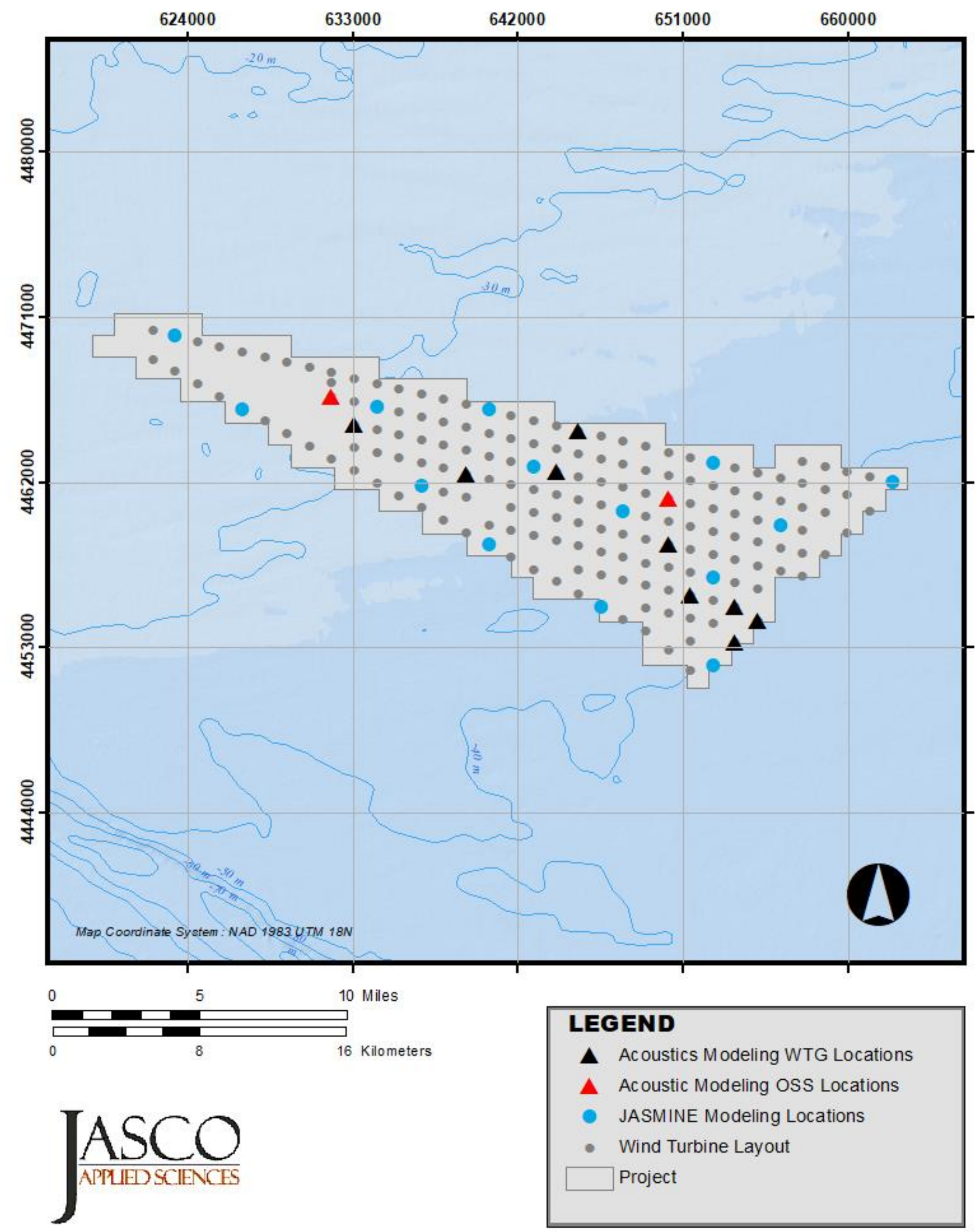

Figure 2. Empire Offshore Wind Farm monopile and jacket foundation locations with acoustic propagation and animal movement modeling locations.

Table 8. Acoustic modeling locations for the monopile and jacket foundations.

Modeled site	Foundation type	Latitude (°)	Longitude (°)	Northing (m)	Easting (m)
L01	Monopile[a]	40.3263	-73.4332	633103.9	4465149.8
L02	Monopile[a]	40.2645	-73.2337	650194.3	4458617.3
L03	Monopile[a]	40.2262	-73.1773	655077.3	4454450.0
R3-L04	Monopile	40.3010	-73.3620	639207.6	4462458.4
T1-L05	Monopile	40.3209	-73.2897	645311.3	4464783.6
U3-L06	Monopile	40.3012	-73.3045	644090.6	4462562.8
R3-L07	Monopile	40.2392	-73.2200	651415.0	4455821.6
T1-L08	Monopile	40.2155	-73.1919	653856.5	4453240.0
U3-L09	Monopile	40.2335	-73.1914	653856.5	4455246.7
OSS1	Jacket	40.3404	-73.4473	631883.2	4466691.3
OSS2	Jacket	40.2871	-73.2331	650194.3	4461125.5

[a] Both typical and difficult to drive monopiles were modeled at these locations.

Table 9. Key piling assumptions used in the source modeling.

Foundation type	Modeled maximum impact hammer energy (kJ)	Pile length (m)	Pile diameter (m)	Pile wall thickness (mm)	Seabed penetration (m)	Number of piles per day
Monopile	2300/5500[a]	78.5	9.6	73–101	38	1–2
Monopile R3	2000	75.3	11	8.5	35	1-2
Monopile T1	2500	84.1	11	8.5	40	1-2
Monopile U3	1300	97.5	11	8.5	55	1-2
Jacket	3200	57–66	2.5	50	47–56	2–3

[a] Typical 2300, difficult to drive 5500.

1.2.2. Modeling Scenario and Pile Construction Schedule

Construction schedules are difficult to predict because of factors like weather and installation variation related to drivability. Because it is hard to anticipate the installation schedule, a conservative approach was used to generate potential installation schedules for animal exposure calculation. The conservative approach is based on the assumption that a maximum of 24 monopiles could be installed per month, with a maximum of 96 monopiles per year, and that the maximum monthly number would be installed in the four highest density months for each species during the May to December period. Thus, each species was presumed to be exposed to the maximum amount of pile driving based on their monthly densities. Table 10 shows the maximum number of piles of each type that could be installed in each of the four highest density months for each species in each of the two construction years.

Table 10. Maximum number of piles to be driven per month for each foundation type in each of the four highest density months for each species during the May to December period.

Foundation type	Year 1				Year 2			
	Monthly Density				Monthly Density			
	Highest	Second	Third	Fourth	Highest	Second	Third	Fourth
WTG monopile - typical	19	20	20	20	24	24	3	0
WTG monopile - difficult	5	4	4	4	0	0	0	0
OSS1 pin pile	12	0	0	0	0	0	0	0
OSS2 pin pile	12	0	0	0	0	0	0	0
Total # of piles	**48**	**24**	**24**	**24**	**24**	**24**	**3**	**0**

It was assumed that 96 monopiles and 24 pin piles (12 for each of the two OSS jacket foundations) would be installed in the first year and the remaining 51 monopiles would be installed in the second year. In the first year, it was assumed that 17 of the 96 monopiles would be installed at locations where the seabed analysis suggested that the piles would be difficult to drive. Monopiles would be installed at five of these difficult to drive locations during the highest density month and at four of these difficult to drive locations during each of the second to fourth highest density months for each species. It was assumed that all 24 pin piles would be installed during the first year in the highest density month unless doing so would exceed 30 days (the number of days in the shortest month) of piling, including the 24 monopiles, in which case the remainder of the jacket pin piles would be installed during the second highest density month. Lastly, it was assumed that no difficult to drive piles or jacket pin piles would be installed during the second year of the buildout.

To estimate exposures, it is necessary to predict not only the number of piles per day but also the number of days of piling. To do this, the modeling included installation at a rate of either one or two monopiles per day and either two or three jacket pin piles per day. The four possible combinations of these piling rates were all modeled (Construction Schedules 1–4) so that the combination that produced the greatest number of predicted exposures could be carried forward as a conservative approach to estimating impacts. Tables 11 to 14 show the number of days of piling under the four different modeled schedules.

Table 11. Construction schedule 1 (1 monopile per day/2 pin piles per day): Total days of piling per month for each foundation type in each of the four highest density months during May to December for each species, used to estimate the number of marine mammal and sea turtle acoustic exposures for Empire Wind.

Foundation type	Year 1				Year 2			
	Monthly Density				Monthly Density			
	Highest	Second	Third	Fourth	Highest	Second	Third	Fourth
Monopile – typical – 1 per day	19	20	20	20	24	24	3	0
Monopile – difficult – 1 per day	5	4	4	4	0	0	0	0
Pin pile – OSS1 – 2 per day	0	6	0	0	0	0	0	0
Pin pile – OSS2 – 2 per day	6	0	0	0	0	0	0	0
Total # of days	**30**	**30**	**24**	**24**	**24**	**24**	**3**	**0**

Table 12. Construction schedule 2 (1 monopile per day/3 pin piles per day): Total days of piling per month for each foundation type in each of the four highest density months during May to December for each species, used to estimate the number of marine mammal and sea turtle acoustic exposures for Empire Wind.

Foundation type	Year 1				Year 2			
	Monthly Density				Monthly Density			
	Highest	Second	Third	Fourth	Highest	Second	Third	Fourth
Monopile – typical – 1 per day	19	20	20	20	24	24	3	0
Monopile – difficult – 1 per day	5	4	4	4	0	0	0	0
Pin pile – OSS1 – 3 per day	2	2	0	0	0	0	0	0
Pin pile – OSS2 – 3 per day	4	0	0	0	0	0	0	0
Total # of days	**30**	**26**	**24**	**24**	**24**	**24**	**3**	**0**

Table 13. Construction schedule 3 (2 monopiles per day/2 pin piles per day): Total days of piling per month for each foundation type in each of the four highest density months during May to December for each species, used to estimate the number of marine mammal and sea turtle acoustic exposures for Empire Wind.

Foundation type	Year 1				Year 2			
	Monthly Density				Monthly Density			
	Highest	Second	Third	Fourth	Highest	Second	Third	Fourth
Monopile – typical – 2 per day	9	10	10	10	12	12	1	0
Monopile – typical – 1 per day	1	0	0	0	0	0	1	0
Monopile – difficult – 2 per day	2	2	2	2	0	0	0	0
Monopile – difficult – 1 per day	1	0	0	0	0	0	0	0
Pin pile – OSS1 – 2 per day	6	0	0	0	0	0	0	0
Pin pile – OSS2 – 2 per day	6	0	0	0	0	0	0	0
Total # of days	**25**	**12**	**12**	**12**	**13**	**12**	**1**	**0**

Table 14. Construction schedule 4 (2 monopiles per day/3 pin piles per day): Total days of piling per month for each foundation type in each of the four highest density months during May to December for each species, used to estimate the number of marine mammal and sea turtle acoustic exposures for Empire Wind.

Foundation type	Year 1				Year 2			
	Monthly Density				Monthly Density			
	Highest	Second	Third	Fourth	Highest	Second	Third	Fourth
Monopile – typical – 2 per day	9	10	10	10	12	12	1	0
Monopile – typical – 1 per day	1	0	0	0	0	0	1	0
Monopile – difficult – 2 per day	2	2	2	2	0	0	0	0
Monopile – difficult – 1 per day	1	0	0	0	0	0	0	0
Pin pile – OSS1 – 3 per day	4	0	0	0	0	0	0	0
Pin pile – OSS2 – 3 per day	4	0	0	0	0	0	0	0
Total # of days	**21**	**12**	**12**	**12**	**13**	**12**	**1**	**0**

2. Methods

The basic modeling approach is to characterize the sound produced by the source, determine how the sounds propagate within the surrounding water column, and then estimate species-specific exposure probability by combing the computed sound fields with animal movement in simulated representative scenarios.

For impact pile driving sounds, time-domain representations of the acoustic pressure waves generated in the water are required for calculating SPL, SEL, and PK. The source signatures associated with installation of each of the modeled monopile and pin pile locations are predicted using a finite-difference model that determines the physical vibration of the pile caused by pile driving equipment. The sound field radiating from the pile is simulated as a vertical array of point sources.

For this study, synthetic pressure waveforms were computed using a Full Waveform Range-dependent Acoustic Model (FWRAM), which is JASCO's acoustic propagation model capable of producing time-domain waveforms (Appendix G.2). The sound propagation modeling incorporated site-specific environmental data including bathymetry, sound speed in the water column, and seabed geoacoustics in the proposed construction area (Appendix G.1). Animal movement modeling integrated the estimated sound fields with species-typical behavioral parameters (e.g., dive patterns) in JASMINE to estimate received sound levels for the modeled animals (animats) that may occur in the construction area. Animats that exceed pre-defined acoustic thresholds/criteria (e.g., NMFS 2018) are identified and the distance for the exceedances determined. The analysis to estimate the number of potential injurious and behavioral exposures is ongoing and will be provided in supplemental filings and permit applications.

2.1. Acoustic Environment

Empire Wind is located in a continental shelf environment characterized by predominantly fine to coarse grained sandy seabed sediments, with some clay content. Water depths in the Empire Wind vary between approximately 24–41 m. From June to September, the average temperature of the upper (10–15 m) water column is higher, which can lead to a surface layer of increased sound speeds (Appendix G.1.3). This creates a downward refracting environment in which propagating sound interacts with the seafloor more than in a well-mixed environment. Increased wind mixing combined with a decrease in solar energy during winter, from December through March, results in a sound speed profile that is more uniform with depth. An average summer and winter sound speed profiles were used in the Project acoustic propagation modeling. See Appendix G for more details on the environmental parameters used in acoustic propagation and exposure modeling.

2.2. Modeling Acoustic Sources

2.2.1. Impact Pile Driving

Piles deform when driven with impact hammers, creating a bulge that travels down the pile and radiates sound into the surrounding air, water, and seabed. This sound may be received as a direct transmission from the sound source to biological receivers (such as marine mammals, sea turtles, and fish) through the water or as the result of reflected paths from the surface or re-radiated into the water from the seabed (Figure 3). Sound transmission depends on many environmental parameters, such as the sound speeds in water and substrates. It also depends on the sound production parameters of the pile and how it is driven, including the pile material, size (length, diameter, and thickness) and the make and energy of the hammer.

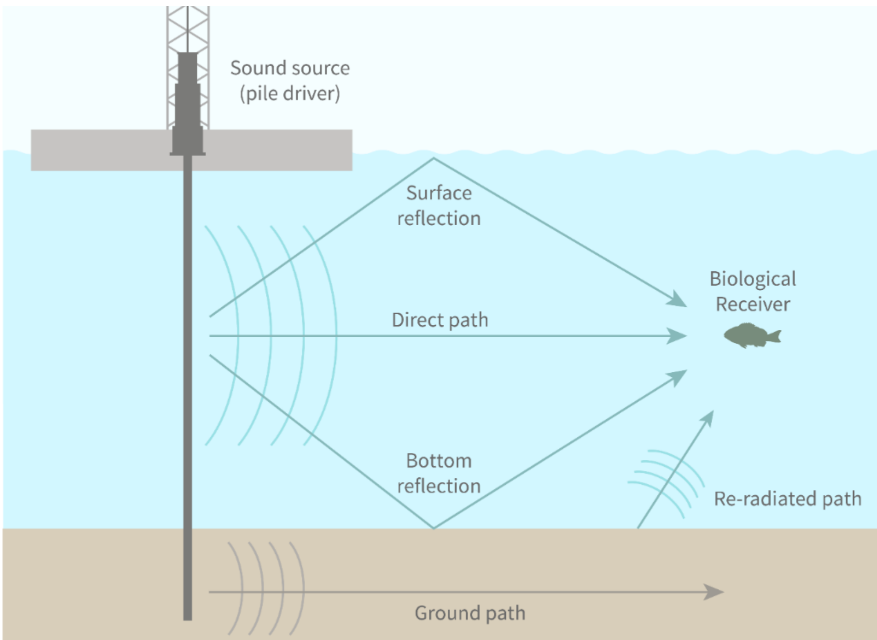

Figure 3. Sound propagation paths associated with pile driving (adapted from Buehler et al. 2015).

JASCO's physical model of pile vibration and near-field sound radiation (MacGillivray 2014) was used in conjunction with the GRLWEAP 2010 wave equation model (GRLWEAP, Pile Dynamics 2010) to predict source levels associated with impact pile driving activities. Piles are modeled with a vertical installation using a finite-difference structural model of pile vibration based on thin-shell theory. The sound radiating from the pile itself was simulated using a vertical array of discrete point sources. These models account for several parameters that describe the operation—pile type, material, size, and length—the pile driving equipment, and approximate pile penetration depth. See Appendix F for a more detailed description.

Forcing functions were computed for the monopile and jacket foundations, using GRLWEAP 2010 (GRLWEAP, Pile Dynamics 2010). The model assumed direct contact between the representative hammers, helmets, and piles (i.e., no cushion material, which provides a more conservative estimate). The forcing functions serve as the inputs to the pile driving source models (PDSM) used to estimate equivalent acoustic source characteristics detailed in Appendix F.1. Decidecade spectral source levels for each pile type, hammer energy and modeled location, using an average summer sound speed profile are provided in Appendix G.

2.3. Noise Mitigation

Noise abatement systems (NASs) are often used to decrease the sound levels in the water near a source by inserting a local impedance change that acts as a barrier to sound transmission. Attenuation by impedance change can be achieved through a variety of technologies, including bubble curtains, evacuated sleeve systems (e.g., IHC-Noise Mitigation System (NMS)), encapsulated bubble systems (e.g., HydroSound Dampers (HSD)), or Helmholtz resonators (AdBm NMS). The effectiveness of each system is frequency dependent and may be influenced by local environmental conditions such as current and depth. For example, the size of the bubbles determines the effective frequency band of an air bubble curtain, with larger bubbles needed for lower frequencies.

Small bubble curtains (bubble curtains positioned within a small radius around the pile) have been measured to reduce sound levels from ~10 dB to more than 20 dB but are highly dependent on water depth and current and how the curtain is configured and operated (Koschinski and Lüdemann 2013, Bellmann 2014, Austin and Li 2016). Larger bubble curtains tend to perform better and more reliably, particularly when deployed with two rings (Koschinski and Lüdemann 2013, Bellmann 2014, Nehls et al. 2016). A California Department of Transportation (CalTrans) study tested several small, single, bubble-curtain systems and found that the best attenuation systems resulted in 10–15 dB of attenuation. Buehler et al. (2015) concluded that attenuation greater than 10 dB could not be reliably predicted from small, single, bubble curtains because sound transmitted through the seabed and re-radiated into the water column is the dominant source of sound in the water for bubble curtains deployed immediately around (within 32 ft [10 m] of) the pile (Buehler et al. 2015).

A recent analysis by Bellmann et al. (2020) of NASs performance measured during impact driving for wind farm foundation installation provides expected performance for common NASs configurations. Measurements with a single bubble curtain and an air supply of 0.3 m^3/min resulted in 7 to 11 dB of broadband attenuation for optimized systems in up to 131 ft (40 m) water depth. Increased air flow (0.5 m^3/min) may improve the attenuation levels up to 11 to 13 dB (M. Bellmann, personal communication, 2019). Double bubble curtains add another local impedance change and, for optimized systems, can achieve 15 to 16 dB of broadband attenuation (measured in up to 131.25 ft [40 m] water depth). The IHC-NMS can provide 15 to 17 dB of attenuation but is currently limited to piles <8 m diameter. Other NASs such as the AdBm NMS achieved 6 to 8 dB (M. Bellmann, personal communication, 2019), but HSDs were measured at 10 to 12 dB attenuation and are independent of depth (Bellmann et al. 2020). Systems may be deployed in series to achieve higher levels of attenuation.

The NAS must be chosen, tailored, and optimized for site-specific conditions. NAS performance of 10 dB broadband attenuation was chosen for this study as an achievable reduction of sound levels produced during pile driving when one NAS is in use, noting that a 10 dB decrease means the sound energy level is reduced by 90%. For exposure modeling, several levels of attenuation were included for comparison purposes.

2.4. Acoustic Criteria for Marine Fauna

The following acoustic criteria, derived from the current US regulatory acoustic criteria, were used for this study (see further details in Sections 2.4.1 and 2.4.2):

1. Peak pressure levels (PK; L_{pk}) and frequency-weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) were from the US National Oceanic and Atmospheric Administration (NOAA) Technical Guidance (NMFS 2018) for marine mammal injury thresholds.
2. Sound pressure level (SPL; L_{p}) for marine mammal behavioral thresholds were based on the unweighted NOAA (2005) and the frequency-weighted Wood et al. (2012) criteria.
3. Injury thresholds (PK and SEL) were derived from the Fisheries Hydroacoustic Working Group (FHWG 2008) and Stadler and Woodbury (2009) for fish that are equal, greater than, or less than 2 g.
4. Injury thresholds (PK and SEL) were obtained from Popper et al. (2014) for fish without swim bladders, fish with swim bladders not involved in hearing, and fish with swim bladders involved in hearing.
5. Behavioral thresholds for fish were developed by the NOAA Fisheries Greater Atlantic Regional Fisheries Office (GARFO) (Andersson et al. 2007, Wysocki et al. 2007, Mueller-Blenkle et al. 2010, Purser and Radford 2011)
6. Peak pressure levels (PK; L_{pk}) and frequency-weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) from Finneran et al. (2017) were used for the onset of permanent threshold shift (PTS) for sea turtles.
7. Behavioral response thresholds for sea turtles were obtained from McCauley et al. (2000), which was confirmed in Finneran et al. (2017).

2.4.1. Acoustic Criteria–Marine Mammals

The Marine Mammal Protection Act (MMPA) prohibits the take of marine mammals. The term “take” is defined as: to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal. MMPA regulations define harassment in two categories relevant to the Project construction and operations. These are:

- **Level A**: Any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild, and
- **Level B**: Any act of pursuit, torment or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing a disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild (16 U.S.C. 1362).

To assess the potential impacts of the underwater sound in the Project, it is necessary to first establish the acoustic exposure criteria used by United States regulators to estimate marine mammal takes. In 2016, National Oceanographic and Atmospheric Administration (NOAA) Fisheries issued a Technical Guidance document that provides acoustic thresholds for onset of PTS in marine mammal hearing for most sound sources, which was updated in 2018 (NMFS 2016, 2018). The Technical Guidance document also recognizes two main types of sound sources: impulsive and non-impulsive. Non-impulsive sources are further broken down into continuous or intermittent categories.

NMFS also provided guidance on the use of weighting functions when applying Level A harassment criteria. The Guidance recommends the use of a dual criterion for assessing Level A exposures, including a PK (unweighted/flat) sound level metric and a cumulative SEL metric with frequency weighting. Both acoustic criteria and weighting function application are divided into functional hearing groups (low-, mid-, and high-frequency and phocid pinnipeds) that species are assigned to, based on their respective hearing distances. The acoustic analysis applies the most recent sound exposure criteria utilized by NMFS to estimate acoustic harassment (NMFS 2018).

Based on observations of mysticetes (Malme et al. 1983, 1984, Richardson et al. 1986, 1990b), sound levels thought to elicit disruptive behavioral response are described using the SPL metric (NMFS and NOAA 2005). NOAA Fisheries (NMFS) currently uses a behavioral response threshold of SPL 160 dB re 1 µPa for marine mammals exposed to impulsive sounds with the modification that 120 dB re 1 µPa be used for migrating mysticetes (NOAA 2005). The SPL 120 dB re 1 µPa threshold is used for all marine mammals exposed to non-impulsive sounds (NMFS 2018). Alternative thresholds used in acoustic assessments include a graded probability of response approach and take into account the frequency-dependence of animal hearing sensitivity (Wood et al. 2012). The 160 dB threshold is used in this assessment as per NOAA guidance (2019).

The publication of ISO 18405 Underwater Acoustics–Terminology (ISO 2017) provided a dictionary of underwater bioacoustics (the previous standard was ANSI and ASA S1.1-2013). In the remainder of this report, we follow the definitions and conventions of ISO (2017) except where stated otherwise (Table 15).

Table 15. Summary of relevant acoustic terminology used by US regulators and in the modeling report.

Metric	NMFS (2018)	ISO (2017)	
		Main text	Equations/tables
Sound pressure level	n/a	SPL	L_p
Peak pressure level	PK	PK	L_{pk}
Cumulative sound exposure level	SELcum[a]	SEL	L_E

[a] The SEL_{cum} metric used by NOAA Fisheries (NMFS) describes the sound energy received by a receptor over a period of 24 h. Accordingly, following the ISO standard, this will be denoted as SEL in this report, except for in tables and equations where L_E will be used.

2.4.1.1. Marine Mammal Hearing Groups

Current data and predictions show that marine mammal species differ in their hearing capabilities, in absolute hearing sensitivity as well as frequency band of hearing (Richardson et al. 1995, Wartzok and Ketten 1999, Southall et al. 2007, Au and Hastings 2008). While hearing measurements are available for a small number of species based on captive animal studies, there are no direct measurements of many odontocetes or any mysticetes. As a result, hearing distances for many odontocetes are grouped with similar species, and predictions for mysticetes are based on other methods including: anatomical studies and modeling (Houser et al. 2001, Parks et al. 2007, Tubelli et al. 2012, Cranford and Krysl 2015); vocalizations (see reviews in Richardson et al. 1995, Wartzok and Ketten 1999, Au and Hastings 2008); taxonomy; and behavioral responses to sound (Dahlheim and Ljungblad 1990, see review in Reichmuth et al. 2007). In 2007, Southall et al. proposed that marine mammals be divided into hearing groups. This division was updated in 2016 and 2018 by NOAA Fisheries using more recent best available science (Table 16).

Southall et al. (2019) published an updated set of Level A sound exposure criteria (including the onset of temporary threshold shift [TTS] and permanent threshold shift [PTS] in marine mammals). While the authors propose a new nomenclature and classification for the marine mammal functional hearing groups, the proposed thresholds and weighting functions do not differ in effect from those proposed by NOAA Fisheries (2018). The new hearing groups proposed by Southall et al. (2019) have not yet been adopted by NOAA. The NOAA Fisheries (NMFS 2018) hearing groups presented in Table 16 are used in this analysis.

Table 16. Marine mammal hearing groups (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 (PW)	50 Hz to 86 kHz
Phocid pinnipeds in air (PA)[b]	50 Hz to 36 kHz

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

[b] Sound from piling will not reach NOAA Fisheries thresholds for behavioral disturbance of seals in air (90 dB [rms] re 20 μPa for harbor seals and 100 dB [rms] re 20 μPa for all other seal species) at the closest land-based sites where seals may spend time out of the water. Thus in-air hearing is not considered further.

2.4.1.2. Marine Mammal Auditory Weighting Functions

The potential for anthropogenic sound to impact marine mammals is largely dependent on whether the sound occurs at frequencies that an animal can hear well unless the sound pressure level is so high that it can cause physical tissue damage regardless of frequency. Auditory (frequency) weighting functions reflect an animal's ability to hear a sound (Nedwell and Turnpenny 1998, Nedwell et al. 2007). Auditory weighting functions have been proposed for marine mammals, specifically associated with PTS thresholds expressed in metrics that consider what is known about marine mammal hearing (e.g., SEL) (Southall et al. 2007, Erbe et al. 2016a, Finneran 2016). Marine mammal auditory weighting functions for all hearing groups (Table 16) published by Finneran (2016) are included in the NMFS (2018) Technical Guidance for use in conjunction with corresponding permanent threshold shift (PTS [Level A]) onset acoustic criteria (Table 17, See Appendix E for a detailed description of the weighting functions).

The application of marine mammal auditory weighting functions emphasizes the importance of taking measurements and characterizing sound sources in terms of their overlap with biologically important frequencies (e.g., frequencies used for environmental awareness, communication, and the detection of predators or prey), and not only the frequencies that are relevant to achieving the objectives of the sound producing activity (i.e., context of sound source; NMFS 2018).

2.4.1.3. Marine Mammal Auditory Injury Exposure Criteria

Injury to the hearing apparatus of a marine mammal may result from a fatiguing stimulus measured in terms of SEL, which considers the sound level and duration of the exposure signal. Intense sounds may also damage hearing independent of duration, so an additional metric of peak pressure (PK) is used to assess acoustic exposure injury risk. A 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 data that indicate the received sound levels at which temporary threshold shift, TTS, occurs, and PTS onset may be extrapolated from TTS onset level and an assumed growth function (Southall et al. 2007). The NMFS (2018) criteria incorporate the best available science to estimate PTS onset in marine mammals from sound energy accumulated over 24 h (SEL), or very loud, instantaneous peak sound pressure levels. These dual threshold criteria of SEL and PK are used to calculate marine mammal exposures (Table 17). If a non-impulsive sound has the potential to exceed the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.

Table 17. Summary of relevant permanent threshold shift (PTS) onset acoustic thresholds for marine mammal hearing groups (NMFS 2018).

Faunal group	Impulsive signals*		Non-impulsive signals
	Unweighted L_{pk} (dB re 1 µPa)	Frequency weighted $L_{E,\,24h}$ (dB re 1 µPa^2·s)	Frequency weighted $L_{E,\,24h}$ (dB re 1 µPa^2·s)
Low-frequency (LF) cetaceans	219	183	199
Mid-frequency (MF) cetaceans	230	185	198
High-frequency (HF) cetaceans	202	155	173
Phocid pinnipeds in water (PW)	218	185	201

[a] Dual metric acoustic thresholds for impulsive sounds: Of these two metrics, the one with the larger acoustic isopleth or the larger exposure effect is used to asses PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds have also been considered.

2.4.1.4. Marine Mammal Behavioral Response Exposure Criteria

Numerous studies on marine mammal behavioral responses to sound exposure have not resulted in consensus in the scientific community regarding the appropriate metric for assessing behavioral reactions. It is recognized that the context in which the sound is received affects the nature and extent of responses to a stimulus (Southall et al. 2007, Ellison et al. 2012). Due to the complexity and variability of marine mammal behavioral responses to acoustic exposure, NOAA has not yet released technical guidance for determining potential behavioral responses of marine mammals exposed to sounds (NMFS 2018). NOAA's National Marine Fisheries Service (NMFS) currently uses a step function to assess behavioral impact (NOAA 2005). The step function sets an SPL of 160 dB re 1 µPa as the behavioral disruption threshold based on the 50% response rate of collated responses in the HESS (1999) report. An SPL of 120 dB re 1 µPa was set as the behavioral disruption threshold for migrating mysticetes (NOAA 2005), which was based on the responses of migrating mysticete whales to airgun sounds (Malme et al. 1983, 1984). The HESS team recognized that behavioral responses to sound may occur at lower levels, but substantial responses were only likely to occur above an SPL of 140 dB re 1 µPa.

An extensive review of behavioral responses to sound was undertaken by Southall et al. (2007, their Appendix B). Southall et al. (2007) found varying responses for most marine mammals between an SPL of 140 and 180 dB re 1 µPa, consistent with the HESS (1999) report, but lack of convergence in the data prevented them from suggesting explicit step functions. In 2012, Wood et al. proposed a graded probability of response for impulsive sounds using a frequency weighted SPL metric. Wood et al. (2012) also designated behavioral response categories for sensitive species (including harbor porpoises and beaked whales) and for migrating mysticetes. For this analysis, both the unweighted NOAA (2005) and the frequency-weighted Wood et al. (2012) criteria are used to estimate Level B exposures to impulsive pile-driving sounds (Table 18).

Table 18. Wood et al. (2012) and NOAA (2005) acoustic sound pressure level (SPL) thresholds used to evaluate potential behavioral impacts to marine mammals. Probabilities are not additive.

Marine mammal group	Species	Frequency weighted probabilistic response[a] (L_p; dB re 1 µPa)				Un-weighted threshold[b] (L_p; dB re 1 µPa)
		>120	>140	>160	>180	160
Sensitive odontocetes	Harbor porpoise	50%	90%	–	–	100%
Migrating mysticete whales	Humpback whale North Atlantic right whale Sei whale Minke whale	10%	50%	90%	–	100%
All other species		–	10%	50%	90%	100%

2.4.2. Acoustic Thresholds for Evaluating Potential Impacts to Sea Turtles and Fish

In a cooperative effort between Federal and State transportation and resource agencies, interim criteria were developed to assess the potential for injury to fish exposed to pile driving sounds (Stadler and Woodbury 2009) and described by the Fisheries Hydroacoustic Working Group (FHWG 2008). Injury and behavioral response levels for fish were based on past literature that was compiled and listed in the NOAA Fisheries Greater Atlantic Regional Fisheries Office acoustics tool (GARFO 2020b) for assessing the potential effects to Endangered Species Act (ESA) listed animals exposed to elevated levels of underwater sound from pile driving. Dual acoustic thresholds for physiological injury to fish included in the tool are 206 dB re 1 µPa PK and either 187 dB re 1 $\mu Pa^2 \cdot s$ SEL (>2 grams [g] fish weight) or 183 dB SEL (<2 g fish weight) (FHWG 2008, Stadler and Woodbury 2009) (Table 19). The behavioral threshold for fish is ≥150 dB SPL (Andersson et al. 2007, Wysocki et al. 2007, Mueller-Blenkle et al. 2010, Purser and Radford 2011).

A technical report by an American National Standards Institute (ANSI) registered committee (Popper et al. 2014) reviewed available data and suggested metrics and methods for estimating acoustic impacts for fish. Their report includes thresholds for potential injury but does not define sound levels that may result in behavioral response, though does indicate a high likelihood of response near impact pile driving (tens of meters), moderate response at intermediate distances (hundreds of meters), and low response far (thousands of meters) from the pile (Popper et al. 2014).

Injury, impairment, 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). Dual criteria (PK and SEL) have been suggested for PTS and TTS, along with auditory weighting functions published by Finneran et al. (2017) used in conjunction with SEL thresholds for PTS and TTS . The behavioral threshold recommended in the GARFO acoustic tool (GARFO 2020b) is an SPL of 175 dB re 1 µPa (McCauley et al. 2000, Finneran et al. 2017) (Table 19).

Table 19. Acoustic metrics and thresholds for fish and sea turtles currently used by NMFS GARFO and Bureau of Ocean Energy Management (BOEM) for impulsive pile driving.

Faunal group	Injury		Impairment		Behavior
	PTS		TTS		
	L_{pk}	$L_{E,\,24h}$	L_{pk}	$L_{E,\,24h}$	L_p
Fish equal to or greater than 2 g[a,b]	206	187	-	-	150
Fish less than 2 g[a,b]		183	-	-	
Fish without swim bladder[c]	213	216	-	-	-
Fish with swim bladder not involved in hearing[c]	207	203	-	-	-
Fish with swim bladder involved in hearing[c]	207	203	-	-	-
Sea turtles[d,e]	232	204	226	189	175

L_{pk} – peak sound pressure (dB re 1 µPa), L_E – sound exposure level (dB re 1 µPa^2·s),
L_p – root mean square sound pressure (dB re 1 µPa).
A dash indicates that distances could not be calculated because thresholds were not reached.
PTS = permanent threshold shift; TTS = temporary threshold shift, which are recoverable hearing effects.
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

2.5. Animal Movement Modeling and Exposure Estimation

JASMINE was used to estimate the probability of exposure of animals to sound arising from pile driving operations during construction of the Project. Sound exposure models such as JASMINE use simulated animals (animats) to sample the predicted 3-D sound fields with movement rules derived from animal observations (Appendix I). An overview of the exposure modeling process using JASMINE is shown in Figure 4.

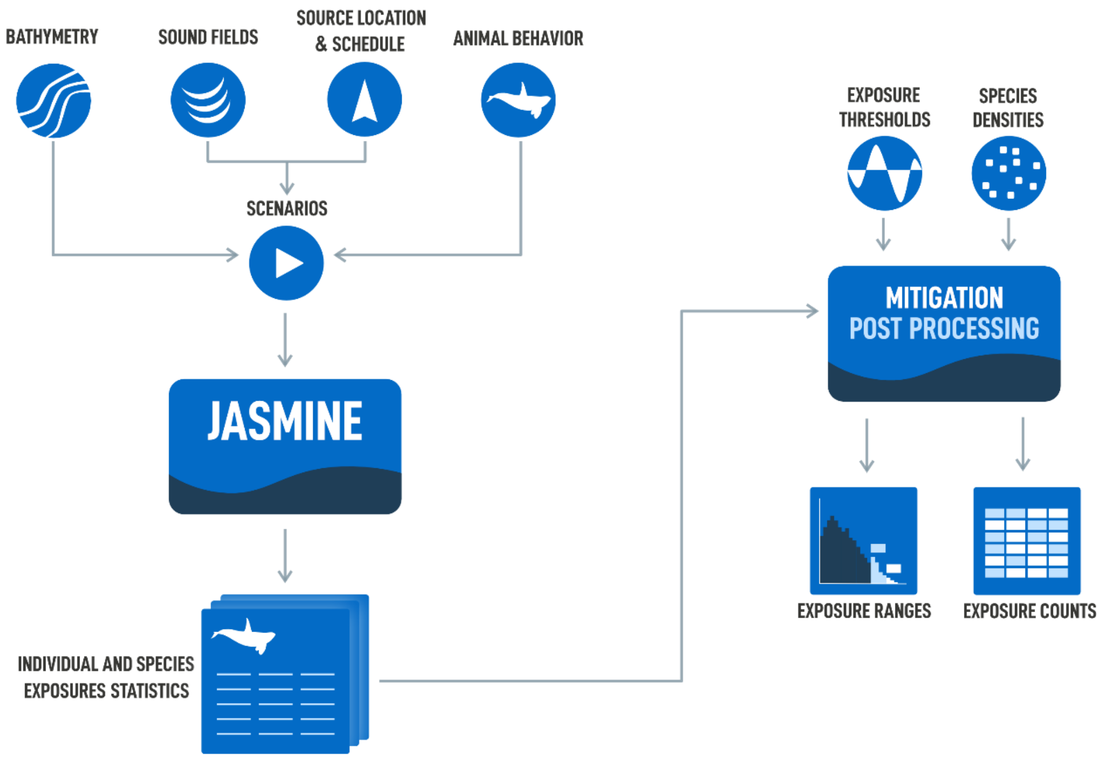

Figure 4. Exposure modeling process overview.

The parameters used for forecasting realistic behaviors (e.g., diving, foraging, and surface times) were determined and interpreted from marine species studies (e.g., tagging studies) where available, or reasonably extrapolated from related species. Time-varying, three-dimensional sound fields were sampled by the model receivers in a way that real animals are expected to by programming animats to behave like marine species that may be present near the Project Area. The output of the simulation is the exposure history for each animat within the simulation. An individual animat's sound exposure levels are summed over a specific duration, i.e., 24 h (Appendix I.1), to determine its total received acoustic energy (SEL) and maximum received PK and SPL. These received levels are then compared to the threshold criteria described in Sections 2.5 and 2.6 within each analysis period. Appendix I.5.I.1 provides fuller description of animal movement modeling and the parameters used in the JASMINE simulations. Due to shifts in animal density and seasonal sound propagation effects, the number of animals predicted to be impacted by the pile driving operations is sensitive to the number of foundations installed during each month.

JASMINE can be used to simulate aversive behaviors, where animals respond to sound. A subset of scenarios was run with aversion and these results are provided for demonstration purposes only (see Section 4.3.1.1). For details on how aversion is implemented in JASMINE, please refer to AppendixAversion I.1.2.

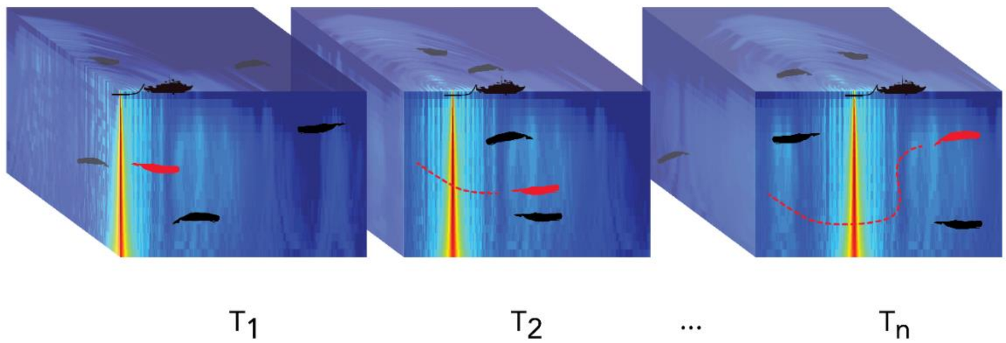

Figure 5. Depiction of animats in an environment with a moving sound field. Example animat (red) shown moving with each time step. The acoustic exposure of each animat is determined by where it is in the sound field, and its exposure history is accumulated as the simulation steps through time.

2.6. Estimating Monitoring Zones for Mitigation

Monitoring zones for mitigation purposes have traditionally been estimated by determining the acoustic distance to injury and behavioral thresholds (see Appendix H). The traditional method tacitly assumes that all receivers (animals) in the area remain stationary for the duration of the sound event. Where an animal is in a sound field, and the pathway it takes through the sound field as it evolves over time, determines the received level for each animal, and so treating animals as stationary may not produce realistic estimates for the monitoring zones.

Animal movement and exposure modeling can be used to account for the movement of receivers when estimating distances for monitoring zones. The closest point of approach (CPA) for each of the species-specific animats during a simulation is recorded and then the CPA distance that accounts for 95% of the animats that exceed an acoustic impact threshold is determined (Figure 6). The $ER_{95\%}$ (95% exposure radial distance) is the horizontal distance that includes 95% of the CPAs of animats exceeding a given impact threshold. $ER_{95\%}$ is reported for marine mammals and sea turtles. If used as an exclusion zone, keeping animals farther away from the source than the $ER_{95\%}$ will reduce exposure estimates by 95%.

Unlike marine mammals and sea turtles for which animal movement modeling was performed, fish were considered static (not moving) receivers, so exposure ranges were not calculated. Instead, the acoustic ranges to fish impact criteria thresholds were calculated by determining the isopleth at which thresholds could be exceeded (Appendix G.3).

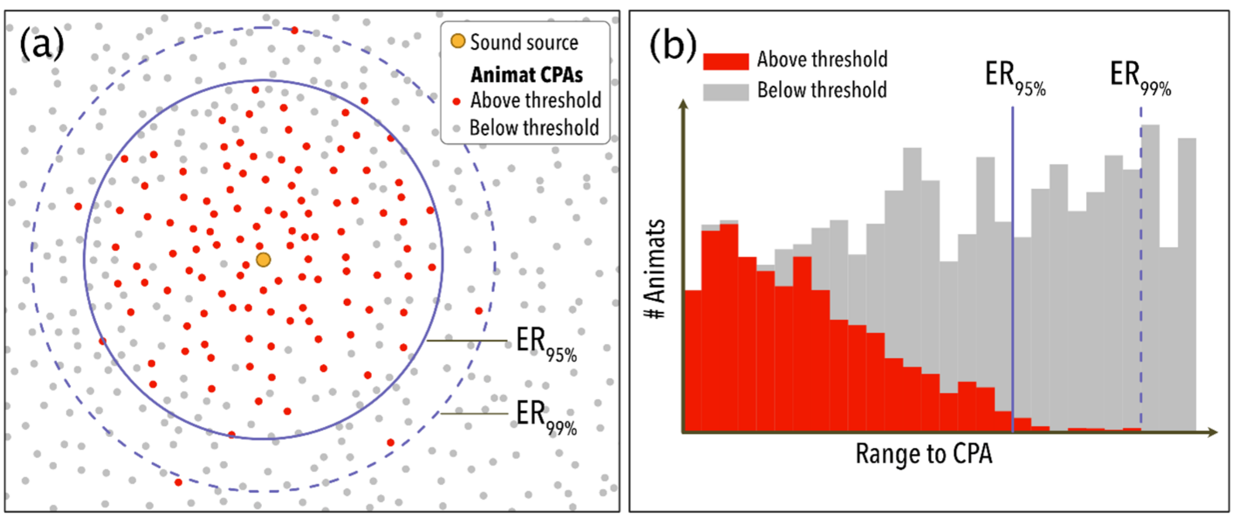

Figure 6. Example distribution of animat closest points of approach (CPAs). Panel (a) shows the horizontal distribution of animat CPAs near a sound source. Panel (b) shows the distribution of distances to animat CPAs. The 95% and 99% exposure ranges ($ER_{95\%}$ and $ER_{99\%}$) are indicated in both panels.

3. Marine Fauna Included in the Acoustic Assessment

Marine fauna included in the acoustic assessment are marine mammals (cetaceans and pinnipeds), sea turtles, and fish.

All marine mammal species are protected under the MMPA. Some marine mammal stocks may be designated as Strategic under the MMPA (2015), which requires the jurisdictional agency (NMFS for the Atlantic offshore species considered in this application) to impose additional protection measures. A stock is considered Strategic if:

- Direct human-caused mortality exceeds its Potential Biological Removal (PBR) level (defined as the maximum number of animals, not including natural mortality, that can be removed from the stock while allowing the stock to reach or maintain its optimum sustainable population level);
- It is listed under the ESA;
- It is declining and likely to be listed under the ESA; or
- It is designated as depleted under the MMPA.

A depleted species or population stock is defined by the MMPA as any case in which:

- The Secretary, after consultation with the Marine Mammal Commission and the Committee of Scientific Advisors on Marine Mammals established under MMPA Title II, determines that a species or population stock is below its optimum sustainable population;
- A State, to which authority for the conservation and management of a species or population stock is transferred under Section 109 of the MMPA, determines that such species or stock is below its optimum sustainable population; or
- A species or population stock is listed as an endangered or threatened species under the Endangered Species Act (2002). Some species are further protected under the ESA (2002).

Under the ESA, a species is considered endangered if it is "in danger of extinction throughout all or a significant portion of its range." A species is considered threatened if it "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (ESE 2002). Six marine mammal species known to occur in the Northwest Atlantic OCS region are ESA listed (Table 20). All four species of sea turtle (Table 22) as well as four fish species (Section 3.3) known to occur in the Northwest Atlantic OCS region are also ESA listed.

3.1. Marine Mammals that May Occur in the Area

Thirty-eight marine mammal species (whales, dolphins, porpoise, and seals) comprising 39 stocks have been documented as present (either year–round, seasonally, or as occasional visitors) in the Northwest Atlantic OCS region (CeTAP 1982, USFWS 2014, Roberts et al. 2016, Hayes et al. 2018, Hayes et al. 2022). All 38 marine mammal species identified in Table 20 are protected under the MMPA and some are also listed under the ESA. The five ESA-listed marine mammal species known to be present year-round, seasonally, or occasionally in the Project Area waters are the sperm whale (*Physeter macrocephalus*), North Atlantic right whale (NARW) (*Eubalaena glacialis*), fin whale (*Balaenoptera physalus physalus*), blue whale (*Balaenoptera musculus*), and sei whale (*Balaenoptera borealis*). The humpback whale (*Megaptera novaeangliae*), which may occur year-round, has been delisted as an endangered species.

Mid-Atlantic waters, including the Project Area (Figure 1), are primarily used as opportunistic feeding areas or habitat during seasonal migratory movements of some large whales that occur between northern feeding areas southern breeding areas. The modeling used in this assessment considered minke, humpback, NARW, and sei whales to be migratory in the region.

The four species of phocids (true seals) that have ranges overlapping the Project Area are harbor seals (*Phoca vitulina*), gray seals (*Halichoerus grypus*), harp seals (*Pagophilus groenlandicus*), and hooded seals (*Cystophora cristata*) (Hayes et al. 2022). . None of these phocids are ESA-listed, but all are protected under the MMPA.

The expected occurrence of each marine mammal species in the Project Area is listed in Table 20. Many of these marine mammal species do not commonly occur in this region of the Atlantic Ocean. For this assessment, species presence was categorized as:

- Common - Occurring consistently in moderate to large numbers;
- Uncommon - Occurring in low numbers or on an irregular basis; and
- Rare - There are limited species records for some years; range includes the proposed Project Area but due to habitat preferences and distribution information, species are not expected to occur in the Project Area, though rare sightings are a possibility. Records may exist for adjacent waters.

Marine mammal species considered *common* and *uncommon* were selected for quantitative assessment by acoustic impact analysis and exposure modeling. Quantitative assessment of bottlenose dolphins (*Tursiops truncatus*) presumed all impacted individuals belong to the Western North Atlantic Offshore stock because the ensonified area for impact pile driving based on a 5.5 km buffer around the lease area does not extend into waters shallower than 20 m deep, the stock delineation between the Offshore and Northern Migratory Coastal stocks of this species. Quantitative assessment of *rare* species was not conducted because impacts to those species approach zero due to their low densities. The modeled species are identified in Table 20. The likelihood of incidental exposure for each species based on its presence, density, and overlap of proposed activities is described in Section 4.3.1.

Table 20. Marine mammals that may occur in the Project Area.

Species	Scientific name	Stock	Regulatory status [a]	Relative occurrence in Empire Wind	Abundance[b]
Baleen whales (Mysteceti)					
Blue whale	*Balaenoptera musculus*	Western North Atlantic	ESA Endangered	Rare	402
Fin whale[c]	*B. physalus*	Western North Atlantic	ESA Endangered	Common	6,802
Humpback whale[c]	*Megaptera novaeangliae*	Gulf of Maine	MMPA	Common	1,396
Minke whale[c]	*B. acutorostrata*	Canadian Eastern Coastal	MMPA	Common	21,968
North Atlantic right whale[c]	*Eubalaena glacialis*	Western	ESA Endangered	Common	368[d]
Sei whale[c]	*B. borealis*	Nova Scotia	ESA Endangered	Common	6,292
Toothed Whales and Dolphins (Odontoceti)					
Sperm Whales (Physiteridae and Kogiidae)					
Sperm whale[c]	*Physeter macrocephalus*	North Atlantic	ESA Endangered	Uncommon	4,349
Dwarf sperm whale	*Kogia sima*	Western North Atlantic	MMPA	Rare	7,750[e]
Pygmy sperm whale	*Kogia breviceps*	Western North Atlantic	MMPA	Rare	7,750[e]
Dolphin Family (Delphinidae)					
Atlantic spotted dolphin[c]	*Stenella frontalis*	Western North Atlantic	MMPA	Uncommon	39,921
Atlantic white-sided dolphin[c]	*Lagenorhynchus acutus*	Western North Atlantic	MMPA	Common	93,233

Bottlenose dolphin[c]	*Tursiops truncatus*	Western North Atlantic, offshore[f]	MMPA	Common	62,851
Bottlenose dolphin	*T. truncatus*	Western North Atlantic, Northern Migratory Coastal	MMPA Depleted and Strategic	Rare	6,639
Clymene dolphin	*S. clymene*	Western North Atlantic	MMPA	Rare	4,237
False killer whale	*Pseudorca crassidens*	Western North Atlantic	MMPA	Rare	1,791
Fraser's dolphin	*Lagenodelphis hosei*	Western North Atlantic	MMPA	Rare	Unknown
Killer whale	*Orcinus orca*	Western North Atlantic	MMPA	Rare	Unknown
Melon-headed whale	*Peponocephala electra*	Western North Atlantic	MMPA	Rare	Unknown
Pan-tropical spotted dolphin	*S. attenuata*	Western North Atlantic	MMPA	Rare	6,593
Pilot whale, long-finned[c]	*Globicephala melas*	Western North Atlantic	MMPA	Uncommon	39,215
Pilot whale, short-finned[c]	*G. macrorhynchus*	Western North Atlantic	MMPA	Uncommon	28,924
Pygmy killer whale	*Feresa attenuata*	Western North Atlantic	MMPA	Rare	Unknown
Risso's dolphin[c]	*Grampus griseus*	Western North Atlantic	MMPA	Uncommon	35,215
Rough-toothed dolphin	*Steno bredanensis*	Western North Atlantic	MMPA	Rare	136
Common dolphin[c]	*Delphinus delphis*	Western North Atlantic	MMPA	Common	172,974
Spinner dolphin	*S. longirostris*	Western North Atlantic	MMPA	Rare	4,102
Striped dolphin	*S. coeruleoalba*	Western North Atlantic	MMPA	Rare	67,036
Beaked whales (Ziphiidae)					
Cuvier's beaked whale	*Ziphius cavirostris*	Western North Atlantic	MMPA	Rare	5,744
Blainville's beaked whale	*Mesoplodon densirostris*	Western North Atlantic	MMPA	Rare	10,107[g]
Gervais' beaked whale	*M. europaeus*	Western North Atlantic	MMPA		
Sowerby's beaked whale	*M. bidens*	Western North Atlantic	MMPA		
True's beaked whale	*Mesoplodon mirus*	Western North Atlantic	MMPA		
Northern bottlenose whale	*Hyperoodon ampullatus*	Western North Atlantic	MMPA	Rare	Unknown
Porpoises (Phocoenidae)					
Harbor porpoise[c]	*Phocoena phocoena*	Gulf of Maine/ Bay of Fundy	MMPA	Common	95,543
Earless seals (Phocidae)					
Gray seal[c]	*Halichoerus grypus*	Western North Atlantic	MMPA	Common	27,300[h]
Harbor seal[c]	*Phoca vitulina*	Western North Atlantic	MMPA	Common	61,336
Harp seal	*Pagophilus groenlandicus*	Western North Atlantic	MMPA	Uncommon	Unknown[i]
Hooded seal	*Cystophora cristata*	Western North Atlantic	MMPA	Rare	Unknown

a Denotes the highest federal regulatory classification. A strategic stock is defined as any marine mammal stock: 1) for which the level of direct human-caused mortality exceeds the potential biological removal level; 2) that is declining and likely to be listed as Threatened under the ESA; or 3) that is listed as Threatened or Endangered under the ESA or as depleted under the MMPA (Hayes et al. 2022).

b Best available abundance estimate is from NOAA Fisheries Stock Assessment Reports (Hayes et al. 2022).

c Modeled species.

d Best available abundance estimate is from NOAA Fisheries Stock Assessment (Hayes et al. 2022). NARW consortium has released the 2021 report card results predicting a NARW population of 336 for 2020 (Pettis et al. 2022). However, the consortium "alters" the methods of Pace et al. (2017, 2021) to subtract additional mortality. This method is used in order to estimate all mortality, not just the observed mortality, therefore the 2021 SAR (Hayes et al. 2022) will be used to report an unaltered output of the Pace et al. (2017, 2021) model (DoC and NOAA 2020).

e This estimate includes both dwarf and pygmy sperm whales. Source: Hayes et al. (2022)

f Bottlenose dolphins occurring in the Offshore Development Area likely belong to the Western North Atlantic Offshore stock (Hayes et al. 2022).

g This estimate includes all undifferentiated Mesoplodon spp. beaked whales in the Atlantic. Sources: Kenney and Vigness-Raposa (2009), Rhode Island Ocean Special Area Management Plan (2011), Waring et al. (2011, 2013, 2015), Hayes et al. (2022)

h Estimate of gray seal population in US waters. Data are derived from pup production estimates; (Hayes et al. 2022) notes that uncertainty about the relationship between whelping areas along with a lack of reproductive and mortality data make it difficult to reliably assess the population trend.

i Hayes et al. (2022) report insufficient data to estimate the population size of harp seals in US waters; the best estimate for the whole population is 7.6 million.

3.2. Mean Monthly Marine Mammal Density Estimates

Mean monthly marine mammal density estimates (animals per 100 square kilometers [animals/100 km^2]) for all species are provided in Table 21. These were obtained using the 2022 Duke University Marine Geospatial Ecology Laboratory model results (Roberts et al. 2016, 2022), which were recently updated for all species. The 2022 updated NARW model (v12) provides model predictions for three eras, 2003–2019, 2003–2009, and 2010–2019, to reflect the apparent shift in NARW distribution around 2010. The modeling reported herein used the 2010–2019 density predictions as recommended by Roberts et al. (2022). Similarly, the 2022 updated humpback whale model (v11) provides model predictions for three eras, 2002–2019, 2002–2008, and 2009–2019. The modeling reported herein used the 2009-2019 density predictions as recommended by Roberts et al. (2022).

Densities were calculated within a perimeter set at 10 km from the lease area (see Figure 7). The perimeter distance was based on the largest 10 dB-attenuated exposure range across all species, scenarios, and threshold criteria (with the exception of the Wood et al. [2012] thresholds) and rounded up to the nearest 5-km increment. Wood et al. (2012) exposure ranges were not considered in this estimate because they include a small subset of very long ranges for migrating mysticetes and harbor porpoise. The mean species density for each month was determined by calculating the unweighted mean of all 5 × 5 km grid cells partially or fully within the analysis polygon (Figure 7). Densities were computed for an entire year to coincide with possible planned activities. In cases where monthly densities were unavailable, annual mean densities were used instead.

For long- and short-finned pilot whales (*Globicephala melas* and *Globicephala macrorhynchus*, respectively), monthly densities are unavailable from Roberts et al. (2022), so annual mean densities were used. Additionally, Roberts et al. (2022) provide density for pilot whales as a guild that includes both species. To obtain density estimates for long-finned and short-finned pilot whales, the guild density from Roberts et al. (2022) was scaled by the relative stock sizes based on the best available abundance estimate from NOAA Fisheries SARs (Hayes et al. 2022). Equation **Error! Reference source not found.** shows an example of how abundance scaling is applied to compute density for short-finned pilot whales:

$$d_{short-finned} = d_{both}\left(\frac{a_{short-finned}}{a_{short-finned}+a_{long-finned}}\right),$$

Where *a* represents abundance and *d* represents density. Similarly, densities are provided for seals as a guild consisting primarily of harbor and gray seals Roberts et al. (2022). Gray and harbor seal densities were scaled by relative NOAA Fisheries SAR (Hayes et al. 2022) abundance.

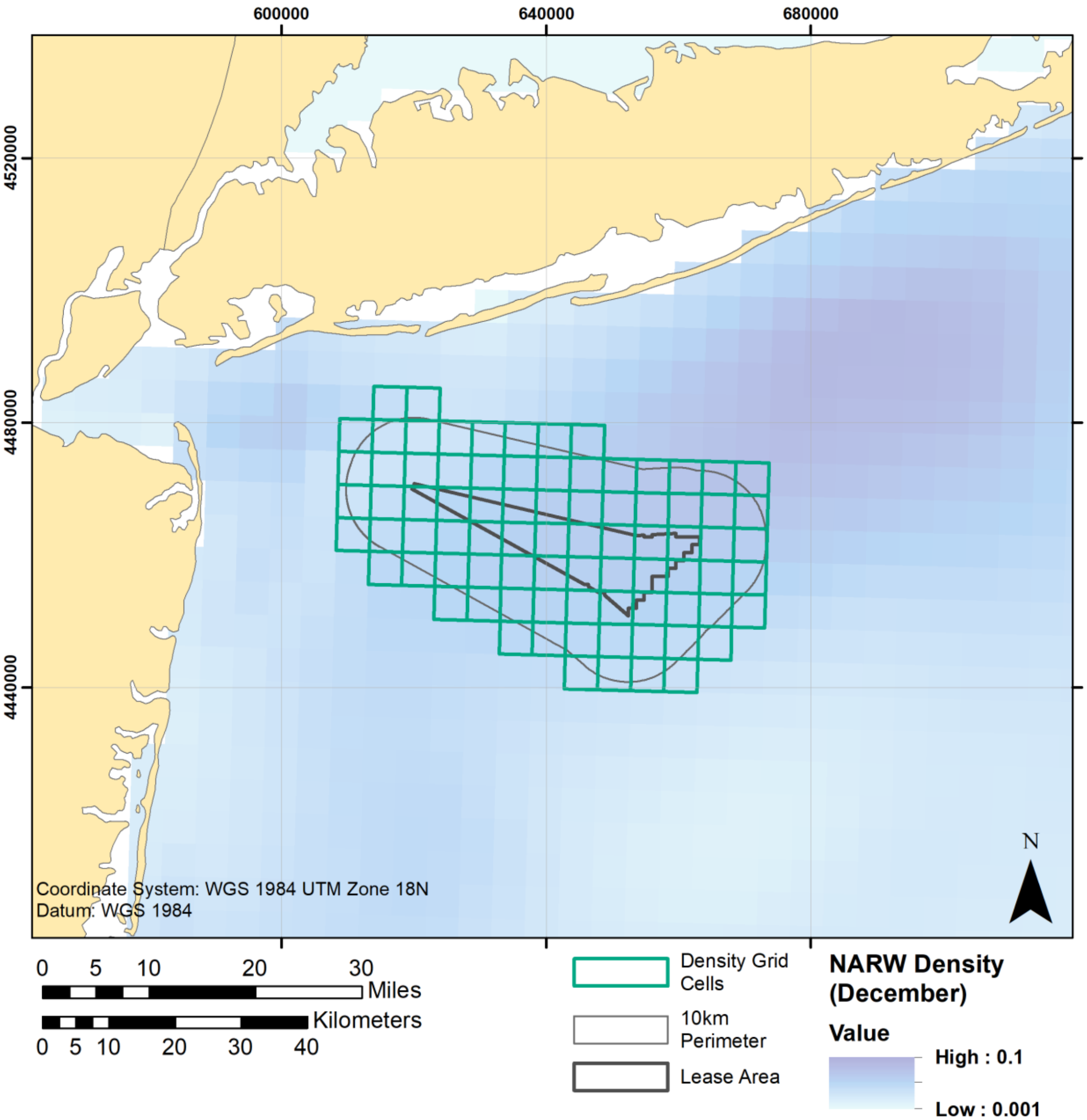

Figure 7. Marine mammal (e.g., NARW) density map showing highlighted grid cells used to calculate mean monthly species estimates within a 10 km perimeter around Lease Area OCS-A 0512 (Roberts et al. 2016, 2022).

Table 21. Mean monthly marine mammal density estimates for all modeled species within a 10 km perimeter around OCS-A 0512 lease area.

Species		Monthly density (animals/100 km²)[a]												Annual mean	May to Dec mean
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
LF	Fin whale[b]	0.172	0.139	0.113	0.137	0.174	0.171	0.157	0.100	0.055	0.040	0.038	0.130	0.119	0.108
	Minke whale (migrating)	0.071	0.060	0.072	0.936	1.485	0.803	0.198	0.107	0.066	0.111	0.026	0.059	0.333	0.357
	Humpback whale (migrating)	0.091	0.061	0.076	0.119	0.133	0.113	0.030	0.022	0.054	0.101	0.130	0.113	0.087	0.087
	North Atlantic right whale[b] (migrating)	0.100	0.116	0.115	0.088	0.025	0.006	0.003	0.003	0.004	0.008	0.016	0.050	0.045	0.014
	Sei whale[b] (migrating)	0.029	0.016	0.033	0.071	0.055	0.011	0.002	0.002	0.005	0.013	0.037	0.049	0.027	0.022
MF	Atlantic white-sided dolphin	0.642	0.399	0.356	0.846	1.373	1.237	0.117	0.049	0.279	0.892	0.863	0.990	0.670	0.725
	Atlantic spotted dolphin	0.001	0.000	0.001	0.003	0.010	0.019	0.033	0.072	0.177	0.260	0.133	0.013	0.060	0.090
	Common dolphin	5.664	1.852	1.246	2.457	3.474	2.835	1.566	1.917	1.623	3.495	7.244	9.177	3.546	3.917
	Offshore bottlenose dolphin	0.851	0.247	0.205	0.629	2.005	3.232	3.534	2.953	2.552	2.898	2.772	2.520	2.033	2.808
	Risso's dolphin	0.042	0.005	0.003	0.021	0.034	0.014	0.014	0.007	0.008	0.010	0.056	0.186	0.033	0.041
	Long-finned pilot whale	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
	Short-finned pilot whale	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
	Sperm whale[b]	0.007	0.002	0.002	0.004	0.005	0.011	0.011	0.015	0.003	0.000	0.008	0.005	0.006	0.007
HF	Harbor porpoise (sensitive)	5.469	5.730	5.916	7.066	2.421	0.347	0.435	0.215	0.130	0.144	0.342	3.757	2.664	0.974
PW	Gray seal	4.762	4.505	3.689	4.337	5.968	1.093	0.071	0.049	0.104	0.684	1.625	4.407	2.608	1.750
	Harbor seal	10.698	10.121	8.289	9.745	13.409	2.456	0.160	0.110	0.233	1.537	3.651	9.902	5.859	3.932

[a] Density estimates are from habitat-based density modeling of the entire Atlantic Exclusive Economic Zone (EEZ) (Roberts et al. 2016, 2022).
[b] Listed as Endangered under the ESA.

3.3. Sea Turtles and Fish Species of Concern that May Occur in the Area

Four species of sea turtles may occur in the Project Area: loggerhead sea turtle (*Caretta caretta*), Kemp's ridley sea turtle (*Lepidochelys kempii*), green sea turtle (*Chelonia mydas*), and leatherback sea turtle (*Dermochelys coriacea*). All are listed as either Endangered or Threatened under the ESA (Table 22). Many species of sea turtle prefer coastal waters; however, both leatherback and loggerhead sea turtles are known to occupy deep-water habitats and are considered common during summer and fall in the Project Area. Kemp's ridley sea turtles are thought to be regular visitors during those seasons. Although uncommon, individual green turtles can be found in the Project Area in the summer and fall when water temperatures are highest.

There are four ESA listed Threatened or Endangered fish species that may occur off the northeast Atlantic coast – the shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), Atlantic salmon (*Salmo salar)*, and giant manta ray (*Manta birostris*).

Atlantic sturgeon distribution varies by season, but they are primarily found in shallow coastal waters (bottom depth less than 20 m) during the summer months (May to September) and move to deeper waters (20–50 m) in winter and early spring (December to March) (Dunton et al. 2010). The New York Bight distinct population segment (DPS) of Atlantic sturgeon is listed as Endangered under the ESA. Shortnose sturgeon occur primarily in fresh and estuarine waters and occasionally enter the coastal ocean. Adults ascend rivers to spawn from February to April, and eggs are deposited over hard bottom, in shallow, fast-moving water (Dadswell et al. 1984). Because of their preference for mainland rivers and fresh and estuarine waters, shortnose sturgeon are unlikely to be found in the vicinity of the Project Area. Atlantic salmon is an anadromous species that historically ranged from northern Quebec southeast to Newfoundland and southwest to Long Island Sound. The Gulf of Maine distinct population segment of the Atlantic salmon that spawns within eight coastal watersheds within Maine is federally listed as Endangered. In 2009, the distinct population segment was expanded to include all areas of the Gulf of Maine between the Androscoggin River and the Dennys River (NOAA Fisheries 2022). Only certain Gulf of Maine populations are listed as Endangered, and Gulf of Maine salmon are unlikely to be encountered south of Cape Cod (BOEM 2014).

The giant manta ray is found worldwide in tropical, subtropical, and temperate bodies of water and is commonly found offshore, in oceanic waters, and near productive coastlines. As such, giant manta rays can be found in cool water, as low as 19 °C, although temperature preference appears to vary by region. For example, off the US East Coast, giant manta rays are commonly found in waters from 19 to 22 °C (66.2 to 71.6°F), whereas those off the Yucatan peninsula and Indonesia are commonly found in waters between 25 to 30 °C (77 to 86°F). Individuals have been observed as far north as New Jersey in the Western Atlantic basin indicating that the Offshore Development Area is located at the northern boundary of the species' range (NOAA Fisheries 2021b).

Table 22. Sea turtle species potentially occurring within the regional waters of the Western North Atlantic Outer Continental Shelf (OCS) and Project Area.

Species	Scientific name	Regulatory status[a]	Relative occurrence in Project Area
Leatherback sea turtle[b]	*Dermochelys coriacea*	ESA Endangered	Common
Loggerhead sea turtle[b]	*Caretta caretta*	ESA Threatened	Common
Kemp's ridley sea turtle[b]	*Lepidochelys kempii*	ESA Endangered	Uncommon
Green sea turtle[b]	*Chelonia mydas*	ESA Threatened	Uncommon

[a] Listing status as stated in NOAA Fisheries n.d., MA NHESP 2019; RI DEM 2011; NYSDEC 2020a.
[b] Modeled species.

3.4. Sea Turtle Density Estimates

There are limited density estimates for sea turtles in the Project area. The Project area is in the Mid-Atlantic North region defined in NEFSC and SEFSC (2011) for sea turtle distribution. Sea turtles are expected to be present in the Project area during summer and fall due to seasonal habitat use, with sea turtles moving to warmer water habitats in winter (Hawkes et al. 2007, Dodge et al. 2014, DoN, 2017). Sea turtles were most commonly observed in summer and fall, absent in winter, and nearly absent in spring during the Kraus et al. (2016) aerial surveys of the Massachusetts Wind Energy Area (MA WEA) and Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA). Kraus et al. (2016) reported that leatherback and loggerhead sea turtles were the most commonly observed turtle species with an additional six Kemp's ridley sea turtles identified over five years. Similarly, aerial surveys conducted for the New York State Department of Environmental Conservation in the New York Offshore Planning Area (NY OPA) monthly over a period of three years recorded sea turtles to be most frequently seen in summer, followed by fall, absent in winter, and rare in spring (Tetra Tech and LGL 2020). Leatherback, loggerhead, and Kemp's ridley sea turtles were reported.

Also in the New York Bight, a multi-year series of seasonal aerial surveys was conducted by Normandeau associates for the New York State Energy Research and Development Authority (NYSERDA; Normandeau Associates and APEM Inc. 2018, 2019b, 2019a, 2019c, 2020). The purpose of the aerial surveys was to gather high resolution data on marine resources within the OPA off Long Island, New York. High-resolution digital aerial photographs were collected along specific line transects each season for three consecutive years. Four sea turtle species were reported as being present in the area during the NYSERDA surveys: loggerhead, leatherback, Kemp's ridley, and green.

To obtain the densities used in the current study, we extracted the maximum seasonal abundance for each species from the NYSERDA data. The abundance was corrected to represent the abundance in the entire OPA and then scaled by the full OPA area to obtain a density in units of animals per square kilometer. Two categories listed in the reports included more than one species: one combined loggerhead and Kemp's ridley turtles, and the other included turtles that were observed but not identified to the species level. The counts within the two categories that included more than one species were distributed amongst the relevant species with a weighting that reflected the recorded counts for each species. For example, loggerhead turtles were identified far more frequently than any other species; therefore, more of the unidentified counts were assigned to them. The underlying assumption is that a given sample of unidentified turtles would have a distribution of species that was similar to the observed distribution within a given season.

The NYSERDA study (Normandeau Associates and APEM Inc. 2018, 2019b, 2019a, 2019c, 2020) reported that in the survey area, most of the sea turtles recorded were loggerhead sea turtles, by an order of magnitude. Seasonal sea turtle densities used in animal movement modeling are listed in Table 23.

Table 23. Sea turtle density estimates for all modeled species within a 10 km perimeter around OCS-A 0512 leasee area.

Common name	Density (animals/100 km^2)[a]			
	Spring	Summer	Fall	Winter
Kemp's ridley sea turtle[b]	0.050	0.991	0.190	0.000
Leatherback sea turtle[b]	0.000	0.331	0.789	0.000
Loggerhead sea turtle	0.254	26.799	0.190	0.025
Green sea turtle	0.000	0.038	0.000	0.000

[a] Densities calculated from NYSERDA aerial survey reports (Normandeau Associates and APEM Inc. 2018, 2019b, 2019a, 2019c, 2020).
[b] Listed as Endangered under the ESA.

4. Results

Sound fields were modeled at two modeling locations for monopiles and two locations for pin piles, representing the range of water depths within the Project (Figure 2; Table 8). This section summarizes the source modeling results (Section 4.1), the acoustic propagation modeling results (Section 4.2), animal movement modeling results for marine mammals and sea turtles (Sections 4.3 and 4.4), and the acoustic radial distance to thresholds for fish (Section 4.5).

4.1. Modeled Source Characteristics

Forcing functions were computed for the monopile and pin pile using GRLWEAP 2010 (GRLWEAP, Pile Dynamics 2010) (Figure 8 through Figure 12). The model assumed direct contact between the hammer, helmet, and pile (i.e., no cushion material). The forcing functions serve as the inputs to JASCO's pile driving source models used to estimate equivalent acoustic source characteristics detailed in Appendix D. Decidecade spectral levels at 10 m for the modeled piles are shown in Figures 13-23. For the Difficult to Drive Monopile Foundations, the forcing functions and spectra include the 5,500 kJ energy level.

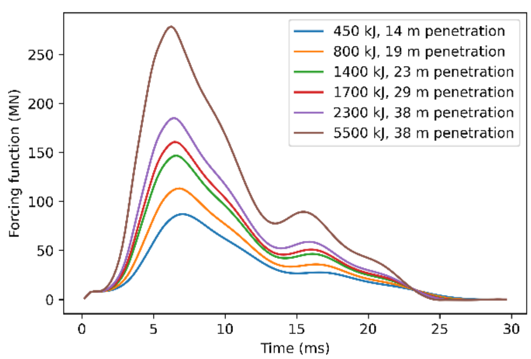

Figure 8. Modeled forcing functions versus time for a 9.6 m diameter monopile as a function of hammer energy.

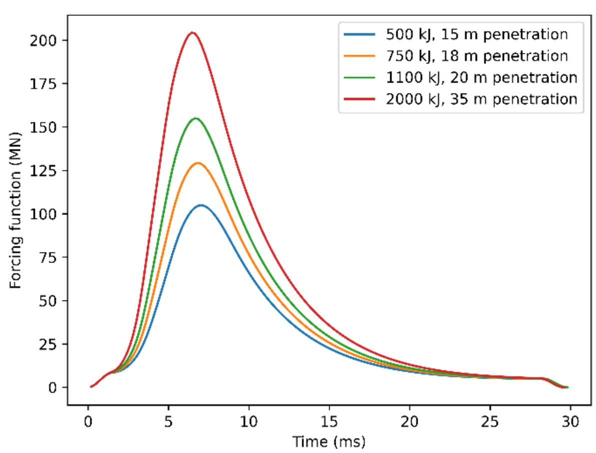

Figure 9. Modeled forcing functions versus time for an 11 m R3 diameter monopile as a function of hammer energy.

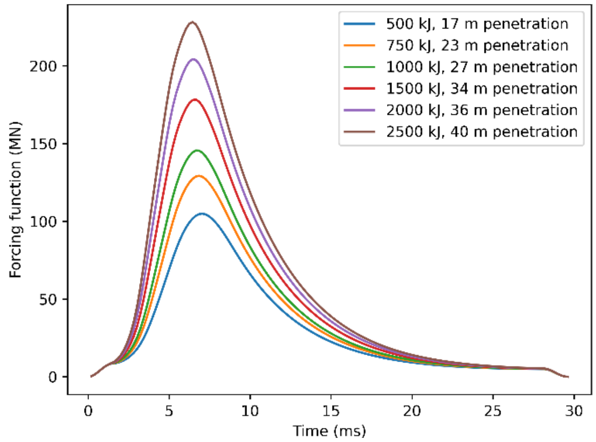

Figure 10. Modeled forcing functions versus time for an 11 m T1 diameter monopile as a function of hammer energy.

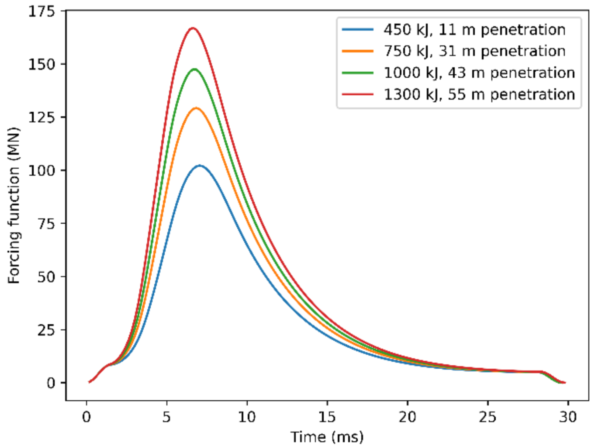

Figure 11. Modeled forcing functions versus time for an 11 m U3 diameter monopile as a function of hammer energy.

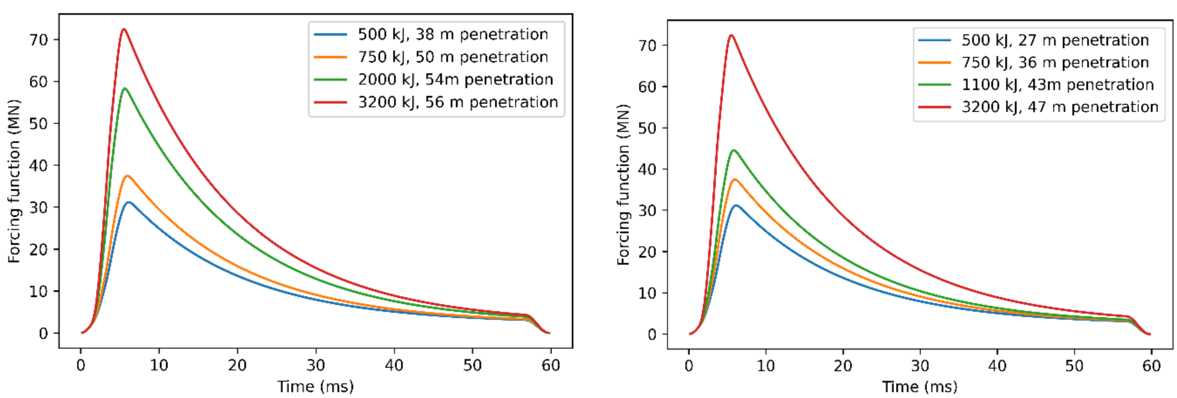

Figure 12. Modeled forcing functions versus time for a 2.5 m diameter jacket pile for locations OSS1 (left) and OSS2 (right) as a function of hammer energy.

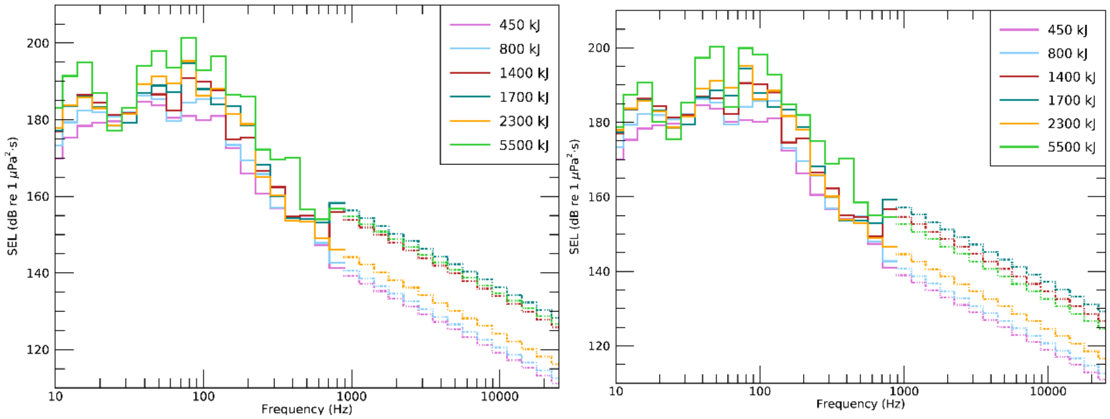

Figure 13. Location L01: Decidecade band spectral levels for 9.6 m diameter monopile at 10 m assuming an expected installation scenario using an IHC S-5500 kJ hammer with an average sound speed profile for (left) summer and (right) winter.

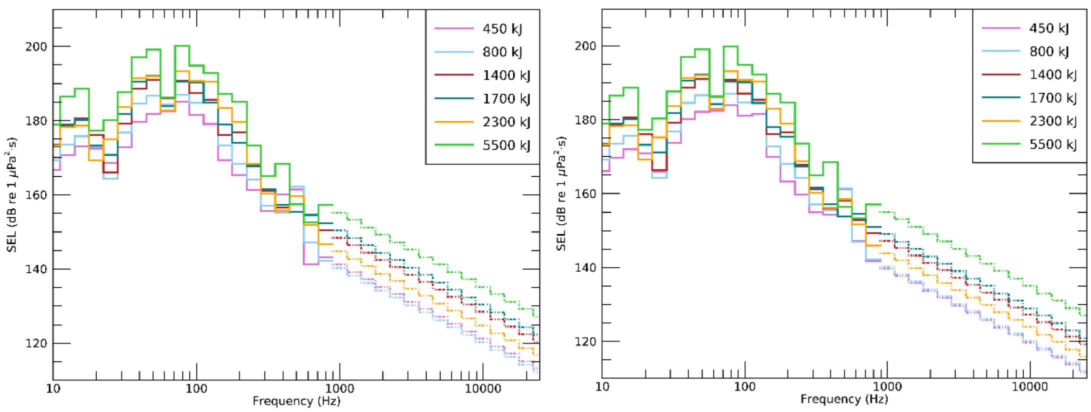

Figure 14. Location L02: Decidecade band spectral levels for 9.6 m diameter monopile at 10 m assuming an expected installation scenario using an IHC S-5500 kJ hammer with an average sound speed profile for (left) summer and (right) winter.

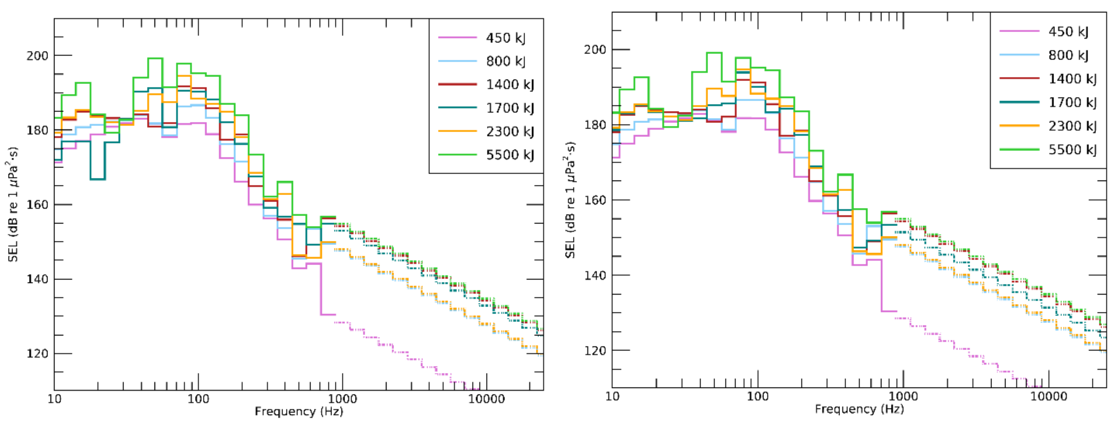

Figure 15. Location L03: Decidecade band spectral levels for 9.6 m diameter monopile at 10 m assuming an expected installation scenario using an IHC S-5500 kJ hammer with an average sound speed profile for (left) summer and (right) winter.

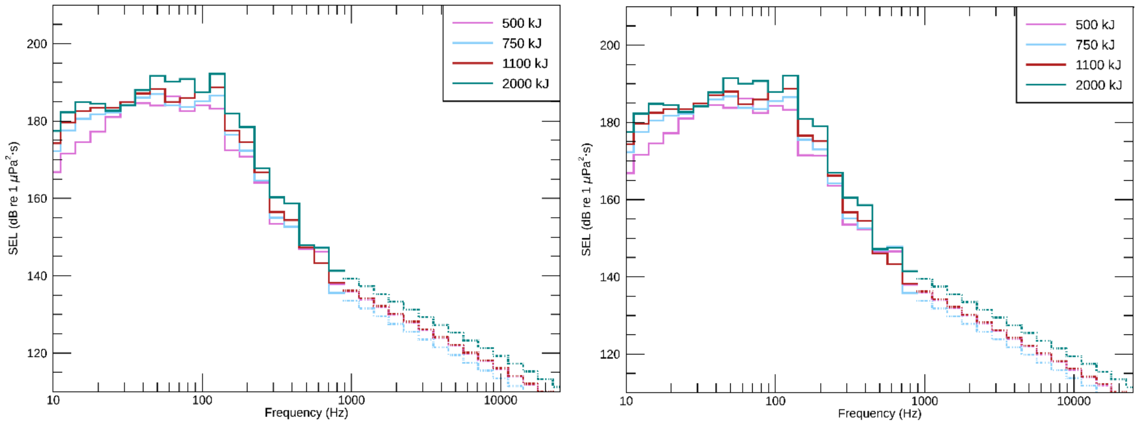

Figure 16. Location L04: Decidecade band spectral levels for 11 m R3 diameter monopile at 10 m assuming an expected installation scenario using an IHC S-5500 kJ hammer with an average sound speed profile for (left) summer and (right) winter.

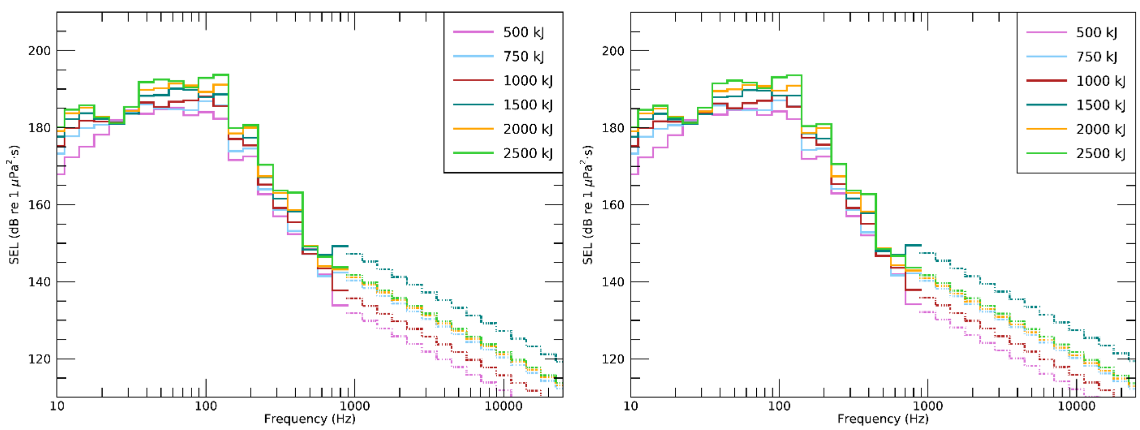

Figure 17. Location L05: Decidecade band spectral levels for 11 m T1 diameter monopile at 10 m assuming an expected installation scenario using an IHC S-5500 kJ hammer with an average sound speed profile for (left) summer and (right) winter.

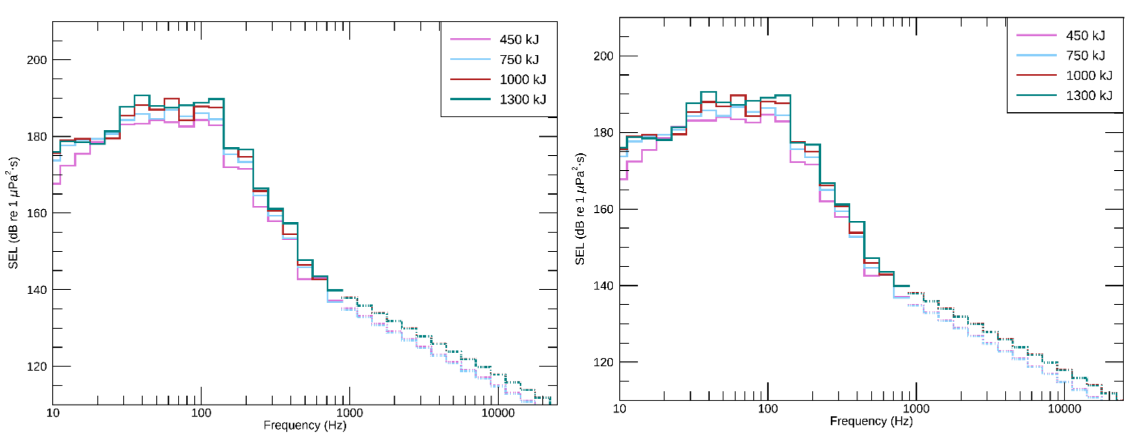

Figure 18. Location L06: Decidecade band spectral levels for 11 m U3 diameter monopile at 10 m assuming an expected installation scenario using an IHC S-5500 kJ hammer with an average sound speed profile for (left) summer and (right) winter.

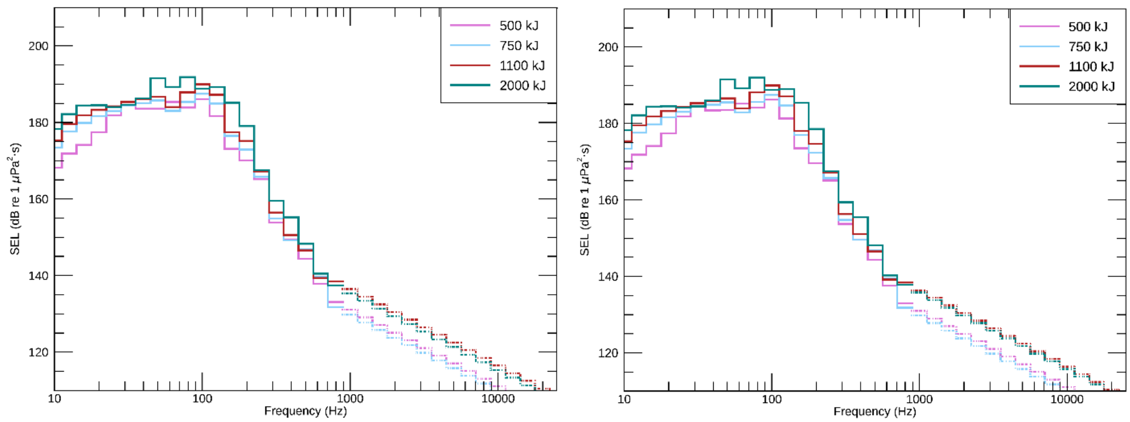

Figure 19. Location L07: Decidecade band spectral levels for 11 m R3 diameter monopile at 10 m assuming an expected installation scenario using an IHC S-5500 kJ hammer with an average sound speed profile for (left) summer and (right) winter.

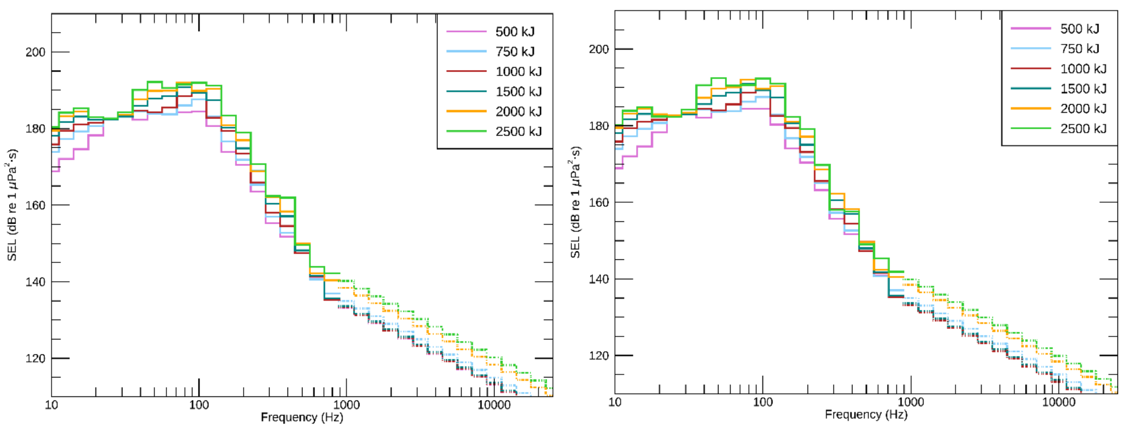

Figure 20. Location L08: Decidecade band spectral levels for 11 m T1 diameter monopile at 10 m assuming an expected installation scenario using an IHC S-5500 kJ hammer with an average sound speed profile for (left) summer and (right) winter.

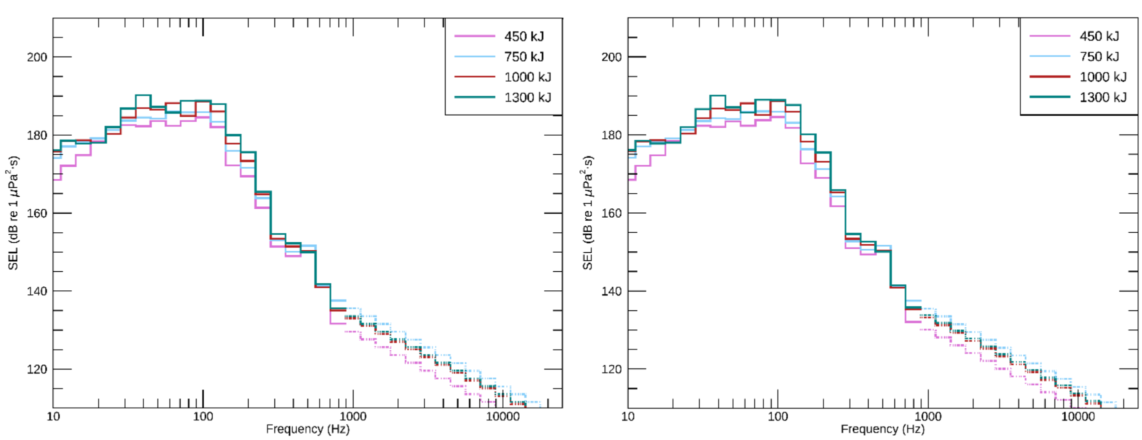

Figure 21. Location L09: Decidecade band spectral levels for 11 m U3 diameter monopile at 10 m assuming an expected installation scenario using an IHC S-5500 kJ hammer with an average sound speed profile for (left) summer and (right) winter.

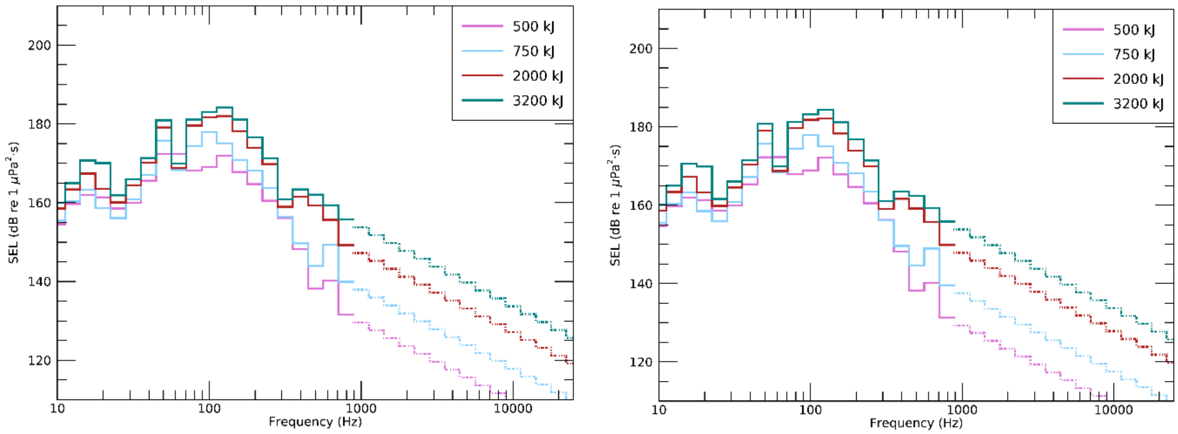

Figure 22. Location OSS1: Decidecade band spectral levels for 2.5 m diameter pin pile at 10 m assuming an expected installation scenario using an IHC S-4000 kJ hammer with an average sound speed profile for (left) summer and (right) winter.

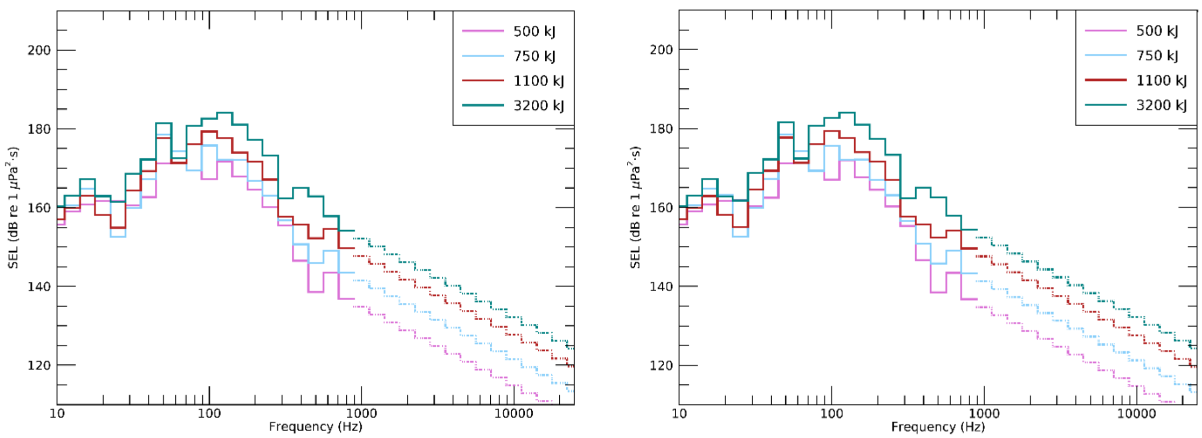

Figure 23. Location OSS2: Decidecade band spectral levels for 2.5 m diameter pin pile at 10 m assuming an expected installation scenario using an IHC S-4000 kJ hammer with an average sound speed profile for (left) summer and (right) winter.

4.2. Modeled Sound Fields

Three dimensional (3-D) sound fields for monopiles and pin piles were calculated using the source characteristics (Section 4.1 and Appendix F.1) at two representative locations for each foundation type (Table 8). Environmental parameters (bathymetry, geoacoustic information, and sound speed profiles) chosen for the propagation modeling and the modeling procedures are found in Appendix G. Subsequent ranges to various isopleths for single hammer strikes at the different hammer energy levels are shown in Appendix H.

4.3. Exposure Estimates

Exposure estimates were calculated for marine mammals and sea turtles for the proposed two-year construction schedule using the four possible combinations of monopiles installed at a rate of 1 per day or 2 per day and jacket pin piles installed at a rate of 2 per day or 3 per day (see Section 1.2.2). Sections 4.3.1 and 4.3.2 include the mean number of animals predicted to receive sound levels above exposure criteria for each metric (SEL, PK, and SPL), assuming 10 dB attenuation. For full results, including all modeled attenuation levels see Appendix I.2.1.

4.3.1. Marine Mammals

Table 24. Construction schedule 1 (1 monopile per day/2 pin piles per day): Mean number of marine mammals predicted to receive sound levels above exposure criteria with 10 dB attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species		Year 1				Year 2			
		Injury		Behavior		Injury		Behavior	
		L_E	L_{pk}	L_p [a]	L_p [b]	L_E	L_{pk}	L_p [a]	L_p [b]
LF	Fin whale[c]	1.15	0	8.78	10.66	0.52	0	4.00	4.84
	Minke whale (migrating)	3.72	0	65.05	267.57	2.18	0	47.73	191.78
	Humpback whale (migrating)	0.36	<0.01	8.12	44.29	0.14	0	3.82	19.04
	North Atlantic right whale[c] (migrating)	0.10	0	2.36	13.02	0.05	0	1.57	8.61
	Sei whale[c] (migrating)	0.27	<0.01	2.78	18.01	0.16	0	1.66	11.65
MF	Atlantic white-sided dolphin	0	0	116.00	39.89	0	0	59.23	20.03
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0
	Common dolphin	0	0	902.19	294.37	0	0	560.75	176.86
	Bottlenose dolphin	0	0	226.02	75.48	0	0	110.28	35.73
	Risso's dolphin	0	0	5.96	2.37	0	0	4.09	1.70
	Long-finned pilot whale	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0.56	0.19	0	0	0.29	0.10
HF	Harbor porpoise (sensitive)	0	0.09	133.70	1436.13	0	0	98.43	1018.82
PW	Gray seal	0.17	0	162.46	124.73	0	0	111.95	87.05
	Harbor seal	0	0	356.44	286.68	0	0	229.89	193.56

[a]NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table 25. Construction schedule 2 (1 monopile per day/3 pin piles per day): Mean number of marine mammals predicted to receive sound levels above exposure criteria with 10 dB attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species		Year 1				Year 2			
		Injury		Behavior		Injury		Behavior	
		L_E	L_{pk}	L_p [a]	L_p [b]	L_E	L_{pk}	L_p [a]	L_p [b]
LF	Fin whale[c]	1.15	0	8.73	10.52	0.52	0	4.00	4.84
LF	Minke whale (migrating)	3.72	0	65.86	266.18	2.18	0	47.73	191.78
LF	Humpback whale (migrating)	0.36	<0.01	8.15	44.04	0.14	0	3.82	19.04
LF	North Atlantic right whale[c] (migrating)	0.10	0	2.37	13.04	0.05	0	1.57	8.61
LF	Sei whale[c] (migrating)	0.27	<0.01	2.78	17.36	0.16	0	1.66	11.65
MF	Atlantic white-sided dolphin	0	0	115.90	39.83	0	0	59.23	20.03
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	905.93	294.72	0	0	560.75	176.86
MF	Bottlenose dolphin	0	0	226.15	75.13	0	0	110.28	35.73
MF	Risso's dolphin	0	0	6.02	2.40	0	0	4.09	1.70
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0.56	0.19	0	0	0.29	0.10
HF	Harbor porpoise (sensitive)	0	0.09	134.33	1405.09	0	0	98.43	1018.82
PW	Gray seal	0.17	0	162.23	122.48	0	0	111.95	87.05
PW	Harbor seal	0	0	356.63	282.22	0	0	229.89	193.56

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table 26. Construction schedule 3 (2 monopiles per day/2 pin piles per day): Mean number of marine mammals predicted to receive sound levels above exposure criteria with 10 dB attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

	Species	Year 1				Year 2			
		Injury		Behavior		Injury		Behavior	
		L_E	L_{pk}	L_p [a]	L_p [b]	L_E	L_{pk}	L_p [a]	L_p [b]
LF	Fin whale[c]	1.12	0	8.03	8.14	0.47	0	3.79	3.71
LF	Minke whale (migrating)	3.15	0	63.23	235.86	1.60	0	44.91	156.60
LF	Humpback whale (migrating)	0.28	<0.01	8.42	41.30	0.10	0	3.94	18.17
LF	North Atlantic right whale[c] (migrating)	0.09	0	2.36	12.40	0.04	0	1.55	7.44
LF	Sei whale[c] (migrating)	0.23	<0.01	2.48	11.75	0.11	0	1.52	7.40
MF	Atlantic white-sided dolphin	0	0	110.28	35.82	0	0	56.03	17.58
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	826.21	284.54	0	0	504.58	168.56
MF	Bottlenose dolphin	0	0	197.35	71.41	0	0	95.09	33.33
MF	Risso's dolphin	0	0	5.93	2.18	0	0	4.00	1.43
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0.53	0.18	0	0	0.27	0.09
HF	Harbor porpoise (sensitive)	0	0.53	123.32	1184.59	0	0.41	90.16	676.04
PW	Gray seal	0.45	0	139.84	93.54	0.36	0	94.11	61.95
PW	Harbor seal	0	0	375.08	249.22	0	0	251.40	164.80

[a]NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table 27. Construction schedule 4 (2 monopiles per day/3 pin piles per day): Mean number of marine mammals predicted to receive sound levels above exposure criteria with 10 dB attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species		Year 1				Year 2			
		Injury		Behavior		Injury		Behavior	
		L_E	L_{pk}	L_p [a]	L_p [b]	L_E	L_{pk}	L_p [a]	L_p [b]
LF	Fin whale[c]	1.12	0	7.98	8.00	0.47	0	3.79	3.71
	Minke whale (migrating)	3.15	0	63.19	228.90	1.60	0	44.91	156.60
	Humpback whale (migrating)	0.28	<0.01	8.45	41.04	0.10	0	3.94	18.17
	North Atlantic right whale[c] (migrating)	0.09	0	2.36	11.99	0.04	0	1.55	7.44
	Sei whale[c] (migrating)	0.23	<0.01	2.47	11.41	0.11	0	1.52	7.40
MF	Atlantic white-sided dolphin	0	0	110.03	35.68	0	0	56.03	17.58
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0
	Common dolphin	0	0	827.21	282.67	0	0	504.58	168.56
	Bottlenose dolphin	0	0	197.32	70.94	0	0	95.09	33.33
	Risso's dolphin	0	0	5.87	2.14	0	0	4.00	1.43
	Long-finned pilot whale	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0.53	0.18	0	0	0.27	0.09
HF	Harbor porpoise (sensitive)	0	0.53	123.11	1084.08	0	0.41	90.16	676.04
PW	Gray seal	0.45	0	139.05	91.06	0.36	0	94.11	61.95
	Harbor seal	0	0	373.70	244.10	0	0	251.40	164.80

[a]NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

4.3.1.1. Effect of Aversion

The mean exposure estimates reported in Tables 24 to 27 do not consider animals avoiding loud sounds (aversion) or implementation of mitigation measures other than sound attenuation using NAS. Some marine mammals are well known for their aversive responses to anthropogenic sound (e.g., harbor porpoise), although it is assumed that most species will avert from noise. The Wood et al. (2012) step function includes a probability of response that is based primarily on observed aversive behavior in field studies. Additional exposure estimates with aversion based on the Wood et al. (2012) response probabilities were calculated for NARW and harbor porpoise in this study. For comparative purposes only, the results are shown with and without aversion for one sample year of one construction schedule (Table 28). Aversion was not applied to exposure estimates and only presented here for comparison.

Table 28. Construction schedule 3, year 1 (2 monopiles per day/2 pin piles per day): Mean number of marine mammals predicted to receive sound levels above exposure criteria with 10 dB attenuation and with and without aversion for aversive species. Construction schedule assumptions are summarized in Section 1.2.2.

Species	10 dB attenuation – no aversion				10 dB attenuation – with aversion			
	Injury		Behavior		Injury		Behavior	
	$L_{E,24h}$	L_{pk}	L_p [a]	L_p [b]	$L_{E,24h}$	L_{pk}	L_p [a]	L_p [b]
North Atlantic right whale[c] (migrating)	0.09	0	2.36	12.40	0.01	0	1.58	11.94
Harbor porpoise (sensitive)	0	0.53	123.32	1184.59	0	0	5.12	927.11

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

4.3.2. Sea Turtles

As was done for marine mammals (see Section 4.3.1), the numbers of individual sea turtles predicted to receive sound levels above threshold criteria were determined using animal movement modeling. The construction schedules described in Section 1.2.2 were used to calculate the total number of real-world individual turtles predicted to receive sound levels above injury and behavior thresholds (Finneran et al. 2017) in the Lease Area. Tables 29 to 32 include results assuming broadband attenuation of 10 dB, calculated in the same way as the marine mammal exposures.

Table 29. Construction schedule 1 (1 monopile per day/2 pin piles per day): Mean number of sea turtles predicted to receive sound levels above exposure criteria (Finneran et al. 2017) with 10 dB attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species	Year 1			Year 2		
	Injury		Behavior	Injury		Behavior
	$L_{E,24h}$	L_{pk}	L_p	$L_{E,24h}$	L_{pk}	L_p
Kemp's ridley turtle[a]	0.33	0	5.48	0.14	0	2.74
Leatherback turtle[a]	0.03	0	1.65	0	0	0.42
Loggerhead turtle	0	0	29.57	0	0	11.72
Green turtle	<0.01	0	0.10	0	0	0.04

[a] Listed as Endangered under the ESA.

Table 30. Construction schedule 2 (1 monopile per day/3 pin piles per day): Mean number of sea turtles predicted to receive sound levels above exposure criteria (Finneran et al. 2017) with 10 dB attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species	Year 1			Year 2		
	Injury		Behavior	Injury		Behavior
	$L_{E,\,24h}$	L_{pk}	L_p	$L_{E,\,24h}$	L_{pk}	L_p
Kemp's ridley turtle[a]	0.33	0	5.48	0.14	0	2.74
Leatherback turtle[a]	0.03	0	1.65	0	0	0.42
Loggerhead turtle	0	0	29.57	0	0	11.72
Green turtle	<0.01	0	0.10	0	0	0.04

[a] Listed as Endangered under the ESA.

Table 31. Construction schedule 3 (2 monopiles per day/2 pin piles per day): Mean number of sea turtles predicted to receive sound levels above exposure criteria (Finneran et al. 2017) with 10 dB attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species	Year 1			Year 2		
	Injury		Behavior	Injury		Behavior
	$L_{E,\,24h}$	L_{pk}	L_p	$L_{E,\,24h}$	L_{pk}	L_p
Kemp's ridley turtle[a]	0.05	0	5.14	<0.01	0	2.67
Leatherback turtle[a]	0.04	0	1.26	0	0	0.32
Loggerhead turtle	0.46	0	62.83	0	0	32.77
Green turtle	<0.01	0	0.16	0	0	0.09

[a] Listed as Endangered under the ESA.

Table 32. Construction schedule 4 (2 monopiles per day/3 pin piles per day): Mean number of sea turtles predicted to receive sound levels above exposure criteria (Finneran et al. 2017) with 10 dB attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species	Year 1			Year 2		
	Injury		Behavior	Injury		Behavior
	$L_{E,\,24h}$	L_{pk}	L_p	$L_{E,\,24h}$	L_{pk}	L_p
Kemp's ridley turtle[a]	0.05	0	5.14	<0.01	0	2.67
Leatherback turtle[a]	0.04	0	1.26	0	0	0.32
Loggerhead turtle	0.46	0	62.83	0	0	32.77
Green turtle	<0.01	0	0.16	0	0	0.09

[a] Listed as Endangered under the ESA.

4.4. Exposure Range Estimates

Exposure ranges, or $ER_{95\%}$, are the horizontal distances that include 95% of the CPAs of animats exceeding a given impact threshold. These were calculated for marine mammals and sea turtles, and these results are summarized in

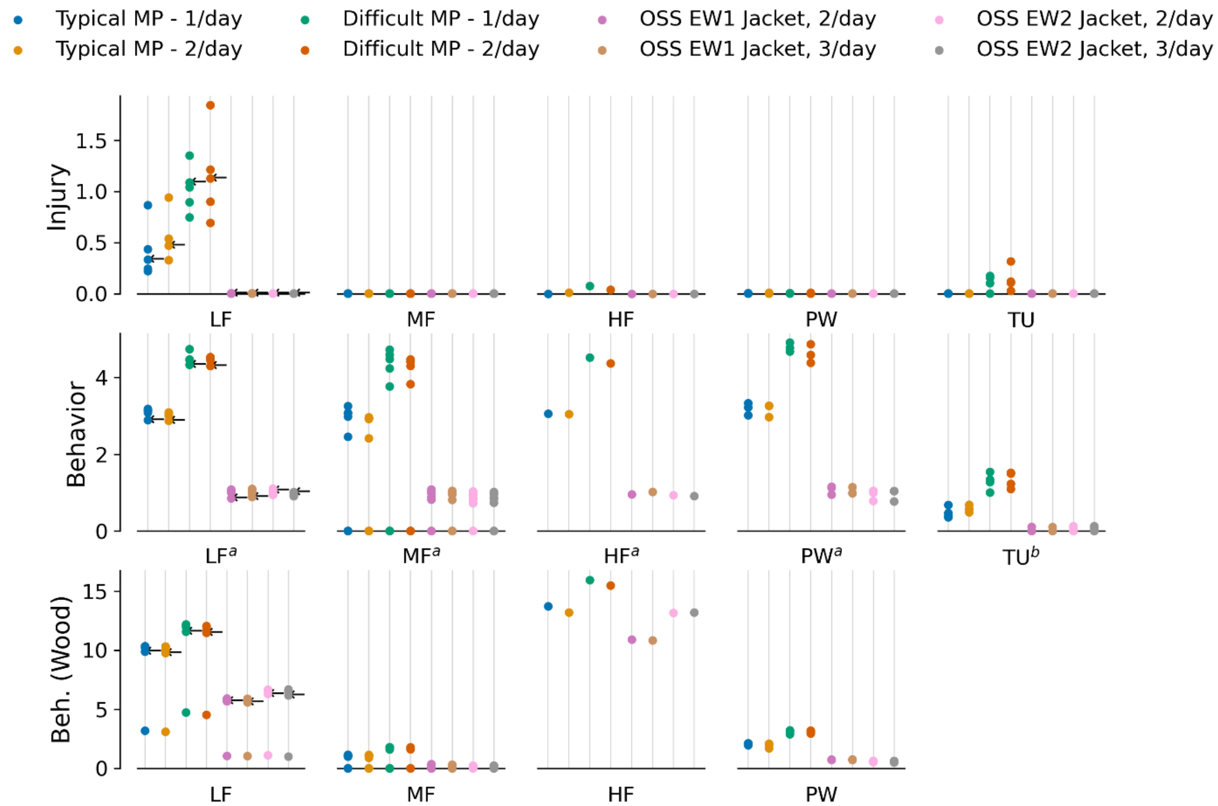

Figure 24 for each of the foundation types and installation schedules included in Section 1.2.2. Sections 4.4.1 and 4.4.2 provide additional detail for each species and metric, assuming 10 dB attenuation and a summer sound speed profile. For full results, including all modeled attenuation levels and both summer and winter sound speed profiles, see Appendix I.2.2.

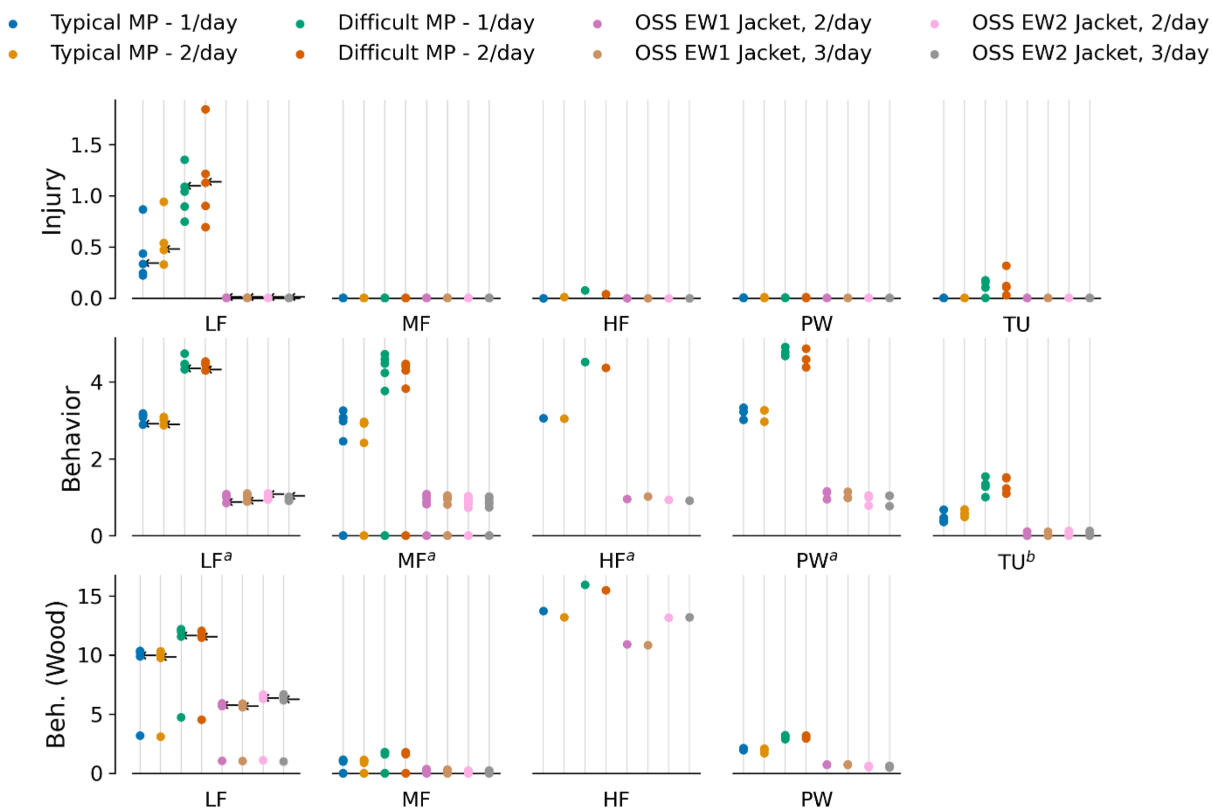

Figure 24. Maximum exposure ranges ($ER_{95\%}$) for injury and behavior thresholds, shown for each hearing group, assuming an attenuation of 10 dB and summer sound speed profile. Each dot represents a species within the indicated hearing group (LF = low frequency cetacean, MF = mid-frequency cetacean, HF = high frequency cetacean, PW = phocid pinniped in water, and TU = turtle), and dot color represents a combination of foundation type (Jacket or Monopile [MP]) and installation schedule (number of piles installed per day). Note the difference in y-axis scaling between the injury and behavior plots. Arrows indicate NARWs. Superscript a indicates that the NOAA (2005) behavioral thresholds for marine mammals were used, and superscript b indicates that the Finneran et al. (2017) behavioral threshold for turtles was used.

4.4.1. Marine Mammals

The exposure ranges, $ER_{95\%}$, to injury and behavior thresholds are summarized in Tables 33–39, assuming 10 dB broadband attenuation and a summer acoustic propagation environment for all modeled foundation types. Exposure ranges are reported for both 1 and 2 piles per day for monopile foundations, and for 2 and 3 pin piles per day for jacket foundations. Results for different seasons and at different attenuation levels can be found in Appendix I.2.2.

Table 33. 9.6 m typical monopile foundation (summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with 10 dB attenuation.

Species		One pile per day				Two piles per day			
		Injury		Behavior		Injury		Behavior	
		L_E	L_{pk}	L_p[a]	L_p[b]	L_E	L_{pk}	L_p[a]	L_p[b]
LF	Fin whale[c]	0.86	0	3.18	3.18	0.94	0	3.09	3.09
LF	Minke whale (migrating)	0.22	0	3.13	10.22	0.54	0	3.02	10.03
LF	Humpback whale (migrating)	0.24	0	3.15	10.33	0.33	0	3.01	10.31
LF	North Atlantic right whale[c] (migrating)	0.33	0	2.89	9.88	0.47	0	2.87	9.76
LF	Sei whale[c](migrating)	0.43	0	3.09	10.33	0.54	0	3.07	10.30
MF	Atlantic white-sided dolphin	0	0	2.98	1.02	0	0	2.94	1.05
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	3.07	1.11	0	0	2.92	1.10
MF	Bottlenose dolphin	0	0	2.46	0.99	0	0	2.41	0.89
MF	Risso's dolphin	0	0	3.07	1.14	0	0	2.93	1.12
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	3.25	1.13	0	0	2.96	1.13
HF	Harbor porpoise (sensitive)	0	0	3.07	13.74	0	<0.01	3.05	13.21
PW	Gray seal	0	0	3.33	2.12	<0.01	0	3.26	2.08
PW	Harbor seal	0	0	3.02	1.95	0	0	2.97	1.69

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table 34. 9.6 m difficult to drive monopile foundation (summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with 10 dB attenuation.

	Species	One pile per day				Two piles per day			
		Injury		Behavior		Injury		Behavior	
		L_E	L_{pk}	L_p [a]	L_p [b]	L_E	L_{pk}	L_p [a]	L_p [b]
LF	Fin whale[c]	1.35	0	4.74	4.73	1.84	0	4.51	4.53
	Minke whale (migrating)	0.89	0	4.46	11.97	0.90	0	4.45	11.63
	Humpback whale(migrating)	0.74	<0.01	4.47	12.18	0.69	0	4.53	11.96
	North Atlantic right whale[c] (migrating)	1.09	0	4.33	11.56	1.13	0	4.30	11.47
	Sei whale[c] (migrating)	1.04	<0.01	4.47	12.15	1.21	0	4.52	12.04
MF	Atlantic white-sided dolphin	0	0	4.24	1.78	0	0	4.30	1.72
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0
	Common dolphin	0	0	4.48	1.75	0	0	4.42	1.78
	Bottlenose dolphin	0	0	3.77	1.60	0	0	3.83	1.61
	Risso's dolphin	0	0	4.73	1.76	0	0	4.41	1.73
	Long-finned pilot whale	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	4.59	1.79	0	0	4.47	1.66
HF	Harbor porpoise (sensitive)	0	0.08	4.52	15.95	0	0.04	4.37	15.49
PW	Gray seal	<0.01	0	4.91	3.21	<0.01	0	4.87	3.19
	Harbor seal	0	0	4.68	2.88	0	0	4.38	2.95

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table 35. 11 m U3 monopile foundation (summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with 10 dB attenuation.

Species		One pile per day				Two piles per day			
		Injury		Behavior		Injury		Behavior	
		L_E	L_{pk}	L_p [a]	L_p [b]	L_E	L_{pk}	L_p [a]	L_p [b]
LF	Fin whale[c]	0.90	0	2.65	2.60	0.58	0	2.48	2.37
	Minke whale (migrating)	0.02	0	2.32	8.19	0.16	0	2.27	8.18
	Humpback whale(migrating)	<0.01	<0.01	2.26	8.34	0.11	0	2.31	8.28
	North Atlantic right whale[c] (migrating)	0.37	0	2.21	8.15	0.28	0	2.20	7.90
	Sei whale[c] (migrating)	0.13	0	2.33	8.38	0.23	0	2.47	8.32
MF	Atlantic white-sided dolphin	0	0	2.24	0.61	0	0	2.23	0.67
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0
	Common dolphin	0	0	2.38	0.72	0	0	2.41	0.72
	Bottlenose dolphin	0	0	1.92	0.60	0	0	1.95	0.63
	Risso's dolphin	0	0	2.41	0.65	0	0	2.40	0.68
	Long-finned pilot whale	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	2.36	0.74	0	0	2.26	0.63
HF	Harbor porpoise (sensitive)	0	0	2.19	10.84	0	<0.01	2.28	10.67
PW	Gray seal	0	0	2.60	1.49	<0.01	<0.01	2.58	1.54
	Harbor seal	0	0	2.50	1.44	0	0	2.36	1.40

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table 36. 11 m T1 monopile foundation (summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with 10 dB attenuation.

	Species	One pile per day				Two piles per day			
		Injury		Behavior		Injury		Behavior	
		L_E	L_{pk}	L_p [a]	L_p [b]	L_E	L_{pk}	L_p [a]	L_p [b]
LF	Fin whale[c]	0.87	0	3.32	3.31	0.83	0	3.16	3.18
LF	Minke whale (migrating)	0.17	0	3.10	9.95	0.35	0	2.98	9.75
LF	Humpback whale(migrating)	0.25	0	3.01	10.17	0.16	0	3.10	10.09
LF	North Atlantic right whale[c] (migrating)	0.20	0	3.09	9.73	0.44	0	2.93	9.48
LF	Sei whale[c] (migrating)	0.44	0	3.19	10.04	0.27	0	3.26	9.90
MF	Atlantic white-sided dolphin	0	0	2.97	0.99	0	0	2.98	0.96
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	3.08	1.08	0	0	2.94	1.05
MF	Bottlenose dolphin	0	0	2.60	1.00	0	0	2.62	0.89
MF	Risso's dolphin	0	0	3.21	1.06	0	0	3.11	1.08
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	3.40	1.03	0	0	3.19	1.10
HF	Harbor porpoise (sensitive)	0	0	3.06	12.97	0	<0.01	3.04	12.72
PW	Gray seal	0	0	3.39	2.16	0	0	3.40	2.24
PW	Harbor seal	0	0	3.25	2.01	0	0	3.09	1.91

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table 37. 11 m R3 monopile foundation (summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with 10 dB attenuation.

	Species	One pile per day				Two piles per day			
		Injury		Behavior		Injury		Behavior	
		L_E	L_{pk}	L_p [a]	L_p [b]	L_E	L_{pk}	L_p [a]	L_p [b]
LF	Fin whale[c]	0.87	0	3.02	3.02	0.43	0	2.89	2.89
LF	Minke whale (migrating)	0.16	0	2.78	9.20	0.26	0	2.82	8.93
LF	Humpback whale(migrating)	0.14	0	2.68	9.11	0.15	0	2.79	9.11
LF	North Atlantic right whale[c] (migrating)	0.20	0	2.72	8.69	0.37	0	2.67	8.63
LF	Sei whale[c] (migrating)	0.31	0	2.96	9.01	0.27	<0.01	2.91	8.86
MF	Atlantic white-sided dolphin	0	0	2.75	0.80	0	0	2.73	0.88
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	2.86	0.92	0	0	2.76	0.93
MF	Bottlenose dolphin	0	0	2.29	0.91	0	0	2.32	0.79
MF	Risso's dolphin	0	0	2.86	0.79	0	0	2.79	0.92
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	2.77	0.74	0	0	2.86	0.94
HF	Harbor porpoise (sensitive)	0	0	2.76	11.74	0	<0.01	2.73	11.71
PW	Gray seal	0	0	2.87	1.88	0	0	3.01	1.91
PW	Harbor seal	0	0	2.91	1.73	0	0	2.75	1.74

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table 38. OSS1 jacket foundation (summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with 10 dB attenuation.

	Species	Two pin piles per day				Three pin piles per day			
		Injury		Behavior		Injury		Behavior	
		L_E	L_{pk}	L_p [a]	L_p [b]	L_E	L_{pk}	L_p [a]	L_p [b]
LF	Fin whale[c]	0	0	1.04	1.05	0	0	1.10	1.04
LF	Minke whale (migrating)	0	0	1.00	5.68	0	0	0.99	5.68
LF	Humpback whale (migrating)	0	0	1.02	5.91	0	0	1.02	5.85
LF	North Atlantic right whale[c] (migrating)	0	0	0.85	5.69	0	0	0.89	5.58
LF	Sei whale[c] (migrating)	<0.01	0	1.08	5.87	<0.01	0	1.04	5.89
MF	Atlantic white-sided dolphin	0	0	0.98	0.17	0	0	0.98	0.17
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	1.03	0.18	0	0	1.03	0.20
MF	Bottlenose dolphin	0	0	0.82	0.13	0	0	0.81	0.15
MF	Risso's dolphin	0	0	1.08	0.36	0	0	1.05	0.27
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0.88	0.32	0	0	0.95	0.31
HF	Harbor porpoise (sensitive)	0	0	0.95	10.90	0	0	1.02	10.86
PW	Gray seal	0	0	1.15	0.71	0	0	1.14	0.70
PW	Harbor seal	0	0	1.12	0.73	0	0	0.99	0.75

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table 39. OSS2 jacket foundation (summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with 10 dB attenuation.

Species		Two pin piles per day				Three pin piles per day			
		Injury		Behavior		Injury		Behavior	
		L_E	L_{pk}	L_p [a]	L_p [b]	L_E	L_{pk}	L_p [a]	L_p [b]
LF	Fin whale[c]	0	0	1.10	1.10	0	0	0.99	0.99
	Minke whale (migrating)	0	0	1.01	6.54	0	0	1.01	6.47
	Humpback whale (migrating)	0	0	0.94	6.66	0	0	0.93	6.57
	North Atlantic right whale[c] (migrating)	0	0	1.06	6.29	0	0	1.01	6.17
	Sei whale[c] (migrating)	0	0	0.94	6.58	0	0	0.91	6.67
MF	Atlantic white-sided dolphin	0	0	0.82	0.22	0	0	0.84	0.23
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0.96	0.23	0	0	0.96	0.22
	Bottlenose dolphin	0	0	0.72	0.15	0	0	0.74	0.14
	Risso's dolphin	0	0	0.87	0.19	0	0	0.86	0.20
	Long-finned pilot whale	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	1.03	0.13	0	0	1.02	0.15
HF	Harbor porpoise (sensitive)	0	0	0.94	13.18	0	0	0.92	13.20
PW	Gray seal	0	0	0.78	0.63	0	0	0.77	0.62
	Harbor seal	0	0	1.05	0.53	0	0	1.04	0.50

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

4.4.2. Sea Turtles

Similar to the results presented for marine mammals (Section 4.4.1), the exposure ranges ($ER_{95\%}$) for sea turtles are summarized in Tables 40–46, assuming 10 dB broadband attenuation and a summer acoustic propagation environment. Results for different seasons and at different attenuation levels can be found in Appendix I.2.2.2.

Table 40. 9.6 m typical monopile foundation (summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria with 10 dB attenuation.

Species	One pile per day			Two piles per day		
	Injury		Behavior	Injury		Behavior
	L_E	L_{pk}	L_p	L_E	L_{pk}	L_p
Kemp's ridley turtle[a]	<0.01	0	0.47	0	0	0.57
Leatherback turtle[a]	0	0	0.68	0	0	0.68
Loggerhead turtle	0	0	0.38	0	0	0.49
Green turtle	0	0	0.36	0	0	0.57

[a] Listed as Endangered under the ESA.

Table 41. 9.6 m difficult to drive monopile foundation (summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria with 10 dB attenuation.

Species	One pile per day			Two piles per day		
	Injury		Behavior	Injury		Behavior
	L_E	L_{pk}	L_p	L_E	L_{pk}	L_p
Kemp's ridley turtle[a]	0.10	0	1.27	0.12	0	1.23
Leatherback turtle[a]	0.15	0	1.54	0.31	0	1.52
Loggerhead turtle	0	0	1.00	0.03	0	1.09
Green turtle	0.17	0	1.34	0.11	0	1.50

[a] Listed as Endangered under the ESA.

Table 42. 11 m U3 monopile foundation (summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria with 10 dB attenuation.

Species	One pile per day			Two piles per day		
	Injury		Behavior	Injury		Behavior
	L_E	L_{pk}	L_p	L_E	L_{pk}	L_p
Kemp's ridley turtle[a]	0	0	0.36	0	0	0.32
Leatherback turtle[a]	0	0	0.15	0	0	0.44
Loggerhead turtle	0	0	0.17	0	0	0.21
Green turtle	0	0	0.17	0	0	0.38

[a] Listed as Endangered under the ESA

Table 43. 11 m T1 monopile foundation (summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria with 10 dB attenuation.

Species	One pile per day			Two piles per day		
	Injury		Behavior	Injury		Behavior
	L_E	L_{pk}	L_p	L_E	L_{pk}	L_p
Kemp's ridley turtle[a]	0	0	0.44	0	0	0.59
Leatherback turtle[a]	0	0	0.74	0	0	0.81
Loggerhead turtle	0	0	0.39	0	0	0.49
Green turtle	0	0	0.81	0	0	0.71

[a] Listed as Endangered under the ESA

Table 44. 11 m R3 monopile foundation (summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria with 10 dB attenuation.

Species	One pile per day			Two piles per day		
	Injury		Behavior	Injury		Behavior
	L_E	L_{pk}	L_p	L_E	L_{pk}	L_p
Kemp's ridley turtle[a]	<0.01	0	0.50	0	0	0.51
Leatherback turtle[a]	0	0	0.71	0	0	0.71
Loggerhead turtle	0	0	0.39	0	0	0.45
Green turtle	0	0	0.45	0	0	0.48

[a] Listed as Endangered under the ESA

Table 45. OSS1 Jacket foundation (summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria with 10 dB attenuation.

Species	Two pin piles per day			Three pin piles per day		
	Injury		Behavior	Injury		Behavior
	L_E	L_{pk}	L_p	L_E	L_{pk}	L_p
Kemp's ridley turtle[a]	0	0	0.11	0	0	0.10
Leatherback turtle[a]	0	0	0	0	0	0
Loggerhead turtle	0	0	0	0	0	0
Green turtle	0	0	0	0	0	0

[a] Listed as Endangered under the ESA.

Table 46. OSS2 Jacket foundation (summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria with 10 dB attenuation.

Species	Two pin piles per day			Three pin piles per day		
	Injury		Behavior	Injury		Behavior
	L_E	L_{pk}	L_p	L_E	L_{pk}	L_p
Kemp's ridley turtle[a]	0	0	0.07	0	0	0.07
Leatherback turtle[a]	0	0	0	0	0	0
Loggerhead turtle	0	0	0	0	0	0
Green turtle	0	0	0.12	0	0	0.12

[a] Listed as Endangered under the ESA.

4.5. Fish and Sea Turtle Acoustic Range Estimates

Although some fish may move during pile driving, they were considered static receivers and acoustic distances where sound levels could exceed fish regulatory thresholds were determined using a maximum-over-depth approach and finding the distance that encompasses at least 95% of the azimuthal area that would be exposed to sound at or above the specified level (Appendix G.3). The calculated acoustic distances for fish to the GARFO (2020) and Popper et al. (2014) thresholds (Andersson et al. 2007, Wysocki et al. 2007, FHWG 2008, Stadler and Woodbury 2009, Mueller-Blenkle et al. 2010, Purser and Radford 2011, Popper et al. 2014) with 10 dB of broadband attenuation are shown in Table 47 through Table 62 (tables with 0, 6, and 15 dB attenuation can be found in Appendix H.5).

Table 47. 9.6 m typical monopile foundation (IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at modeling location L01 for different hammer energy levels with 10 dB attenuation, for one foundation.

Faunal group	Metric	Threshold	Hammer energy in kJ									
			Summer					Winter				
			450	800	1400	1700	2300	450	800	1400	1700	2300
Fish equal to or greater than 2 g	L_E [a]	187	2.59					2.78				
	L_{pk} [a]	206	-	-	0.03	0.04	0.05	-	-	0.03	0.04	0.05
	L_p [b]	150	2.77	3.67	4.63	4.93	5.15	3.09	4.12	5.29	5.64	5.90
Fish less than 2 g	L_E [a]	183	3.48					3.87				
	L_{pk} [a]	206	-	-	0.03	0.04	0.05	-	-	0.03	0.04	0.05
	L_p [b]	150	2.77	3.67	4.63	4.93	5.15	3.09	4.12	5.29	5.64	5.90
Fish without swim bladder	L_E [c]	216	0.06					0.06				
	L_{pk} [c]	213	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.47					0.50				
	L_{pk} [c]	207	-	-	0.02	0.03	0.05	-	-	0.02	0.03	0.05
Fish with swim bladder involved in hearing	L_E [c]	203	0.47					0.50				
	L_{pk} [c]	207	-	-	0.02	0.03	0.05	-	-	0.02	0.03	0.05
Sea turtles	L_E [d]	204	0.41					0.44				
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.15	0.27	0.45	0.52	0.68	0.16	0.28	0.46	0.56	0.72

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table 48. 9.6 m typical monopile foundation (IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at modeling location L02 for different hammer energy levels with 10 dB attenuation, for one foundation.

Faunal group	Metric	Threshold	Hammer energy in kJ									
			Summer					Winter				
			450	800	1400	1700	2300	450	800	1400	1700	2300
Fish equal to or greater than 2 g	L_E [a]	187	2.96					3.26				
	L_{pk} [a]	206	-	0.01	0.02	0.04	0.06	-	0.01	0.02	0.04	0.06
	L_p [b]	150	3.37	4.42	5.54	5.88	6.08	3.75	5.01	6.42	6.81	6.86
Fish less than 2 g	L_E [a]	183	4.09					4.48				
	L_{pk} [a]	206	-	0.01	0.02	0.04	0.06	-	0.01	0.02	0.04	0.06
	L_p [b]	150	3.37	4.42	5.54	5.88	6.08	3.75	5.01	6.42	6.81	6.86
Fish without swim bladder	L_E [c]	216	0.07					0.07				
	L_{pk} [c]	213	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.52					0.55				
	L_{pk} [c]	207	-	0.01	0.01	0.02	0.05	-	0.01	0.01	0.01	0.05
Fish with swim bladder involved in hearing	L_E [c]	203	0.52					0.55				
	L_{pk} [c]	207	-	0.01	0.01	0.02	0.05	-	0.01	0.01	0.01	0.05
Sea turtles	L_E [d]	204	0.46					0.48				
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.16	0.30	0.43	0.59	0.77	0.15	0.30	0.46	0.61	0.80

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table 49. 9.6 m typical monopile foundation (IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at modeling location L03 for different hammer energy levels with 10 dB attenuation, for one foundation.

Faunal group	Metric	Threshold	Hammer energy in kJ									
			Summer					Winter				
			450	800	1400	1700	2300	450	800	1400	1700	2300
Fish equal to or greater than 2 g	L_E [a]	187	3.19					3.46				
	L_{pk} [a]	206	-	-	0.02	0.04	0.06	-	-	0.02	0.03	0.06
	L_p [b]	150	3.68	4.72	5.85	6.14	6.62	4.04	5.29	6.74	6.95	7.66
Fish less than 2 g	L_E [a]	183	4.34					4.74				
	L_{pk} [a]	206	-	-	0.02	0.04	0.06	-	-	0.02	0.03	0.06
	L_p [b]	150	3.68	4.72	5.85	6.14	6.62	4.04	5.29	6.74	6.95	7.66
Fish without swim bladder	L_E [c]	216	0.08					0.08				
	L_{pk} [c]	213	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.54					0.57				
	L_{pk} [c]	207	-	-	-	0.02	0.05	-	-	-	0.02	0.05
Fish with swim bladder involved in hearing	L_E [c]	203	0.54					0.57				
	L_{pk} [c]	207	-	-	-	0.02	0.05	-	-	-	0.02	0.05
Sea turtles	L_E [d]	204	0.44					0.46				
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.17	0.32	0.47	0.64	0.72	0.16	0.32	0.48	0.66	0.75

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table 50. 9.6 m difficult to drive monopile foundation (IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds modeling location L01 for different energy levels with 10 dB attenuation, for one foundation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
Fish equal to or greater than 2 g	L_E [a]	187	3.83						4.21					
	L_{pk} [a]	206	-	-	0.03	0.04	0.05	0.07	-	-	0.03	0.04	0.05	0.08
	L_p [b]	150	2.77	3.67	4.63	4.93	5.18	6.66	3.09	4.12	5.29	5.64	5.98	8.14
Fish less than 2 g	L_E [a]	183	4.75						5.37					
	L_{pk} [a]	206	-	-	0.03	0.04	0.05	0.07	-	-	0.03	0.04	0.05	0.08
	L_p [b]	150	2.77	3.67	4.63	4.93	5.18	6.66	3.09	4.12	5.29	5.64	5.98	8.14
Fish without swim bladder	L_E [c]	216	0.15						0.15					
	L_{pk} [c]	213	-	-	-	-	-	0.02	-	-	-	-	-	0.02
Fish with swim bladder not involved in hearing	L_E [c]	203	0.97						1.05					
	L_{pk} [c]	207	-	-	0.02	0.03	0.05	0.06	-	-	0.02	0.03	0.05	0.07
Fish with swim bladder involved in hearing	L_E [c]	203	0.97						1.05					
	L_{pk} [c]	207	-	-	0.02	0.03	0.05	0.06	-	-	0.02	0.03	0.05	0.07
Sea turtles	L_E [d]	204	0.88						0.92					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.15	0.27	0.45	0.52	0.66	1.31	0.16	0.28	0.46	0.56	0.69	1.37

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table 51. 9.6 m difficult to drive monopile foundation (IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds modeling location L02 for different energy levels with 10 dB attenuation, for one foundation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
Fish equal to or greater than 2 g	L_E [a]	187	4.44						4.83					
	L_{pk} [a]	206	-	0.01	0.02	0.04	0.06	0.09	-	0.01	0.02	0.04	0.06	0.10
	L_p [b]	150	3.37	4.42	5.54	5.88	6.15	7.86	3.75	5.01	6.42	6.81	7.08	9.12
Fish less than 2 g	L_E [a]	183	5.58						6.23					
	L_{pk} [a]	206	-	0.01	0.02	0.04	0.06	0.09	-	0.01	0.02	0.04	0.06	0.10
	L_p [b]	150	3.37	4.42	5.54	5.88	6.15	7.86	3.75	5.01	6.42	6.81	7.08	9.12
Fish without swim bladder	L_E [c]	216	0.15						0.16					
	L_{pk} [c]	213	-	-	-	-	-	0.01	-	-	-	-	-	0.01
Fish with swim bladder not involved in hearing	L_E [c]	203	1.16						1.21					
	L_{pk} [c]	207	-	0.01	0.01	0.02	0.05	0.09	-	0.01	0.01	0.01	0.05	0.09
Fish with swim bladder involved in hearing	L_E [c]	203	1.16						1.21					
	L_{pk} [c]	207	-	0.01	0.01	0.02	0.05	0.09	-	0.01	0.01	0.01	0.05	0.09
Sea turtles	L_E [d]	204	1.00						1.05					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.16	0.30	0.43	0.59	0.75	1.50	0.15	0.30	0.46	0.61	0.78	1.56

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table 52. 9.6 m difficult to drive monopile foundation (IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds modeling location L03 for different energy levels with 10 dB attenuation, for one foundation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
Fish equal to or greater than 2 g	L_E [a]	187	4.77						5.20					
	L_{pk} [a]	206	-	-	0.02	0.04	0.06	0.10	-	-	0.02	0.03	0.06	0.11
	L_p [b]	150	3.68	4.72	5.85	6.14	6.43	8.23	4.04	5.29	6.74	6.95	7.22	9.28
Fish less than 2 g	L_E [a]	183	5.97						6.64					
	L_{pk} [a]	206	-	-	0.02	0.04	0.06	0.10	-	-	0.02	0.03	0.06	0.11
	L_p [b]	150	3.68	4.72	5.85	6.14	6.43	8.23	4.04	5.29	6.74	6.95	7.22	9.28
Fish without swim bladder	L_E [c]	216	0.15						0.16					
	L_{pk} [c]	213	-	-	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	1.21						1.27					
	L_{pk} [c]	207	-	-	-	0.02	0.06	0.09	-	-	-	0.02	0.05	0.09
Fish with swim bladder involved in hearing	L_E [c]	203	1.21						1.27					
	L_{pk} [c]	207	-	-	-	0.02	0.06	0.09	-	-	-	0.02	0.05	0.09
Sea turtles	L_E [d]	204	1.01						1.08					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.17	0.32	0.47	0.64	0.78	1.59	0.16	0.32	0.48	0.66	0.82	1.67

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 (dB re 1 μPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table 53. 11m monopile foundation (IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at modeling location R3-L04 for different hammer energy levels with 10 dB attenuation, for one foundation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			450	750	1100	2000	450	750	1100	2000
Fish equal to or greater than 2 g	L_E [a]	187	2.41				2.58			
	L_{pk} [a]	206	0.01	0.01	0.01	0.05	0.01	0.01	0.01	0.05
	L_p [b]	150	3.52	3.87	4.32	5.21	3.87	4.31	4.89	5.97
Fish less than 2 g	L_E [a]	183	3.25				3.61			
	L_{pk} [a]	206	0.01	0.01	0.01	0.05	0.01	0.01	0.01	0.05
	L_p [b]	150	3.52	3.87	4.32	5.21	3.87	4.31	4.89	5.97
Fish without swim bladder	L_E [c]	216	0.06				0.06			
	L_{pk} [c]	213	-	-	-	0.01	-	-	-	0.01
Fish with swim bladder not involved in hearing	L_E [c]	203	0.40				0.41			
	L_{pk} [c]	207	0.01	0.01	0.01	0.04	0.01	0.01	0.01	0.04
Fish with swim bladder involved in hearing	L_E [c]	203	0.40				0.41			
	L_{pk} [c]	207	0.01	0.01	0.01	0.04	0.01	0.01	0.01	0.04
Sea turtles	L_E [d]	204	0.37				0.38			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.23	0.28	0.35	0.61	0.24	0.29	0.36	0.64

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table 54. 11m monopile foundation (IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at modeling location T1-L05 for different hammer energy levels with 10 dB attenuation, for one foundation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
Fish equal to or greater than 2 g	L_E [a]	187	2.56						2.72					
	L_{pk} [a]	206	-	-	-	0.04	0.05	0.06	-	-	-	0.03	0.05	0.06
	L_p [b]	150	3.54	3.97	4.34	4.97	5.38	5.66	3.88	4.41	4.89	5.65	6.16	6.54
Fish less than 2 g	L_E [a]	183	3.45						3.79					
	L_{pk} [a]	206	-	-	-	0.04	0.05	0.06	-	-	-	0.03	0.05	0.06
	L_p [b]	150	3.54	3.97	4.34	4.97	5.38	5.66	3.88	4.41	4.89	5.65	6.16	6.54
Fish without swim bladder	L_E [c]	216	0.06						0.06					
	L_{pk} [c]	213	-	-	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.44						0.46					
	L_{pk} [c]	207	-	-	-	0.02	0.05	0.06	-	-	-	0.02	0.04	0.06
Fish with swim bladder involved in hearing	L_E [c]	203	0.44						0.46					
	L_{pk} [c]	207	-	-	-	0.02	0.05	0.06	-	-	-	0.02	0.04	0.06
Sea turtles	L_E [d]	204	0.40						0.41					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.23	0.29	0.34	0.48	0.65	0.76	0.24	0.30	0.35	0.52	0.68	0.82

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table 55. 11m monopile foundation (IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at modeling location U3-L06 for different hammer energy levels with 10 dB attenuation, for one foundation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			450	750	1000	1300	450	750	1000	1300
Fish equal to or greater than 2 g	L_E [a]	187	2.62				2.79			
	L_{pk} [a]	206	--	--	--	0.04	--	--	--	0.03
	L_p [b]	150	3.54	4.06	4.46	4.77	3.88	4.52	5.01	5.39
Fish less than 2 g	L_E [a]	183	3.58				3.94			
	L_{pk} [a]	206	--	--	--	0.04	--	--	--	0.03
	L_p [b]	150	3.54	4.06	4.46	4.77	3.88	4.52	5.01	5.39
Fish without swim bladder	L_E [c]	216	0.06				0.06			
	L_{pk} [c]	213	--	--	--	--	--	--	--	--
Fish with swim bladder not involved in hearing	L_E [c]	203	0.46				0.48			
	L_{pk} [c]	207	--	--	--	0.02	--	--	--	--
Fish with swim bladder involved in hearing	L_E [c]	203	0.46				0.48			
	L_{pk} [c]	207	--	--	--	0.02	--	--	--	--
Sea turtles	L_E [d]	204	0.41				0.42			
	L_{pk} [d]	232	--	--	--	--	--	--	--	--
	L_p [e]	175	0.21	0.29	0.39	0.47	0.22	0.30	0.40	0.50

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table 56. 11m monopile foundation (IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at modeling location R3-L07 for different hammer energy levels with 10 dB attenuation, for one foundation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			450	750	1100	2000	450	750	1100	2000
Fish equal to or greater than 2 g	L_E [a]	187	2.69				2.84			
	L_{pk} [a]	206	-	-	0.02	0.06	-	-	-	0.06
	L_p [b]	150	4.00	4.38	4.90	5.86	4.34	4.86	5.53	6.63
Fish less than 2 g	L_E [a]	183	3.73				4.04			
	L_{pk} [a]	206	-	-	0.02	0.06	-	-	-	0.06
	L_p [b]	150	4.00	4.38	4.90	5.86	4.34	4.86	5.53	6.63
Fish without swim bladder	L_E [c]	216	0.06				0.06			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.46				0.47			
	L_{pk} [c]	207	-	-	-	0.06	-	-	-	0.06
Fish with swim bladder involved in hearing	L_E [c]	203	0.46				0.47			
	L_{pk} [c]	207	-	-	-	0.06	-	-	-	0.06
Sea turtles	L_E [d]	204	0.36				0.36			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.27	0.32	0.38	0.62	0.27	0.32	0.40	0.66

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table 57. 11m monopile foundation (IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at modeling location T1-L08 for different hammer energy levels with 10 dB attenuation, for one foundation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
Fish equal to or greater than 2 g	L_E [a]	187	2.89						3.14					
	L_{pk} [a]	206	-	-	-	0.05	0.06	0.07	-	-	-	0.04	0.06	0.07
	L_p [b]	150	4.11	4.62	5.05	5.81	6.25	6.59	4.45	5.11	5.67	6.51	7.09	7.51
Fish less than 2 g	L_E [a]	183	4.03						4.35					
	L_{pk} [a]	206	-	-	-	0.05	0.06	0.07	-	-	-	0.04	0.06	0.07
	L_p [b]	150	4.11	4.62	5.05	5.81	6.25	6.59	4.45	5.11	5.67	6.51	7.09	7.51
Fish without swim bladder	L_E [c]	216	0.07						0.07					
	L_{pk} [c]	213	-	-	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.48						0.51					
	L_{pk} [c]	207	-	-	-	0.02	0.05	0.06	-	-	-	0.02	0.05	0.06
Fish with swim bladder involved in hearing	L_E [c]	203	0.48						0.51					
	L_{pk} [c]	207	-	-	-	0.02	0.05	0.06	-	-	-	0.02	0.05	0.06
Sea turtles	L_E [d]	204	0.41						0.42					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.22	0.33	0.38	0.57	0.70	0.84	0.24	0.33	0.39	0.59	0.73	0.87

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table 58. 11m monopile foundation (IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at modeling location U3-L09 for different hammer energy levels with 10 dB attenuation, for one foundation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			450	750	1000	1300	450	750	1000	1300
Fish equal to or greater than 2 g	L_E [a]	187	2.91				3.18			
	L_{pk} [a]	206	0.01	0.01	0.01	0.04	0.01	0.01	0.01	0.04
	L_p [b]	150	3.99	4.55	5.00	5.35	4.31	5.03	5.56	5.96
Fish less than 2 g	L_E [a]	183	4.04				4.39			
	L_{pk} [a]	206	0.01	0.01	0.01	0.04	0.01	0.01	0.01	0.04
	L_p [b]	150	3.99	4.55	5.00	5.35	4.31	5.03	5.56	5.96
Fish without swim bladder	L_E [c]	216	0.07				0.07			
	L_{pk} [c]	213	-	-	0.01	0.01	-	-	0.01	0.01
Fish with swim bladder not involved in hearing	L_E [c]	203	0.49				0.52			
	L_{pk} [c]	207	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fish with swim bladder involved in hearing	L_E [c]	203	0.49				0.52			
	L_{pk} [c]	207	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sea turtles	L_E [d]	204	0.43				0.44			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.21	0.33	0.42	0.48	0.21	0.33	0.44	0.52

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table 59. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS1 for different hammer energy levels with 10 dB attenuation, for 2 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	2000	3200	500	750	2000	3200
Fish equal to or greater than 2 g	L_E [a]	187	1.11				1.09			
	L_{pk} [a]	206	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
	L_p [b]	150	1.51	1.92	2.78	3.13	1.59	2.02	2.87	3.25
Fish less than 2 g	L_E [a]	183	1.72				1.74			
	L_{pk} [a]	206	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
	L_p [b]	150	1.51	1.92	2.78	3.13	1.59	2.02	2.87	3.25
Fish without swim bladder	L_E [c]	216	0.01				0.01			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.11				0.11			
	L_{pk} [c]	207	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
Fish with swim bladder involved in hearing	L_E [c]	203	0.11				0.11			
	L_{pk} [c]	207	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
Sea turtles	L_E [d]	204	0.10				0.10			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.04	0.04	0.12	0.15	0.04	0.04	0.12	0.16

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table 60. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS1 for different hammer energy levels with 10 dB attenuation, for 3 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	2000	3200	500	750	2000	3200
Fish equal to or greater than 2 g	L_E [a]	187	1.35				1.35			
	L_{pk} [a]	206	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
	L_p [b]	150	1.51	1.92	2.78	3.13	1.59	2.02	2.87	3.25
Fish less than 2 g	L_E [a]	183	2.02				2.07			
	L_{pk} [a]	206	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
	L_p [b]	150	1.51	1.92	2.78	3.13	1.59	2.02	2.87	3.25
Fish without swim bladder	L_E [c]	216	0.01				0.01			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.14				0.14			
	L_{pk} [c]	207	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
Fish with swim bladder involved in hearing	L_E [c]	203	0.14				0.14			
	L_{pk} [c]	207	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
Sea turtles	L_E [d]	204	0.12				0.12			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.04	0.04	0.12	0.15	0.04	0.04	0.12	0.16

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table 61. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS2 for different hammer energy levels with 10 dB attenuation, for 2 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	3200	500	750	1100	3200
Fish equal to or greater than 2 g	L_E [a]	187	1.02				1.04			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	1.60	2.38	2.35	3.23	1.67	2.54	2.36	3.20
Fish less than 2 g	L_E [a]	183	1.70				1.74			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	1.60	2.38	2.35	3.23	1.67	2.54	2.36	3.20
Fish without swim bladder	L_E [c]	216	-				-			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.09				0.10			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.09				0.10			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.06				0.07			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.04	0.06	0.06	0.14	0.04	0.06	0.06	0.14

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table 62. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS2 for different hammer energy levels with 10 dB attenuation, for 3 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	3200	500	750	1100	3200
Fish equal to or greater than 2 g	L_E [a]	187	1.32				1.34			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	1.60	2.38	2.35	3.23	1.67	2.54	2.36	3.20
Fish less than 2 g	L_E [a]	183	2.06				2.12			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	1.60	2.38	2.35	3.23	1.67	2.54	2.36	3.20
Fish without swim bladder	L_E [c]	216	0.00				0.00			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.12				0.12			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.12				0.12			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.10				0.10			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.04	0.06	0.06	0.14	0.04	0.06	0.06	0.14

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

5. Summary

This study predicted underwater sound levels associated with the installation of piles supporting WTG and OSS foundations. While a range of potential monopile diameters remains under consideration, a monopile diameter of 9.6 m was selected for modeling as representative of the most likely scenario based on currently available data. The jacket foundations use 2.5 m diameter pin piles. Sounds fields produced during impact pile driving for installation of the monopile and jacket foundations were found by a three-step process: First, the force applied by the impact hammer at the top of the pile was computed. Second, JASCO's PDSM was used to model the vibration of the pile and to obtain a point-source array representation of the sound radiating from the pile due to such vibrations. Third, JASCO's FWRAM model was used to propagate this sound field into the environment. Acoustic ranges to injury and behavioral thresholds were calculated for installation of the monopile and jacket foundations (see Section 4.5 and Appendix G).

Sound fields were sampled by simulating animal movement within the sound fields and determining if simulated marine mammal and sea turtle animats (simulated animals) exceed regulatory thresholds. For those animats that exceeded thresholds, the closest point of approach to the source was found and the distance accounting for 95% of exceedances was reported as the exposure range, $ER_{95\%}$. The species-specific $ER_{95\%}$ (see tables in Section 4.4) were determined with different broadband attenuation levels (0, 6, 10, and 15 dB) to account for the use of noise reduction systems, such as bubble curtains. $ER_{95\%}$ can be used for mitigation purposes, like establishing monitoring areas or shutdown zones. Fish were considered as static receivers, so exposure ranges were not calculated. Instead, the acoustic distance to their regulatory thresholds were determined and reported, with the different broadband attenuation levels (see tables in Section 4.5).

Exposure estimates (Section 4.3) and exposure ranges (Section 4.4) for monopile and jacket foundation installation were calculated for four different construction schedules over the two-year construction period. The construction schedules are based on the conservative assumption that a maximum of 24 monopiles could be installed per month, with a maximum of 96 monopiles per year, and that the maximum monthly number would be installed in the four highest density months for each species during the May to December period (Section 1.2.2).

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Appendix A. Glossary

1/3-octave

One third of an octave. Note: A one-third octave is approximately equal to one decidecade (1/3 oct ≈ 1.003 ddec; ISO 2017).

1/3-octave-band

Frequency band whose bandwidth is one one-third octave. Note: The bandwidth of a one-third octave-band increases with increasing center frequency.

absorption

The reduction of acoustic pressure amplitude due to acoustic particle motion energy converting to heat in the propagation medium.

attenuation

The gradual loss of acoustic energy from absorption and scattering as sound propagates through a medium.

audiogram weighting

The process of applying an animal’s audiogram to sound pressure levels to determine the sound level relative to the animal’s hearing threshold (HT). Unit: dB re HT.

Auditory frequency weighting (auditory weighting function, frequency-weighting function)

The process of band-pass filtering sounds to reduce the importance of inaudible or less-audible frequencies for individual species or groups of species of aquatic mammals (ISO 2017). One example is M-weighting introduced by Southall et al. (2007) to describe “Generalized frequency weightings for various functional hearing groups of marine mammals, allowing for their functional bandwidths and appropriate in characterizing auditory effects of strong sounds”.

azimuth

A horizontal angle relative to a reference direction, which is often magnetic north or the direction of travel. In navigation, it is also called bearing.

bandwidth

The range of frequencies over which a sound occurs. Broadband refers to a source that produces sound over a broad range of frequencies (e.g., seismic airguns, vessels) whereas narrowband sources produce sounds over a narrow frequency range (e.g., sonar) (ANSI and ASA S1.13-2005 (R2010)).

bathymetry

The submarine topography of a region, usually expressed in terms of water depth

broadband sound level

The total sound pressure level measured over a specified frequency range. If the frequency range is unspecified, it refers to the entire measured frequency range.

continuous sound

A sound whose sound pressure level remains above ambient sound during the observation period (ANSI and ASA S1.13-2005 (R2010)). A sound that gradually varies in intensity with time, for example, sound from a marine vessel.

compressional wave

A mechanical vibration wave in which the direction of particle motion is parallel to the direction of propagation. Also called primary wave or P-wave.

decade

Logarithmic frequency interval whose upper bound is ten times larger than its lower bound (ISO 2006).

decidecade

One tenth of a decade (ISO 2017). Note: An alternative name for decidecade (symbol ddec) is “one-tenth decade”. A decidecade is approximately equal to one third of an octave (1 ddec ≈ 0.3322 oct) and for this reason is sometimes referred to as a “one-third octave”.

decidecade band

Frequency band whose bandwidth is one decidecade. Note: The bandwidth of a decidecade band increases with increasing center frequency.

decibel (dB)

One-tenth of a bel. Unit of level when the base of the logarithm is the tenth root of ten, and the quantities concerned are proportional to power (ANSI S1.1-1994 (R2004)).

frequency

The rate of oscillation of a periodic function measured in cycles-per-unit-time. The reciprocal of the period. Unit: hertz (Hz). Symbol: f. 1 Hz is equal to 1 cycle per second.

geoacoustic

Relating to the acoustic properties of the seabed.

hearing threshold

The sound pressure level for any frequency of the hearing group that is barely audible for a given individual in the absence of significant background noise during a specific percentage of experimental trials.

hertz (Hz)

A unit of frequency defined as one cycle per second.

impulsive sound

Sound that is typically brief and intermittent with rapid (within a few seconds) rise time and decay back to ambient levels (NOAA and US Dept of Commerce 2013, ANSI S12.7-1986 (R2006)). For example, seismic airguns and impact pile driving.

octave

The interval between a sound and another sound with double or half the frequency. For example, one octave above 200 Hz is 400 Hz, and one octave below 200 Hz is 100 Hz.

parabolic equation method

A computationally-efficient solution to the acoustic wave equation that is used to model transmission loss. The parabolic equation approximation omits effects of back-scattered sound, simplifying the computation of transmission loss. The effect of back-scattered sound is negligible for most ocean-acoustic propagation problems.

peak sound pressure (L_{pk})

The maximum instantaneous sound pressure, in a stated frequency band, within a stated period. Also called zero-to-peak sound pressure. Unit: decibel (dB).

permanent threshold shift (PTS)

A permanent loss of hearing sensitivity caused by excessive noise exposure. PTS is considered auditory injury.

point source

A source that radiates sound as if from a single point (ANSI S1.1-1994 (R2004)).

pressure, acoustic

The deviation from the ambient hydrostatic pressure caused by a sound wave. Also called overpressure. Unit: pascal (Pa). Symbol: p.

pressure, hydrostatic

The pressure at any given depth in a static liquid that is the result of the weight of the liquid acting on a unit area at that depth, plus any pressure acting on the surface of the liquid. Unit: pascal (Pa).

propagation loss

The decibel reduction in sound level between two stated points that results from sound spreading away from an acoustic source subject to the influence of the surrounding environment. Also called transmission loss.

received level

The sound level measured at a receiver.

rms

root-mean-square.

rms sound pressure level (L_p)

The root-mean-square average of the instantaneous sound pressure as measured over some specified time interval. For continuous sound, the time interval is one second. See also sound pressure level (L_p) and 90% rms SPL.

shear wave

A mechanical vibration wave in which the direction of particle motion is perpendicular to the direction of propagation. Also called secondary wave or S-wave. Shear waves propagate only in solid media, such as sediments or rock. Shear waves in the seabed can be converted to compressional waves in water at the water-seabed interface.

signature

Pressure signal generated by a source.

sound

A time-varying pressure disturbance generated by mechanical vibration waves travelling through a fluid medium such as air or water.

sound exposure

Time integral of squared, instantaneous frequency-weighted sound pressure over a stated time interval or event. Unit: pascal-squared second ($Pa^2 \cdot s$) (ANSI S1.1-1994 (R2004)).

sound exposure level (SEL)

A cumulative measure related to the sound energy in one or more pulses. Unit: dB re 1 $\mu Pa^2 \cdot s$. SEL is expressed over the summation period (e.g., per-pulse SEL [for airguns], single-strike SEL [for pile drivers], 24-hour SEL).

sound field

Region containing sound waves (ANSI S1.1-1994 (R2004)).

sound pressure level (SPL)

The decibel ratio of the time-mean-square sound pressure, in a stated frequency band, to the square of the reference sound pressure (ANSI S1.1-1994 (R2004)).

For sound in water, the reference sound pressure is one micropascal (p_0 = 1 μPa) and the unit for SPL is dB re 1 μPa^2:

$$L_p = 10\log_{10}(p^2/p_0^2) = 20\log_{10}(p/p_0)$$

Unless otherwise stated, SPL refers to the root-mean-square (rms) pressure level. See also 90% sound pressure level and fast-average sound pressure level. Non-rectangular time window functions may be applied during calculation of the rms value, in which case the SPL unit should identify the window type.

sound speed profile

The speed of sound in the water column as a function of depth below the water surface.

source level (SL)

The sound level measured in the far-field and scaled back to a standard reference distance of 1 meter from the acoustic center of the source. Unit: dB re 1 μPa·m (pressure level) or dB re 1 $\mu Pa^2 \cdot s \cdot m$ (exposure level).

temporary threshold shift (TTS)

Temporary loss of hearing sensitivity caused by excessive noise exposure.

Appendix B. Summary of Acoustic Assessment Assumption

B.1. Impact Pile Driving

The amount of sound generated during pile installation varies with the energy required to drive the piles to the desired depth, which depends on the sediment resistance encountered. Sediment types with greater resistance require pile drivers that deliver higher energy strikes. Maximum sound levels from pile installation usually occur during the last stage of driving (Betke 2008). The representative make and model of impact hammers, and the hammering energy schedule, were provided by Empire Wind.

Empire Wind is expected to install different WTG monopile foundations consisting of single, tapered and uniform piles. For monopile foundation models, piles are assumed to be vertical and driven to a penetration depths of 125 ft (38 m) for tapered 9.6 m piles, 115 ft (35 m) for uniform R3 piles, 131 ft (40 m) for uniform T1 piles, and 180.5 ft (55 m) for uniform U3 piles. OSS jacket foundations are also expected to be installed in the Project. For such installations, uniform pin piles were also assumed to be vertical and driven to penetration depths of 184 ft (56 m) and 154 ft (47 m) at locations in OSS1 and OSS2, respectively. While monopile and pin pile penetrations across the Project will vary, these values were chosen as maximum penetration depths. The estimated number of strikes required to install piles to completion were obtained from Empire Wind in consultation with potential hammer suppliers. All acoustic evaluation was performed assuming that only one pile is driven at a time. Modeling input, assumptions, and methods are listed in Table B-1. Sound from the piling barge was not included in the model.

Table B-1. Details of model inputs, assumptions, and methods for the expected installation scenarios. Monopile values in parentheses were used for the Difficult to Drive piles.

Parameter	Description
Tapered monopile foundation	
Modeling method	Finite-difference structural model of pile vibration based on thin-shell theory; Hammer forcing functions computed using GRLWEAP
Impact hammer energy	5500 kJ
Modeled hammer energies	450, 800, 1400, 1700, and 2300 kJ (450, 800, 1400, 1700, 2300, and 5500 kJ)
Ram weight	2715 kN
Helmet weight	5100 kN
Strike rate (min^{-1})	30
Estimated number of strikes to drive pile	5497 (7165)
Expected maximum penetration	38 m
Modeled seabed penetration per energy level	2, 12, 5, 4, 6, and 9 m (2, 12, 5, 4, 6, 4 and 5 m)
Pile length	78.5 m
Pile diameter	9.6 m
Pile wall thickness	73 - 101 mm
Shaft resistance	45%, 52%, 57%, 64%, and 70% (45%, 52%, 57%, 64%, 67% and 70%) (for each energy level in increasing order of soil penetration)

Uniform monopile foundations	
Modeling method	Finite-difference structural model of pile vibration based on thin-shell theory; Hammer forcing functions computed using GRLWEAP
Impact hammer energy	5500 kJ
Modeled hammer energies	R3: 500, 750, 1100, and 2000 kJ T1: 500, 750, 1000, 1500, 2000, and 2500 kJ U3: 450, 750, 1000, and 1300 kJ
Ram weight	2715 kN
Helmet weight	5100 kN
Strike rate (min^{-1})	30
Estimated number of strikes to drive pile	R3: 4025 T1: 4919 U3: 7335
Expected maximum penetration	R3: 35 m T1: 40 m U3: 55 m
Modeled seabed penetration per energy level	R3: 14, 3, 2, 15 m (1 m self-penetration) T1: 14, 6, 4, 7, 2, 4 m (3 m self-penetration) U3: 6, 20, 12, 12 m (5 m self-penetration)
Pile length	R3: 75.3 m, T1: 84.1 m, U3: 97.5 m
Pile diameter	11 m
Pile wall thickness	85 mm
Shaft resistance	(for each energy level in increasing order of soil penetration) R3: 46%, 50%, 53%, and 67% T1: 49%, 56%, 62%, 67%, 68%, and 70% U3: 38%, 65%, 72%, and 77%
jacket foundation	
Modeling method	Finite-difference structural model of pile vibration based on thin-shell theory; Hammer forcing functions computed using GRLWEAP
Impact hammer energy	4000 kJ
Modeled hammer energies	OSS1: 500, 750, 2000, and 3200 kJ OSS2: 500, 750, 1100, and 3200 kJ
Ram weight	1977.151 kN
Helmet weight	2256 kN
Strike rate (min-1)	30
Estimated number of strikes to drive pile	OSS1: 4340 OSS2: 3711
Expected maximum penetration	OSS1: 56 m OSS2: 47 m
Modeled seabed penetration per energy level	OSS1: 30, 12, 4, and 2 m (8 m self-penetration) OSS2: 22, 9, 7, and 4 m (5 m self-penetration)

Pile length	OSS1: 66 m OSS2: 57 m
Pile diameter	2.5 m
Pile wall thickness	50 mm
Shaft resistance	(for each energy level in increasing order of soil penetration) OSS1: 79%, 84%, 85%, and 85% OSS2: 73%, 79%, 81%, and 83%
Environmental parameters for all pile types	
Sound speed profile	GDEM data averaged over region
Bathymetry	SRTM 15 data
Geoacoustics	Elastic seabed properties based on client-supplied description of seabed layering
Quake (shaft and toe)	2.54 mm (2.77 mm for tapered monopile quake toe, 2.83 mm for uniform monopile quake toe)
Shaft damping	0.164 s/m
Toe damping	0.49 s/m
Propagation model for all pile types	
Modeling method	FWRAM full-waveform parabolic equation propagation model with 22.5° azimuthal resolution
Source representation	Vertical line array
Frequency range	10–32,000 Hz
Synthetic trace length	(All Monopiles) 300 ms (Jacket) 925 ms
Maximum modeled range	90 km

Appendix C. Secondary Sound Sources in the Project Area

C.1. Vessels

All vessels emit sound from propulsion systems while in transit, and engines and machinery emit noise through the hull while in use. The emitted sounds are typically broadband, non-impulsive, continuous, low-frequency noise. A vessel's acoustic signature depends on the vessel type (e.g., tanker, bulk carrier, tug, container ship, recreational vessel) and vessel characteristics (e.g., engine specifications, propeller dimensions and number, length, draft, hull shape, gross tonnage, speed). Large shipping vessels and tankers produce lower frequency sounds with primary acoustic energy ~40 Hz and apparent underwater source levels (SLs) of SPL 177 to 188 dB re 1 µPa (McKenna et al. 2012). Dynamically positioned (DP) vessels use thrusters to maneuver and maintain station, and generate substantial underwater noise with apparent SLs ranging from SPL 150 to 180 dB re 1 µPa depending on operations and thruster use (BOEM 2014). Smaller, high-speed vessels may produce higher-frequency sound (1,000 to 5,000 Hz) with apparent SLs between SPL 150 and 180 dB re 1 µPa (Kipple 2002, Kipple and Gabriele 2003).

Marine mammals, sea turtles, fish and invertebrates in many locations are regularly subjected to vessel activity and may be habituated to vessel noise as a result of frequent or prolonged exposure (BOEM 2014). Non-Project vessel traffic in the vicinity of the Project may include recreational vessels, fishing vessels, cargo vessels, tankers, passenger vessels, and others. Vessels associated with the project during construction and operation will not contribute considerably more vessel traffic above baseline conditions and therefore the potential risk of impact from Project vessel noise is low to very low.

C.1.1. Potential Impacts to Marine Fauna

C.1.1.1. Marine Mammals

The vessel sounds emitted by ship engines, propellers, thrusters, and hulls are within the (assumed) best hearing frequency ranges of low-frequency cetaceans and are audible by all marine mammals (NMFS 2018). Vessel activities in the Project Area will add to the existing ambient vessel sound level of regular vessel traffic in the area, which could cause behavioral impacts to marine mammals (Kraus et al. 2005, Southall 2005, Clark et al. 2009, Geo-Marine 2010). As with other anthropogenic sound, the potential effects from vessel noise depends on factors such as the marine mammal species, the marine mammal's location and activity, the novelty of the sound, habitat, and oceanographic conditions.

Marine mammals exposed to vessel sounds have reported variable behavioral responses. Analyses of observations made during the Behavioral Response of Australian Humpback whales (*Megaptera novaeangliae*) to Seismic Surveys (BRAHSS) study, Dunlop et al. (2015, 2016a, 2016b, 2017a, 2017b, 2018) found only minor and temporary changes in the migratory behavior of humpback whales in response to exposure to vessel and seismic airgun sounds. Increased proximity of vessels, however, led to aversive reactions (Dunlop et al. 2017b) and to reduced social interactions between migrating humpback whales (Dunlop et al. 2020). In other studies of humpback whales, most individuals did not respond to sonar vessels with the sonar turned off (Sivle et al. 2016, Wensveen et al. 2017), and Tsujii et al. (2018) found that humpback whales moved away from large vessels, while others noted temporary changes in respiratory behavior (Baker and Herman 1989, Frankel and Clark 2002)) or temporary cessation of foraging activities (Blair et al. 2016). Researchers have also reported a temporary change in the distribution and behavior of marine mammals in areas experiencing increased vessel traffic, particularly associated with whale watching, likely due to increases in ambient noise from concentrated vessel activity (Erbe 2002, Nowacek et al. 2004). The large number of studies on humpback whales and the resulting variety of documented responses clearly demonstrate how context affects behavior.

Marine mammals in the Project Area are regularly subjected to commercial shipping traffic and other vessel noise and could potentially be habituated to vessel noise (BOEM 2014). Hatch et al. (2012) estimated that calling North Atlantic right whales (*Eubalaena glacialis*) (NARWs) may have lost 63 to 67% of their communication "space" due to shipping noise. Although received levels of sound may, at times, be above the non-impulsive sound threshold for Level B harassment (120 dB SPL), NARWs have been known to continue to feed in Cape Cod Bay, Massachusetts despite disturbance from passing vessels (Brown et al. 2000). In another study, NARWs showed no behavioral response to ship sounds at all, or at least not to received levels of 132 to 142 dB re 1 µPa from large ships passing within 1 nm (1.9 km) distance, nor to received levels of 129 to 139 dB re 1 µPa (main energy between 50 and 500 Hz) to artificial playback of ship noise (Nowacek et al. 2004).

Studies of responses by mid-frequency cetaceans to vessel sounds, conducted in various parts of the world and with a variety of species, have also shown mixed results. Groups of Pacific humpback dolphins (*Sousa chinensis*) in eastern Australia that included mother-calf pairs, increased their rate of whistling after a vessel transited the area (Van Parijs and Corkeron 2001). The authors postulated that vessel sounds disrupted group cohesion, especially between mother-calf pairs, requiring re-establishment of vocal contact after vessel noise temporarily masked their communication. Lesage et al. (1999) revealed that beluga whales (*Delphinapterus leucas*) reduced their overall call rate in the presence of vessels but increased the emission and repetition of specific calls and shifted to higher frequency bands. In response to high levels of vessel traffic, killer whales increased the duration (Foote et al. 2004) or the amplitude (Holt et al. 2009) of their calls. Other studies of killer whales (*Orcinus orca)* showed temporary changes in behavior in response to vessel noise including less foraging and increased surface-active behavior), respiration, swim speed, and direction occurred at received levels above 130 dB re 1 µPa (0.01 to 50 kHz) (Williams et al. 2002, Lusseau et al. 2009, Noren et al. 2009, Williams et al. 2014). Marley et al. (2017) found that Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) in Fremantle Inner Harbor, Australia significantly increased their average movement speed in the presence of high vessel densities during resting behavior. Behavioral budgets also changed in the presence of vessels, with animals spending more time traveling and less time resting or socializing.

Mid-frequency Cuvier's beaked whales (*Ziphius cavirostris*) responded to ship sounds by decreasing their vocalizations when they attempted to catch prey (Aguilar Soto et al. 2006), and foraging changes were observed in Blainville's beaked whales (*Mesoplodon densirostris*) when they were exposed to vessel noise (Pirotta et al. 2012). Harbor porpoises (*Phocoena phocoena*) tend to swim away from approaching vessels emitting high frequency noise in the Bay of Fundy, Canada (Polacheck and Thorpe 1990) and have been observed to move rapidly out of the path of a survey vessel within 1 km on the western coast of North America (Barlow 1988). Both harbor porpoises and beaked whale species are known to avoid relatively low levels of anthropogenic sound, and are generally recognized as behaviorally sensitive species (Wood et al. 2012 criteria).

In response to vessel noise, a tagged seal changed its diving behavior, switching quickly from a dive ascent to descent (Mikkelsen et al. 2019). This observation agrees with descriptions of changes in diving reported from juvenile northern elephant seals (*Mirounga angustirostris*) (Fletcher et al. 1996, Burgess et al. 1998). The tagging study also found that harbor seals (*Phoca vitulina*) and grey seals *(Halichoerus grypus*) are routinely exposed to vessel noise 2.2 to 20.5% of their time at sea (Mikkelsen et al. 2019).

Sound levels and the presence of vessels associated with the Project may result in behavioral responses by marine mammals, but within the context of an already highly trafficked region, the intermittent nature of vessel activity suggests that the impacts due to Project vessels are likely to be low.

C.1.1.2. Sea Turtles

Most of the underwater sound produced by ships is low frequency (~20–500 Hz) and overlaps with the known or assumed best hearing frequency range of all sea turtles. The broadband (20–1,000 Hz) apparent source level of a modern commercial ship (54,000 gross ton container ship traveling at 21.7 knots) is up to 188 dB re 1µPa (McKenna et al. 2012). This source level is below the non-impulsive acoustic injury threshold of 200 dB re 1 µPa for sea turtles (Finneran et al. (2017), meaning that only behavioral responses could be expected from sea turtles exposed to Project related vessel noise. Underwater noise that is detectable by sea turtles can mask signal detection, and influence behavior, but the consequences of masking and attendant behavioral changes on the survival of sea turtles are not known (Popper et al. 2014).

Many of the proposed Project-related vessels are significantly smaller than cargo ships and most will transit at slower speeds than cargo ships. The apparent source levels of smaller, slower vessels may be below the behavioral response thresholds of sea turtles or limited to the area immediately adjacent to the vessel. As with marine mammals, sea turtles are regularly subjected to commercial shipping traffic and other vessel noise and may be habituated to vessel noise as a result of this exposure (BOEM 2014). Given the lower sound levels associated with vessel transit and operation and the limited ensonified area produced by this source, the risk of impact to sea turtles is expected to be very low to low.

C.1.1.3. Fish

Vessel noise may interfere with feeding and breeding, alter schooling behaviors and migration patterns (Buerkle 1973, Olsen et al. 1983, Schwarz and Greer 1984, Soria et al. 1996, Vabø et al. 2002, Mitson and Knudsen 2003, Ona et al. 2007, Sarà et al. 2007), mask important environmental auditory cues (CBD 2012, Barber 2017), and induce endocrine stress response (Wysocki et al. 2006). Fish communication is mainly in the low-frequency (<1000 Hz) range (Ladich and Myrberg 2006, Myrberg and Lugli 2006) so masking is a particular concern because many fish species have unique vocalizations that allow for inter- and intra-species identification, and because fish vocalizations are generally not loud, usually ~120 dB SPL with the loudest sounds reaching 160 dB SPL (Normandeau Associates 2012). Behavioral responses in fishes differ depending on species and life stage, with younger, less mobile age classes being the most vulnerable to vessel noise impacts (Popper and Hastings 2009, Gedamke et al. 2016).

Underwater sound from vessels can cause avoidance behavior, which has been observed for Atlantic herring (*Clupea harengus*) and Atlantic cod (*Gadus morhua*), and is a likely behavior of other species as well (Vabø et al. 2002, Handegard et al. 2003). Fish may respond to approaching vessels by diving towards the seafloor or by moving horizontally out of the vessel's path, with reactions often initiated well before the vessel reaches the fish (Ona et al. 2007, Berthe and Lecchini 2016). The avoidance of vessels by fish has been linked to high levels of infrasonic and low-frequency sound (~10 to 1,000 Hz) emitted by vessels. Accordingly, it was thought that quieter vessels would result in less avoidance (and consequently quieter vessels would have a higher chance of encountering fish) (De Robertis et al. 2010). By comparing the effects of a quieted and conventional research vessel on schooling herring, it was found that the avoidance reaction initiated by the quieter vessel was stronger and more prolonged than the one initiated by the conventional vessel (Ona et al. 2007). In a comment to this publication, Sand et al. (2008) pointed out that fish are sensitive to particle acceleration and that the cue in this case may have been low-frequency particle acceleration caused by displacement of water by the moving hull. This could explain the stronger response to the larger, noise-reduced vessel in the study by Ona et al. (2007), which would have displaced more water as it approached.

Nedelec et al. (2016) investigated the response of reef-associated fish by exposing them in their natural environment to playback of vessel engine sounds. They found that juvenile fish increased hiding and ventilation rate after a short-term vessel sound playback, but responses diminished after long-term playback, indicating habituation to sound exposure over longer durations. These results were corroborated by Holmes et al. (2017) who also observed short-term behavioral changes in juvenile reef fish after exposure to vessel noise as well as desensitization over longer exposure periods.

While sounds emitted by vessel activity are unlikely to injure fish, vessel sound has been documented to cause temporary behavioral responses (Holmes et al. 2017). Fish in the area are already exosed to vessel sounds in this high-traffic area. Project-related vessel noise will be intermittent and of short duration, so the overall impacts to fish are expected to be low.

C.1.1.4. Invertebrates

Although the study of effects of sound on invertebrates (e.g., crustaceans, cephalopods, and bivalves) is in its nascency, it is evident that invertebrates are sensitive to particle motion (as opposed to pressure) (Popper and Hawkins 2018) and that they can detect vibrations in the sea bed (Roberts et al. 2015b, Roberts and Breithaupt 2016, Roberts and Elliott 2017). While there are currently no agreed upon metrics or clearly defined levels (in terms of sound pressure or particle motion) for assessing the effects or impacts of sound on invertebrates (Hawkins and Popper 2017), recent experiments have measured sound pressure levels and particle motion associated with trauma in cuttlefish (*Sepia officinalis*) (Solé et al. 2017) and longfin squid (*Doryteuthis pealeii*) (Mooney et al. 2016, Jones et al. 2020, Jones et al. 2021). And, some studies have found potential behavioral effects (e.g., flight or retraction) or physiological (e.g., stress) responses in invertebrates. For example, shore crabs (*Carcinus maenas*) in the presence of vessel noise ceased feeding and were slower to retreat to shelter (Wale et al. 2013b). The common prawn (*Palaemon serratus*) had fewer intra-specific interactions and spent more time outside of their shelters where the sound pressure levels were lower (Filiciotto et al. 2016). Lobsters (*Nephrops norvegicus*) reduced locomotor activity and clams (*Ruditapes philippinarum*) exhibited behaviors that ultimately prevented feeding (Solan et al. 2016).

Shore crabs exposed to playbacks of vessel noise demonstrated an increase in oxygen consumption that was presumed to indicate a higher metabolic rate and/or stress (Wale et al. 2013a). A similar response was observed in the blue mussel (*Mytilus edulis*), which not only increased oxygen consumption but also had more fragmentation of cellular DNA (Wale et al. 2016). In Pacific oysters (*Magallana gigas*), chronic exposure to vessel noise was shown to depress activity and food uptake, ultimately limiting growth (Charifi et al. 2018). Evidence from a field experiment with sea hares (*Stylocheilus striatus*) demonstrated a significant increase in the likelihood of developmental failure at the embryonic stage and mortality at the free-swimming stage, when exposed to play-backs of vessel noise (Nedelec et al. 2014).

Overall, while there are preliminary indications of potential impacts of vessel noise on some invertebrates, most research has been conducted in a laboratory setting, where tank boundaries may affect the acoustic field and observed behavioral response (Rogers et al. 2016, Popper and Hawkins 2018). Further, nearly all studies measured sound pressure rather than particle motion (Jesus et al. (2020). Although high-intensity noise may produce high sound pressure levels and high levels of particle motion concurrently, it is impossible to determine this relationship without proper measurements (Popper and Hawkins 2018). It is unlikely, however, that these stimuli have more than short-term consequences. For example, the shore crabs that showed an increase in oxygen consumption did not respond after repeated exposures to vessel noise (Wale et al. 2013a). Thus, overall risks of impacts to invertebrates associated with vessel noise are expected to be low.

C.1.2. Monitoring and Mitigation

Sound levels associated with vessels vary with vessel class, speed, and activity. High speeds and the use of thrusters increase noise levels significantly (Richardson et al. 1995) though marine fauna are regularly subjected to commercial shipping traffic and other vessel noise and are likely habituated to vessel noise as a result of this regular exposure (BOEM 2014). Many of the proposed Project-related vessels are much smaller than cargo ships that frequently transit the area and, for mitigation purposes, will typically transit at slower speeds.

C.2. Aircraft

Aircraft, both fixed wing and helicopter, may be used during Project construction and operation for crew transfers and biological monitoring activities. The evaluation of aircraft sound on marine fauna differs from other underwater sound sources in that sound generated by aircraft is produced within the air, transmitted through the water surface, and propagated underwater. Most sound energy from aircraft reflects off the air-water interface; only sound radiated downward within a 26-degree cone penetrates below the water surface (Urick 1972).

In general, underwater sound levels produced by fixed wing aircraft and helicopters are typically low frequency (16–500 Hz) and range between 84–159 dB re 1 µPa (Richardson et al. 1995, Patenaude et al. 2002, Erbe et al. 2018). Patenaude et al. (2002) recorded the transmission of sound into water from two types of aircraft: a Twin Otter fixed-wing airplane and a Bell 212 helicopter. Sound levels were measured at 3 m and 18 m below the water surface while the aircraft flew at various airspeeds and four altitudes overhead. Maximum received levels in the 10 to 500 Hz frequency band at 18 m water depth were approximately 120 dB re 1 µPa for both the Twin Otter and Bell 212 (Patenaude et al. 2002). Received PK sound levels were generally higher at 3 m depth than 18 m depth by an average of 2.5 dB but varied considerably with both the altitude and speed of the aircraft (Patenaude et al. 2002). Because underwater sound from aircraft depends on height, angle, speed, and sound propagation in different environmental conditions (temperature, humidity in air, and salinity in water) (Hubbard 1991, Erbe et al. 2018), underwater sound levels from aircraft are highly variable.

There is limited research on the impacts of aircraft sounds to marine fauna; however, sound emitted by aircraft that propagates underwater has the potential to cause behavioral responses in marine mammal, sea turtle, and fish (McCauley et al. 2000, Popper et al. 2014, Todd et al. 2015, Finneran et al. 2017, NMFS 2018). Further information is required to determine the potential underwater effects of aircraft in invertebrates (Hawkins et al. 2015). Given that the majority of sound emitted by aircraft is reflected off the surface of the water, impacts to marine fauna are expected to be very low to low.

C.2.1. Potential Impacts to Marine Fauna

C.2.1.1. Marine mammals

Aircraft noise is typically low- to mid-frequency, overlapping with cetacean calls and with the potential to cause temporary changes in behavior and localized displacement of marine mammals when transmitted from air through the water surface (Richardson et al. 1985a, Richardson and Würsig 1997, Nowacek et al. 2007). Marine mammals react to aircraft noise more often when the aircraft is lower in altitude, closer in lateral distance, and flying over shallow water (Richardson et al. 1985b, Patenaude et al. 2002). Temporary reactions displayed by marine mammals include short surfacing, hasty dives, aversion from the aircraft, or dispersal from the incoming aircraft (Bel'kovich 1960, Kleĭnenberg et al. 1964, Richardson et al. 1985a, Richardson et al. 1985b, Luksenburg and Parsons 2009). The response of cetaceans to aircraft noise largely depends on the species as well as the animals' behavioral state at the time of exposure (e.g., migrating, resting, foraging, socializing) (Würsig et al. 1998).

Cetaceans within the low frequency hearing group showed varied behavioral response when exposed to aircraft noise. Bowhead whales (*Balaena mysticetus*) displayed frequent behavioral reactions to fixed-wing aircraft and helicopter sounds at altitudes <305 m (Dahlheim 1981, Richardson et al. 1985b, Koski et al. 1988, Richardson and Malme 1993). However, Patenaude et al. (2002) noted that only 17% of observed bowhead whales showed behavioral response to passing helicopters, even at the lower altitudes (150 m) and lateral distances of 250 m. Behavioral changes were also seen in gray whales (*Eschrichtius robustus*) in response to the sound from a Bell 212 helicopter (Malme et al. 1984).

Variable behavioral reactions to aircraft sound were also observed in mid-frequency cetaceans. In the Gulf of Mexico, beaked whales, pygmy and dwarf sperm whales (*Kogia spp*.), and various delphinids (pantropical spotted [*Stenella attenuate*], Clymene [*Stenella clymene*], striped [*Stenella coeruleoalba*] and spinner [*Stenella longirostris*] dolphins) showed a strong behavioral response to an approaching fixed-winged aircraft by quickly diving (Würsig et al. 1998). Several studies reported defensive behavioral responses to approaching aircraft in sperm whales (Würsig et al. 1998, Richter et al. 2003, Richter et al. 2006, Smultea et al. 2008). In contrast, only 3.2% (or 24 of 760) of beluga whales responded to fixed wing aircraft at heights above the water ranging from 182 m to 427 m (Patenaude et al. 2002). Given that recorded SPL at 18 m was approximately equivalent (~120 dB SPL) to the regulatory defined acoustic behavioral response threshold level for marine mammals, the lack of response is unsurprising in this study (Patenaude et al. 2002).

The sound emitted by aircraft has the potential to elicit temporary behavioral responses in marine mammals and Project-related aircraft can be at low altitude, but due to the intermittent nature and the small ensonified area of this sound source, the risks of aircraft impact to marine mammals are expected to be low.

C.2.1.2. Sea turtles

Although aircraft sounds can be within the hearing frequency range of turtles, very few studies have analyzed the impacts of aircraft noise on sea turtles. The only documented behavioral responses were from nesting sea turtles near (1.7 km) a military jet airfield in which the turtles exhibited postnatal behavioral reactions to in-air aircraft noise (Balazs and Ross 1974).

Given the frequency range and sound levels produced by aircraft, sea turtles may have adverse behavioral responses to this source. However, the intermittent nature and the small area of ensonification produced by aircraft is unlikely to impact sea turtles. Risk of impact are therefore expected to be very low.

C.2.1.3. Fish

Because documented sound levels in water from aircraft can be higher than the regulatory-defined non-impulsive behavioral acoustic thresholds for fish (Andersson et al. 2007, Wysocki et al. 2007, Mueller-Blenkle et al. 2010, Purser and Radford 2011), it can be inferred that aircraft may cause behavioral responses in fish. It is unlikely, however, that the underwater sound from aircraft associated with the Project will have much impact on fish because the sound produced by these aircraft is intermittent and has a small ensonified area. The risks of impacts to fish from aircraft sound are expected to be very low.

C.2.1.4. Invertebrates

Aircraft may produce low-frequency sounds within the hearing range of marine invertebrates but there are currently no data available on the potential impacts of this underwater sound on marine invertebrates. As with fish, the risks of impacts to invertebrates from aircraft sound propagated underwater are expected to be very low due to the small ensonified area and intermittent nature of the source.

C.2.2. Monitoring and Mitigation

To mitigate potential impacts to marine fauna from aircraft noise during aerial surveys, uncrewed aerial systems (drones) equipped with a camera system may be used for real time monitoring of marine mammals. With uncrewed aerial systems, Protected Species Observers (PSOs) monitor high-definition drone camera footage in real time from shore or a vessel. This monitoring approach minimizes traditional, more intrusive methods to detect marine mammals and limits sound from fixed-wing aircraft that is typically used in marine mammal and sea turtle aerial surveys. The underwater sound levels recorded from drones (<100 dB re 1 µPa) is well below underwater noise regulatory thresholds (Erbe et al. 2017). Helicopter and fixed-wing aircraft used during the Project construction and operation phase will be in operation intermittently and primarily maintain safe altitudes (150 to 300 m) above sea level. At these heights, and with the use of drones for aerial surveys, overall aircraft noise may elicit only short-term behavioral response in marine mammals such that the impact risk is very low.

C.3. High Resolution Geophysical (HRG) Surveys

High resolution geophysical (HRG) surveys are required to characterize the seafloor and inform the Project design. Seafloor mapping and bottom-penetrating imaging systems differ primarily in the frequency range that the various sources produce. Higher frequencies resolve smaller features so seafloor mapping is conducted using high-frequency sources while lower frequencies are used to characterize conditions below the seabed.

Acoustic signals produced by HRG sources are impulsive, tonal, or frequency-modulated (FM) chirp pulses (short duration signals that sweep through a band of frequencies) (Halvorsen and Heaney 2018). Impulsive signals are produced by a variety of sources such as airguns, boomers, and sparkers using a variety of mechanisms (e.g., release of compressed air and electrostatic discharge) (Crocker and Fratantonio 2016). Tonal and FM chirp signals are produced by electromechanical sonars. Sub-bottom profilers are electromechanical sources that (typically) produce FM chirp signals at low frequencies able to penetrate the seafloor. Other electromechanical HRG sources such as side-scan and multibeam sonars, and echosounders produce tonal or FM chirp signals at higher frequencies for seafloor mapping. The source level, beamwidth, pulse duration, and pulse repetition rate of such sources are typically adjustable and selected for the needs of each survey. For regulatory purposes, sound signals are classified as either impulsive or non-impulsive with accompanying thresholds for assessing potential impacts on animals (see Section 2). Airguns, boomers, sub-bottom profilers, and sparkers are classified by NMFS as impulsive sound sources, while all electromechanical HRG sources are classified as non-impulsive.

Penetrating HRG systems produce low frequency sounds with high source levels. Mini-airguns emit sounds <5 kHz with source levels of 217–228 re 1 µPa (Crocker and Fratantonio 2016). Sub-bottom profilers produce sounds with primary acoustic energy in frequency bands 2–115 kHz at levels from 178 to 241 dB re 1 µPa and penetrating seismic profilers produce sound at lower frequencies (0.25–15 kHz) with source levels 205–206 dB re 1 µPa range (Crocker and Fratantonio 2016). Many seafloor mapping systems are operated at frequencies >200 kHz, which is above the hearing range of all marine animals and not expected to have any impacts. Some electromechanical systems, however, operate at lower frequencies and are audible to marine mammals. These systems produce sounds within the 0.4–170 kHz frequency range and sound levels from 177–247 dB re 1 µPa (Crocker and Fratantonio 2016). For example, multibeam echosounders (MBES) produced sounds ~30 to 70 kHz at source levels up to ~230 dB re 1 µPa. And, though not used for imaging, underwater positioning equipment (e.g., ultra-short baseline, USBL, systems) used during HRG surveys emit sound in the 20–50 kHz band with source levels up to 188–191 dB re 1 µPa.

There is an overall paucity of information on the effects of HRG sounds on marine fauna. Impulsive sources used for imaging below the seabed such as sub-bottom profilers and airguns are likely audible to all marine fauna and their use may result in injury and behavioral disruption. If such sources are used, a quantitative impact analysis following established guidelines should be conducted. Electromechanical HRG sources operating within the established hearing range of marine fauna are classified as non-impulsive by NMFS, eliminating the potential for injury, but do have the potential to cause behavioral disturbance. These sources tend to be highly directive with narrow beams and small ensonified areas so animals are likely to receive only short-duration exposures. Impacts to marine fauna from HRG sounds are expected to be low.

C.3.1. Potential Impacts to Marine Fauna

C.3.1.1. Marine Mammals

Many HRG sources operate at frequencies (>200 kHz) above the hearing range of marine mammals so are not expected to result in impacts. Research suggests that sound levels produced by HRG sources operating within the hearing range of marine mammals are unlikely to cause injury but could result in temporary behavioral responses.

While Varghese et al. (2020) found no consistent changes in Cuvier's beaked whale foraging behavior during multibeam echosounder surveys, analogous studies assessing mid-frequency active sonar on beaked whale foraging found that individuals would stop echolocating and leave the area. Other studies have focused on the responses of marine mammals exposed to sonar. For example, minke whales (*Balaenoptera acutorostrata*) demonstrated strong avoidance to mid-frequency sonar at 146 dB re 1 µPa (Sivle et al. 2015, Kvadsheim et al. 2017) and Wensveen et al. (2019) showed northern bottlenose whales (*Hyperoodon ampullatus*) had a greater response to (military) sonar signals. Surface-feeding blue whales (*Balaenoptera musculus*) showed no changes in behavior to mid-frequency sonar, but blue whales feeding at deeper depths and non-feeding whales displayed temporary reactions to the source; including cessation of feeding, reduced initiation of deep foraging dives, generalized avoidance responses, and changes to dive behavior (DeRuiter et al. 2013, Goldbogen et al. 2013, Sivle et al. 2015). Several behavioral reactions were seen in beaked whale species in response to mid-frequency sonar sounds (12–400 kHz and 230 dB re 1 μPa) including cessation of clicking, termination of foraging dives, changes in direction to avoid the sound source, slower ascent rates to the surface, longer deep and shallow dive durations, and other atypical dive behavior (Tyack et al. 2011, DeRuiter et al. 2013, Stimpert et al. 2014, Miller et al. 2015, Cholewiak et al. 2017). Exposure to mid-frequency sonar at various sound levels (125–185 dB re 1 μPa) caused behavioral responses in California sea lions (*Zalophus californianus*), including a refusal to participate in trials, hauling out, an increase in respiration rate, and an increase in the time spent submerged (Houser et al. 2013, Houser et al. 2016). Hooded seals (*Cystophora cristata*) showed initial avoidance behavior to 1–7 kHz sonar signals at levels between 160 and 170 dB re 1 μPa, but these animals did adapt to the sound and stopped avoiding the source (Kvadsheim et al. 2010).

Non-impulsive, sonar-type HRG sources operating within the hearing range of marine mammals are unlikely to produce injury but could cause behavioral responses. These sources typically have narrow beams that would expose marine mammals for short time periods and only negligible effects on marine mammal species could be expected. A previous analysis by BOEM (2014) on the potential effects of sound associated with HRG surveys on marine mammals in the Mid- and South-Atlantic wind planning areas concluded that impacts are expected to be minimal with the implementation of mitigation measures for sources operating at or below 200 kHz. With mitigation and monitoring practices, impacts to marine mammals from HRG sound sources are expected to be low.

C.3.1.2. Sea Turtles

HRG surveys that use non-impulsive sources are not expected to impact sea turtles because they operate at frequencies above the sea turtle hearing range (<1 kHz). Low-frequency impulsive HRG equipment may produce sounds within the hearing ranges of sea turtles and impacts should be evaluated using a quantitative approach.

C.3.1.3. Fish

Non-impulsive sounds produced by HRG survey operations are outside of fish hearing range and are not expected to produce injury or behavioral responses in fish (BOEM 2014, Popper et al. 2014, Popper and Hawkins 2019). Potential impacts of low frequency impulsive HRG sources on fish may include behavioral responses, masking of biologically important sounds, temporary hearing loss, and physiological effects (BOEM 2014, Popper et al. 2014, Popper and Hawkins 2019). Given the mobile and therefore intermittent nature of HRG surveys, the short-duration and infrequent surveying of small areas of the seafloor relative to the overall area, and the likelihood that fish will move away from the sound source, the impacts of underwater noise from impulsive HRG source surveys are expected to be low.

C.3.1.4. Invertebrates

As with sea turtles and fish, non-impulsive HRG sound sources are above the hearing range of invertebrates and are not expected to cause impacts, but impulsive sources may be within the hearing range of some invertebrates. For most marine invertebrate species sensitivity to underwater sound and susceptibility to noise-induced effects has not been investigated. Anatomical and experimental evidence suggests that particle motion (not sound pressure) is the primary mode for marine invertebrates perceiving acoustic stimuli. Nearly all studies on noise-induced effects on marine invertebrates, however, have measured sound pressure rather than particle motion reducing the relevance of their findings. There are currently no appropriate metrics or clearly defined levels (sound pressure or particle motion) for assessing the effect of underwater sound on marine invertebrates (Hawkins and Popper 2017). Even though criteria and thresholds are not available for invertebrates, the short-term and infrequent nature of impulsive HRG surveys are expected to be of low risk of impact to invertebrates.

C.3.2. Monitoring and Mitigation

Monitoring and mitigation during HRG surveys can decrease the potential impacts to marine mammals from HRG sound exposure by reducing the zone of influence (ZOI) and therefore the likelihood of sound exposures exceeding regulatory thresholds. The National Oceanic and Atmospheric Administration (NOAA) and BOEM have advised that HRG sources that operate at and below 200 kilohertz (kHz) have the potential to cause acoustic harassment to marine species, including marine mammals, and therefore require the establishment and monitoring of exclusion zones (BOEM 2014). Standard mitigation employed during HRG surveys includes the use of PSOs, time of year restrictions, protective zones, ramp-up of active sound sources and shut down of sources should marine mammals or sea turtles enter the established exclusion zones.

C.4. Drilling

Project construction activities will likely include drilling for geotechnical surveys and horizontal directional drilling (HDD). Geotechnical studies are conducted using drill rigs or other excavating tools to characterize the subsurface conditions in locations where foundational structures are expected to be installed (Shell Gulf of Mexico Inc. 2015). In some areas, such as the export cable landfall location, an HDD rig may be needed to create a conduit for the cable to be pulled through.

For both activities, a drill head produces vibrations that propagate as sound through the sediment and water column (Hall and Francine 1991, Nguyen 1996, Willis et al. 2010). Geotechnical drilling operations can emit sound both from the drill at the seabed and from the machinery on the barge (Gales 1982). HDD emits sound at the mouth of the borehole and the drill head. Unlike offshore drill rigs used for geotechnical drilling that are acoustically connected to the water column via drillships (floating rigs) or drill rigs (bottomed rigs), HDD rigs are installed on shore and the sound they produce that enters the water is often negligible (Hall and Francine 1991, Nguyen 1996, Willis et al. 2010).

Most measurements of offshore drilling sounds have been made for oil exploration and production drilling. The sound levels associated with those drilling operations have been documented to be within the hearing range of many marine species and above the recommended marine mammal, sea turtle, and fish injury and behavioral thresholds (Greene 1987, NOAA 2005, Popper et al. 2014, Finneran et al. 2017, NMFS 2018). The underwater sounds from those drilling activities are non-impulsive, low frequency (20 −1000 Hz), and of varying levels ranging from an SPL of 117 to 184 dB re 1 µPa (Greene 1987, Blackwell et al. 2004a, Dow Piniak et al. 2012). However, the types of drilling likely to be used during project construction are of a smaller scale and are unlikely to produce the maximum sounds reported for oil drilling. Schlesinger et al. (2016) estimated a broadband source level of 170.7 dB re 1 µPa for offshore rock socket drilling in British Columbia. The modeled maximum distance to an SPL of 120 dB re 1 µPa was 5.8 km for that drilling activity. Only two papers have measured sounds from geotechnical drilling. Erbe and McPherson (2017) measured broadband (30 Hz to 2 kHz) sound source levels of 142 and 145 dB re 1 µPa for small-core drilling from a jack-up rig at two locations off western Australia. The sound levels were up to 35 dB above ambient sound levels at some frequencies, and thus audible to marine fauna, but much less than oil production drilling sounds and below levels used in marine noise regulations. Willis et al. (2010) recorded a peak sound level of 107 dB re 1 $\mu Pa_{0\text{-}pk}$ at 7.5 m from hard-rock drilling.

Underwater sound emitted by project construction drilling activities is not expected to produce injury to marine fauna but is likely to be audible and could elicit temporary behavioral responses. Impacts associated with this activity are expected to be low.

C.4.1. Potential Impacts to Marine Fauna

C.4.1.1. Marine Mammals

Impacts to marine mammals from underwater sound from drilling depend on the species, distance from the source, and type of drilling activity (Awbrey and Stewart 1983, Richardson et al. 1990a, Richardson et al. 1990b, Miller et al. 2005, Blackwell et al. 2017). Observed responses can include changes in migratory pathways, avoidance, changes in calling behavior, and altered diving and feeding patterns . For prolonged, large, drilling activities, acoustic masking may be a concern for marine mammals if the sounds interfere with their ability to detect or recognize important biological acoustic signals (Richardson et al. 1999, Houser and Cross 2014).

While underwater drilling sounds can have a negative effect on some marine mammals (bowhead and beluga whales), others (ringed seals and harbor porpoises) have been documented to be far more tolerant to drilling activities (Moulton et al. 2003, Todd et al. 2009). Received sound levels of drilling from construction operations were within the hearing range of phocid seals (<100 Hz); however, no aversion to sound was observed for ringed seals (Blackwell et al. 2004b). In the North Sea, high frequency odontocete species, such as harbor porpoises, have been found feeding around offshore drilling rigs and platforms during routine drilling and production operations at relatively low sound pressure levels (120 dB re 1 µPa) (Todd et al. 2009). The lack of behavioral response from harbor porpoises to drilling sounds could cause acoustic masking; however, this impact was not discussed within this study (Todd et al. 2009).

The potential impacts on marine mammals from underwater sound exposure produced by drilling operations may be behavioral disruption, acoustic masking, and physiological responses (i.e., stress) (Richardson et al. 1999, Miller et al. 2005, Blackwell et al. 2017). These responses are expected when underwater sounds associated with drilling activities are above marine mammal behavioral thresholds (NOAA 2005). However, past research suggests not all marine mammals respond negatively to drilling operations and any reactions to this source are short-term (Blackwell et al. 2004b, Todd et al. 2009). In addition, most behavioral reactions have been reported in response to oil production drilling, whereas drilling operations associated with wind farm construction activities would be of a much smaller magnitude. Sounds emitted by offshore drilling activities for wind farm development are non-impulsive and intermittent, which makes this activity unlikely to cause prolonged behavioral responses or acoustic masking. Given the short-duration and non-impulsive nature of this source, behavioral responses to underwater marine drilling sounds during the construction phase are expected to be minor.

C.4.1.2. Sea Turtles

There is insufficient information on the impacts of underwater drilling sounds to sea turtles. However, sea turtle hearing sensitivity is within the frequency range (100–1000 Hz) of sound produced by low-frequency sources such as marine drilling (for a summary, see Popper et al. 2014). Sound levels emitted by construction drilling operations are likely to be audible to sea turtles. However, it is unlikely that the sound from construction drilling operations will reach behavioral thresholds, and even more unlikely that the sound will reach injury thresholds, unless the sea turtle is within close proximity to the drilling activity (McCauley et al. 2000, Dow Piniak et al. 2012, Finneran et al. 2017). Risks of impact are expected to be low, but further research is required to understand the potential effects of marine drilling noise during wind turbine installation to sea turtles.

C.4.1.3. Fish

It is unclear whether or not the sound emitted by marine drilling activities impacts fish. The available literature suggests that noise effects on fish produced by continuous drilling operations may mask acoustic signals conveying important environmental information (McCauley 1994, Popper et al. 2014). Masking may arise when sounds exceed the hearing thresholds of fish and it is probable that, within close proximity to drilling operations, sounds would reach above the recommend thresholds. McCauley (1998) determined that any noise effects to fish from 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). Recordings of planktivorous fish choruses 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). 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.

C.4.1.4. Invertebrates

There are no data on the effect of sound from drilling on marine invertebrates. However, evidence from research on the levels of particle motion associated with behavioral responses in blue mussels indicates that the threshold of sensitivity in this species falls within vibration levels measured near blasting, pile driving, and impact drilling (Roberts et al. 2015b). Only a small number of studies have indicated reception of vibration in bivalves and an associated behavioral response, which included closing syphons and, in more active mollusks, moving away from the substrate (Mosher 1972, Ellers 1995, Kastelein 2008). Anticipated drilling for the Project is typically short duration and intermittent, so it is unlikely that drilling has more than short-term consequences. Risk of impact to invertebrates from sounds emitted by marine drilling are expected to be low.

C.4.2. Monitoring and Mitigation

Recorded drilling operation source levels were highly variable, ranging from 123 dB to 184 dB SPL for oil production drilling (Greene 1987, Blackwell et al. 2004a, Dow Piniak et al. 2012). While received sound levels could exceed behavioral response thresholds for some marine fauna, the limited area of ensonification and intermittent nature of drilling operations mean the noise impacts from this activity are expected to be very low to low. Currently, no monitoring or mitigation practices are used for sound produced by underwater drilling.

C.5. Dredging

Dredging is most often used to create or maintain depth in channels or harbors by removing materials from the seafloor, but other uses for dredging include contaminated sediment removal, flood/storm protection, extraction of mineral resources, and fishing benthic species. As it pertains to offshore wind, dredging may be used to remove materials from the seafloor in preparation of offshore foundation and export cable locations.

There are two fundamental types of dredge that could be used by the Project – mechanical and hydraulic. Mechanical dredging refers to crane-operated buckets, grabs (clamshell), or backhoes used to remove seafloor material. Hydraulic (suction) dredging and controlled flow excavation (CFE) dredging involve the use of a suction to either remove sediment from the seabed or relocate sediment from a particular location on the seafloor. There are a variety of hydraulic and CFE dredge types including trailing suction, cutter-suction, auger suction, jet-lift, and air-lift. The sound produced by hydraulic dredging results from the combination of sounds generated by the impact and abrasion of the sediment passing through the draghead, suction pipe, and pump. The frequency of the sounds produced range from ~1 to 2 kHz, with reported sound levels from 172 to 190 dB re 1 µPa for suction dredges (Robinson et al. 2011, Todd et al. 2015, McQueen 2019).

There is limited research on the impacts of underwater noise related to dredging activity on marine fauna. It is unlikely that dredging operations will exceed the marine mammal, sea turtle, and fish injury thresholds unless animals are within the immediate vicinity of the operating equipment (McCauley et al. 2000, Popper et al. 2014, Todd et al. 2015, Finneran et al. 2017, 2018). Further information is required to determine the effects of dredging activity to underwater invertebrates (Hawkins et al. 2015). Overall, the impacts of dredging are expected to be expected to be very low to low.

C.5.1. Potential Impacts to Marine Fauna

C.5.1.1. Marine Mammals

Few studies have investigated the direct effects of sound of dredging on marine mammals. The topic is further confounded by the difficulty of separating the effects of dredging from other anthropogenic activity (such as vessel noise). Most marine mammals would not be expected to exceed PTS (injury) thresholds, but as dredging occurs in one area for relatively long periods, they may experience TTS and behavioral responses (Todd et al. 2015, NMFS 2018). A case study by McQueen et al. (2020) on the expected effects of underwater dredging noise concluded that although harbor porpoises may experience TTS within 74 m from the sound source there was no evidence of significant behavioral avoidance. However, the modeling scenario was based on relatively simple sound exposure estimates, there was uncertainty about sound propagation in the environment, and uncertainty in the exposure-response relationship in the behavior of the animals, leading the authors to conclude that the impacts may be underestimated (McQueen et al. 2020).

Although most research cannot isolate the acoustic impacts of dredging from other anthropogenic activity, there is evidence to suggest that it at least contributes to the negative effects observed on some marine mammals, including displacement in bowhead whales (Richardson et al. (1990b), grey whales Bryant et al. (1984), minke whales, Anderwald et al. (2013), and grey seals (*Halichoerus grypus*, Anderwald et al. (2013)). Diederichs et al. (2010) found short-term avoidance in harbor porpoises at ranges of 600 m from a dredger operating in the North Sea. However, the most compelling evidence for potential impacts of dredging is from research that used models to differentiate the observed impacts of dredging from the vessel traffic in a busy Scotland harbor (Pirotta et al. 2013). Despite a documented tolerance of high vessel presence, bottlenose dolphins spent less time in the area during periods of high-intensity dredging (Pirotta et al. 2013).

The few existing studies suggest that acoustic exposure from dredging operations may elicit behavioral responses or cause TTS to marine mammals close to the source. With the short-duration and intermittent sounds produced by dredging activities, risks to marine mammals are expected to be low.

C.5.1.2. Sea Turtles

While the acoustic impacts of dredging to sea turtles are expected to be similar to other secondary sound sources, the response thresholds for sea turtles are not well researched and are poorly understood relative to marine mammals. There are no thresholds suggested for sea turtles exposed to non-impulsive noise but suction dredging may produce sounds up to 190 dB re 1 µPa (Robinson et al. 2011, Todd et al. 2015), which exceeds the impulsive threshold of 175 dB re 1 µPa for behavioral disruption suggested by Finneran et al. (2017) based on impulsive sounds studied by (McCauley et al. 2000). Accumulated sound energy will not exceed the recommended sea turtle cumulative sound exposure threshold for TTS or PTS (SEL: 189 and 204 dB re 1 µPa, respectively) (Popper et al. 2014, Finneran et al. 2017).

There is currently no information on the direct effects of dredging noise on sea turtles (Popper et al. 2014). There is evidence, however, of potentially positive impacts of dredging to breeding flatback turtles (*Natator depressus*), which increased their use of a dredging area and made longer and deeper resting dives during dredging operations (Whittock et al. 2017). The most likely driver for the observed behavioral response was speculated to be the absence of predators which were displaced by the noise from dredging operations. In general, sound emitted by dredging operations is intermittent and typically short-term. The impacts of noise from dredging operations are likely to be very low to low.

C.5.1.3. Fish

Sound generated by dredging operations is assumed to be primarily relevant to fish that are sensitive to sound pressure (i.e., have swim bladders) (McQueen et al. 2020). However, underwater sound from activities such as dredging can cause avoidance behavior, which has been observed in Atlantic herring and Atlantic cod (Vabø et al. 2002, Handegard et al. 2003). It is unlikely that fish would be exposed to noise levels from dredging that would result in impairment or injury, but behavioral effects, such as auditory masking, could result from exposure to dredging noise (Popper et al. 2014, McQueen et al. 2020). Given that dredging operations are short-term and localized, the impacts from underwater noise to fish from are expected to be low.

C.5.1.4. Invertebrates

There is no available research on the effect of sound from dredging on invertebrates. Contact of the draghead with the seabed may result in substrate-borne vibration, which is likely to be of greater concern to benthic invertebrates than sound pressure (Roberts et al. 2015b, Roberts and Breithaupt 2016, Roberts and Elliott 2017). Only a small number of studies have indicated reception of vibration in bivalves and an associated behavioral response, which included closing syphons and, in more active mollusks, moving away from the substrate (Mosher 1972, Ellers 1995, Kastelein 2008). Nevertheless, to date, there is no convincing evidence for any significant effects induced by non-impulsive noise in benthic invertebrates. It is unlikely that these stimuli have more than short-term consequences so the potential impacts of dredging sounds to invertebrates are expected to be very low.

C.6. Wind Turbine Generator Operations

Sound is generated by operating wind turbine generators (WTGs) due to pressure differentials across the airfoils of moving turbine blades and from mechanical noise of bearings and the generator converting kinetic energy to electricity. Sound generated by the airfoils, like aircraft, is produced in air and enters the water through the air water interface. Mechanical noise associated with the operating WTG is transmitted into the water as vibration through the foundation and subsea cable. There is also a known particle motion component to noise from wind turbines (Sigray and Andersson 2012). Both airfoil sound and mechanical vibration may result in continuous underwater noise.

Underwater sound radiated from operating WTGs is low-frequency and low level (Nedwell and Edwards 2004). At distances of 14 to 20 m from operational WTGs in Europe, underwater sound pressure levels ranged from 109 dB to 127 dB re 1µPa (Tougaard et al. 2009). Pangerc et al. (2016) recorded sound levels at ~50 m from two individual 3.6 megawatt (MW) WTGs monopile foundations over a 21-day operating period. The sound pressure level increased with wind speed up to an average value of 128 dB re 1 µPa at a wind speed of ~10 m/s, and then showed a general decrease in sound levels with increasing wind speed as the turbine blades were feathered. Miller and Potty (2017) measured an SPL of 100 dB re 1 µPa within 50 m of five General Electric Haliade 150–6 MW wind turbines with a peak signal frequency of 72 Hz. At the Block Island Wind Farm off of Rhode Island, sound levels were found to be 112 −120 dB re 1 µPa near the WTG when wind speeds were 2 to 12 m/s and the WTG sound levels declined to ambient within 1 km from the WTG (Elliott et al. 2019). Tougaard et al. (2009) found that sound level from three different WTG types in European waters was only measurable above ambient sound levels at frequencies below 500 Hz, and Thomsen et al. (2016) suggest that at approximately 500 m from operating WTGs, sound levels are expected to approach ambient levels.

WTG foundation design was found to influence sound levels in the water as a function of distance. Sound levels measured at 150 m from a steel monopile WTG foundation were 133 dB re 1µPa with peak frequencies between 50–140 Hz, while measurements at 150 m from a jacket WTG foundation were 122 dB re 1µPa with a peak frequency of 50 Hz and secondary peaks at 150, 400, 500, and 1,200 Hz. However, at 40 m the sound pressure levels were comparable between the steel monopile (135 dB) and jacket foundation types (137 dB) (Thomsen et al. 2016).

Two recent meta-papers (Tougaard et al. 2020, Stöber and Thomsen 2021) assessed WTG operational sounds by extracting sound levels measured at various distances from operating WTGs from currently available reports. Tougaard et al. (2020) used a linear model to fit sound levels as a function of turbine size, wind speed, and distance. Their model suggested that sound from multiple WTGs would be detectable out to a few km in areas with very low ambient noise levels but would be below ambient unless "very close" to individual WTGs in areas with high ambient noise from shipping or wind. Notably, the available data were from lower-power WTGs than are currently being planned for the U.S. east coast, and primarily from geared, rather than direct drive, WTGs. Stöber and Thomsen (2021) attempted to fill this knowledge gap by extracting a strictly defined subset of the data used by Tougaard et al. (2020) to extrapolate sound levels to larger turbine sizes and to direct drive turbines. However, the small size of their data subset greatly increases the already considerable uncertainty of the modeling results. Additionally, their model assumed that SPL increases linearly with WTG capacity, which contrasts with what is known of typical mechanical systems. Both studies found sounds to generally be higher for higher powered WTGs, and thus distances to a given sound threshold are likely to be greater for higher powered WTGs. However, as Stöber and Thomsen (2021) point out, direct drive technology could reduce these distances substantially. Importantly, no measurements exist for these larger turbine sizes and few measurements have been made for direct drive turbines so the uncertainty in these estimates is large.

The frequency and sound level generated from operating WTGs depend on WTG size, wind speed and rotation, foundation type, water depth, seafloor characteristics, and wave conditions (Cheesman 2016, Elliott et al. 2019). Operational noise from WTGs is low frequency (60 to 300 Hz) and at relatively low sound pressure levels near the foundation (100 to 151 dB re 1 µPa) and decreases to ambient within 1 km (Tougaard et al. 2009, Lindeboom et al. 2011, Dow Piniak et al. 2012). Underwater sounds emitted by WTGs are audible to marine mammals, sea turtles, fish, and invertebrates but are lower than the regulatory injury and typically lower than the behavioral thresholds for marine fauna, and often are lower than the ambient sound levels that these animals typically experience. It is unlikely that WTG operations will cause injury or behavioral responses to marine fauna, so the risk is of impact is expected to be low.

C.6.1. Potential Impacts to Marine Fauna

C.6.1.1. Marine Mammals

While underwater noise from WTGs has been measured within the hearing frequency range of marine mammals, impacts at the anticipated noise levels are limited to behavioral response and auditory masking (Bergström et al. 2014) (MMS 2007). Behavioral responses may include changes in foraging, socialization, or movement, including avoidance of the area. For example, there is evidence that harbor porpoises avoided WTGs during construction and initial operation (Teilmann and Carstensen 2012). However, they appeared to slowly increase their use of the WTG area during continued operation, demonstrating potential long-term habituation. This result also suggests that noise impacts are greater during construction than operation (Madsen et al. 2006). Harbor seals also show avoidance behavior when exposed to simulated sound from WTGs, however this response was limited to distances of less than 500m to the source (Hastie et al. 2018). Finally, research into both harbor porpoises and harbor seals demonstrated fewer surfacings when exposed to playbacks of noise from WTGs, but this response was limited to 200m from the source (Koschinski et al. 2003)

Auditory masking could also impact marine mammals, potentially affecting foraging, social interactions, and predator avoidance (Weilgart 2007, Erbe et al. 2016b). The potential for masking is highly dependent on the species in question, and those with low-frequency hearing will be more susceptible due to the overlap with the frequency range of WTG underwater noise.

Research with captive harbor porpoises indicated the potential for auditory masking from simulated WTG underwater noise. As with behavioral responses, the area of impact was predicted to be relatively close to the source (10–20 m) (Lucke et al. 2007).Therefore, the potential for auditory masking is likely limited to short ranges from the WTG.

Tougaard et al. (2020) estimated that WTG sounds would drop below the 120-dB re 1 µPa U.S. regulatory threshold for marine mammal behavioral impacts from continuous sounds (NMFS 2005) within approximately 50–100 m of the WTG, using currently available sound measurements taken at various distances from operational WTGs. These WTGs all had a lower capacity than those planned for installation off the US east coast and most were from geared-drive WTGs. Thus, Stöber and Thomsen (2021) extrapolated sound levels to larger WTG sizes, and found the distance to the behavioral threshold could extend out to several kilometers. However, the small size of their dataset and choice of modeling methods make these predicted distances unreliable. Additionally, those authors suggest that this distance could be reduced substantially (almost fivefold) for newer direct drive WTGs. The authors also noted that larger sized wind farms, for which data are nonexistent, might only have limited impacts related to behavioral response in marine mammals.

Overall, noise generated from WTG operation is minor and does not cause injury or lead to permanent avoidance at distances greater than 0.5 nm (1 km) for the species studied (e.g., harbor porpoise, seals, and fish) (Wahlberg and Westerberg 2005, Stenberg et al. 2015), with potential to have minimal effects at much closer distances up to within a few meters of the WTG (Bergström et al. 2013). Underwater noise impact to marine mammals associated with WTG operation is expected to be very low to low.

C.6.1.2. Sea Turtles

Low-frequency sound emitted by WTGs is of concern for sea turtles. Their most sensitive hearing range is confined to low frequencies (Ridgway et al. 1969, Bartol et al. 1999), and sea turtles have shown behavioral avoidance to low frequency sound (O'Hara and Wilcox 1990, Dow Piniak et al. 2012). Operational WTG underwater noise may be slightly higher than ambient sound however, WTG sound levels decline to ambient levels within 1 km from the turbine (Kraus et al. 2016, Elliott et al. 2019). Because of these lower sound levels, sea turtles are unlikely to detect sounds generated by WTGs at large distances away from the Project in the presences of ambient sound. Therefore, sea turtles are at very low risk from exposure due to WTG noise. Any behavioral changes caused by exposure to WTG underwater sounds are expected to be short-term and localized to areas near the WTGs.

C.6.1.3. Fish

Underwater sound generated by operating WTGs is in the best hearing frequency range of fish but is of low intensity (Madsen et al. 2006). The measured sound levels are well below existing non-impulsive acoustic thresholds for injury or behavioral response in fish (McCauley et al. 2000, Popper et al. 2014, Finneran et al. 2017). While the underwater sound levels are related to WTG power and wind speed, with increased wind speeds creating increased underwater sound levels, even at high wind speeds Wahlberg and Westerberg (2005) estimated permanent avoidance by fish would only occur within four meters of a WTG foundation. Stöber and Thomsen (2021) extrapolated measured sound levels to larger WTG sizes and found larger distances to a given sound threshold but noted that impacts might be limited to behavioral responses in fishes that could be offset by benefits from lower fishing effort and the creation of artificial reefs at wind farm sites.

In a study on fish near the Svante wind farm in Sweden, Atlantic cod, and roach (*Rutilus rutilus*) catch rates were significantly higher near turbines when the rotors were stopped, which could indicate fish attraction to turbine structure and avoidance to noise when operational (Westerberg 2000 as cited in Thomsen et al. 2006). In another study, no avoidance behavior was observed as fish densities increased around turbine foundations of the Lillgrund offshore wind farm in Sweden (Bergström et al. 2014). It is important to note that ambient sound levels can influence how fish detect other sounds and a change in background noise could alter how fish perceive and react to biological stimuli (Popper and Fay 1993). Current understanding is that underwater noise generated by WTG operation is of minor significance for fish (Wahlberg and Westerberg 2005, Stenberg et al. 2015). Underwater noise risks to fish associated with WTG operation is expected to be low.

C.6.1.4. Invertebrates

There are limited data on the effects of underwater sound from operating WTGs on invertebrates. Pine et al. (2012) found potential impacts on the median time to metamorphosis of estuarine crabs (*Austrohelice crassa* and *Hemigrapsus crenulatus*), although this experiment only measured the sound pressure level, not particle motion. Invertebrates may be susceptible to detecting particle motion produced by operational WTGs at the seabed, which could cause a behavioral response (Roberts et al. 2015b, Roberts and Breithaupt 2016, Roberts and Elliott 2017). However, there is a paucity of data regarding responses of invertebrates to acoustic exposure, and no studies of noise-induced hearing effects. Overall, risks are expected to be very low.

C.6.1.5. Monitoring and Mitigation

Noise generated by operating WTGs is typically below regulatory thresholds for injury and behavioral disruption, and does not lead to permanent avoidance at distances >1 km for the species studied (e.g., harbor porpoise, seals, and fish) (Wahlberg and Westerberg 2005, Stenberg et al. 2015). Although there are potential behavioral impacts within a few meters of an operational WTG (Bergström et al. 2013), the risks are very low to low and no mitigation or monitoring is used for underwater sound produced by WTG operations.

C.7. Impact Risk Definitions

Risk rankings of secondary sound sources are very low, low, moderate, or high based on the probability of marine fauna exposure and the vulnerability of the marine species to a particular development stressor (Table C-1). Marine species occurrence and their relationships to the established criteria were evaluated using: existing literature on marine mammal, sea turtle, fish distribution and presence/use of Lease Area OCS-A 0512, information on the potential impacts of offshore wind farm construction and operations in both the US and globally, and studies that provide a general understanding of hearing, response to anthropogenic sound, and other factors that influence the potential underwater noise impacts of offshore wind construction, operations, and decommissioning activities on marine fauna.

Table C-1. Definitions of Impact risk, exposure, and vulnerability used in impact assessment.

Risk level	Exposure	Individual vulnerability
Very low	No or limited observations of the species in or near the proposed Project infrastructure and acoustic exposure zones (low expected occurrence), and/or Species tends to occur mainly in other habitat (e.g., deeper water or at lower/higher latitudes), and/or No indication that the Lease Area has regional importance as it pertains to a particular species life history characteristics.	Literature and/or research suggest the affected species and timing of the stressor are not likely to overlap, and/or Literature suggests limited sensitivity to the stressor, and/or Little or no evidence of impacts from the stressor in the literature.
Low	Few observations of the species in or near the proposed Project infrastructure and noise exposure zones (occasional occurrence), and/or Seasonal pattern of occurrence in or near the proposed Project infrastructure and acoustic exposure zones.	Literature and/or research suggest the affected species and timing of the stressor may overlap and/or Literature suggests some low sensitivity to the stressor and/or Literature suggests impacts are typically short-term (end within days or weeks of exposure) and/or Literature describes mitigation/best management practices (BMPs) that reduce risk
Moderate	Moderate year-round use of the areas associated with proposed Project infrastructure and acoustic exposure zones	Literature and/or research suggest the affected species and timing of the stressor are likely to overlap, and/or Literature and/or research suggest a moderate susceptibility to the stressor exists in the region and/or from similar activities elsewhere, and Literature does not describe mitigation/BMPs that reduce risk.
High	Significant year-round use of the areas associated with proposed Project infrastructure and acoustic exposure zones	Literature and/or research suggest the affected species and timing of the stressor will overlap, and Literature suggests significant use of WTA and ECC and acoustic exposure zones for feeding, breeding, or migration, and Literature does not describe mitigation/BMPs that reduce risk.

Appendix D. Underwater Acoustics

This section provides a detailed description of the acoustic metrics relevant to the modeling study and the modeling methodology.

D.1. Acoustic Metrics

Underwater sound pressure amplitude is measured in decibels (dB) relative to a fixed reference pressure of p_0 = 1 μPa in water and p_0 = 20 μPa in air. Because the perceived loudness of sound, especially impulsive noise such as from seismic airguns, pile driving, and sonar, is not generally proportional to the instantaneous acoustic pressure, several sound level metrics are commonly used to evaluate noise and its effects on marine life. Here we provide specific definitions of relevant metrics used in the accompanying report. Where possible, we follow ISO standard definitions and symbols for sound metrics (e.g., ISO 2017).

The zero-to-peak sound pressure, or peak sound pressure (PK or L_{pk}; dB re 1 µPa), is the decibel level of the maximum instantaneous acoustic pressure in a stated frequency band attained by an acoustic pressure signal, $p(t)$:

$$L_{p,\mathrm{pk}} = 10\log_{10}\frac{\max|p^2(t)|}{p_0^2} = 20\log_{10}\frac{\max|p(t)|}{p_0}$$

PK is often included as a criterion for assessing whether a sound is potentially injurious; however, because it does not account for the duration of a noise event, it is generally a poor indicator of perceived loudness.

The peak-to-peak sound pressure (PK-PK or $L_{pk\text{-}\mathrm{pk}}$; dB re 1 µPa) is the difference between the maximum and minimum instantaneous sound pressure, possibly filtered in a stated frequency band, attained by an impulsive sound, $p(t)$:

$$L_{p,\mathrm{pk\text{-}pk}} = 10\log_{10}\frac{[\max(p(t)) - \min(p(t))]^2}{p_0^2}$$

The sound pressure level (SPL or L_p; dB re 1 µPa) is the root-mean-square (rms) pressure level in a stated frequency band over a specified time window (T; s). It is important to note that SPL always refers to an rms pressure level and therefore not instantaneous pressure:

$$L_p = 10\log_{10}\left(\frac{1}{T}\int_T g(t)\,p^2(t)\,dt \Big/ p_0^2\right)\ \mathrm{dB}$$

where $g(t)$ is an optional time weighting function. In many cases, the start time of the integration is marched forward in small time steps to produce a time-varying L_p function. For short acoustic events, such as sonar pulses and marine mammal vocalizations, it is important to choose an appropriate time window that matches the duration of the signal. For in-air studies, when evaluating the perceived loudness of sounds with rapid amplitude variations in time, the time weighting function $g(t)$ is often set to a decaying exponential function that emphasizes more recent pressure signals. This function mimics the leaky integration nature of mammalian hearing. For example, human-based fast time-weighted L_p ($L_{p,\mathrm{fast}}$) applies an exponential function with time constant 125 ms. A related simpler approach used in underwater acoustics sets $g(t)$ to a boxcar (unity amplitude) function of width 125 ms; the results can be referred to as

$L_{p,\text{boxcar 125ms}}$. Another approach, historically used to evaluate L_p of impulsive signals underwater, defines $g(t)$ as a boxcar function with edges set to the times corresponding to 5% and 95% of the cumulative square pressure function encompassing the duration of an impulsive acoustic event. This calculation is applied individually to each impulse signal, and the results have been referred to as 90% SPL ($L_{p,90\%}$).

The sound exposure level (SEL or L_E; dB re 1 µPa²·s) is the time-integral of the squared acoustic pressure over a duration (T):

$$L_E = 10\log_{10}\left(\int_T p^2(t)\,dt \Big/ T_0 p_0^2\right)\text{ dB}$$

where T_0 is a reference time interval of 1 s. L_E continues to increase with time when non-zero pressure signals are present. It is a dose-type measurement, so the integration time applied must be carefully considered in terms of relevance for impact to the exposed recipients.

SEL can be calculated over a fixed duration, such as the time of a single event or a period with multiple acoustic events. When applied to impulsive sounds, SEL can be calculated by summing the SEL of the N individual pulses. For a fixed duration, the square pressure is integrated over the duration of interest. For multiple events, the SEL can be computed by summing (in linear units) the SEL of the N individual events:

$$L_{E,N} = 10\log_{10}\left(\sum_{i=1}^{N} 10^{\frac{L_{E,i}}{10}}\right)\text{ dB}$$

D.2. Decidecade Band Analysis

The distribution of a sound's power with frequency is described by the sound's spectrum. The sound spectrum can be split into a series of adjacent frequency bands. Splitting a spectrum into 1 Hz wide bands, called passbands, yields the power spectral density of the sound. This splitting of the spectrum into passbands of a constant width of 1 Hz, however, does not represent how animals perceive sound.

Because animals perceive exponential increases in frequency rather than linear increases, analyzing a sound spectrum with passbands that increase exponentially in size better approximates real-world scenarios. In underwater acoustics, a spectrum is commonly split into decidecade bands, which are one tenth of a decade wide. A decidecade is sometimes referred to as a "1/3-octave" because one tenth of a decade is approximately equal to one third of an octave. Each decade represents a factor 10 in sound frequency. Each octave represents a factor 2 in sound frequency. The center frequency of the ith band, $f_{c(}(i)$, is defined as:

$$f_c(i) = 10^{\frac{i}{10}}\text{ kHz}$$

and the low (f_{lo}) and high (f_{ji}) frequency limits of the ith decade band are defined as:

$$f_c(i) = 10^{\frac{i}{10}}\text{ kHz}$$

The decidecade bands become wider with increasing frequency, and on a logarithmic scale the bands appear equally spaced (Figure D-1). The acoustic modeling spans from band −24 (f_c (−24) = -4 kHz) to band 14 (f_c (14) = 25 kHz).

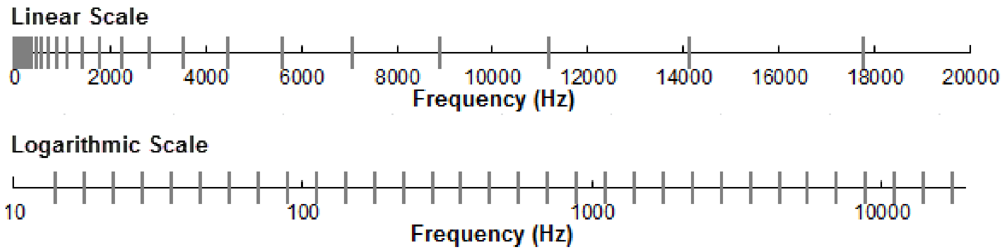

Figure D-1. Decidecade frequency bands (vertical lines) shown on a linear frequency scale and a logarithmic scale.

The sound pressure level in the *i*th band ($L_{p,i}$) is computed from the spectrum $S(f)$ between $f_{lo,i}$ and $f_{hi,I}$:

$$L_{p,i} = 10\log_{10} \int_{f_{lo,i}}^{f_{hi,i}} S(f)\, df$$

Summing the sound pressure level of all the bands yields the broadband sound pressure level:

$$\text{Broadband SPL} = 10\log_{10} \sum_{i} 10^{\frac{L_{p,i}}{10}}$$

Figure D-2 shows an example of how the decidecade band sound pressure levels compare to the sound pressure spectral density levels of an ambient noise signal. Because the decidecade bands are wider than 1 Hz, the decidecade band SPL is higher than the spectral levels at higher frequencies. Acoustic modeling of decidecade bands requires less computation time than 1 Hz bands and still resolves the frequency-dependence of the sound source and the propagation environment.

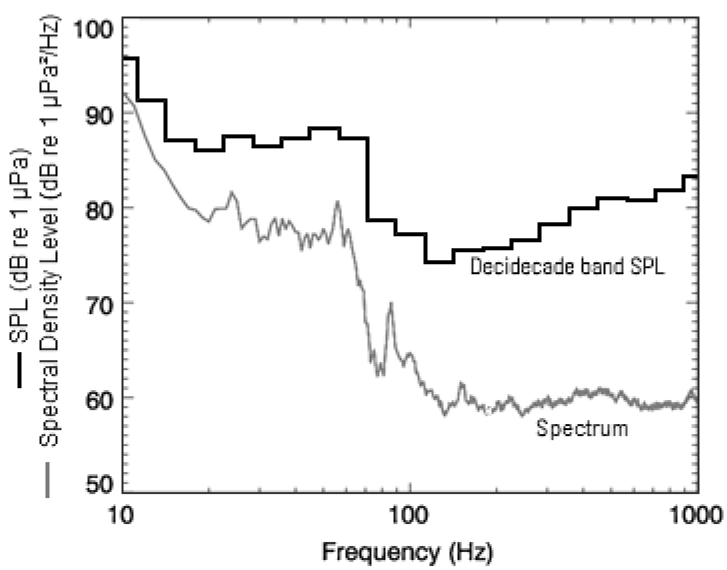

Figure D-2. Sound pressure spectral density levels and the corresponding decidecade band sound pressure levels of example ambient noise shown on a logarithmic frequency scale. Because the decidecade bands are wider with increasing frequency, the decidecade band SPL is higher than the power spectrum.

Appendix E. Auditory (Frequency) Weighting Functions

The potential for noise to affect animals of a certain species depends on how well the animals can hear it. Noises are less likely to disturb or injure an animal if they are at frequencies that the animal cannot hear well. An exception occurs when the sound pressure is so high that it can physically injure an animal by non-auditory means (i.e., barotrauma). For sound levels below such extremes, the importance of sound components at particular frequencies can be scaled by frequency weighting relevant to an animal's sensitivity to those frequencies (Nedwell and Turnpenny 1998, Nedwell et al. 2007).

E.1. Frequency Weighting Functions-Technical Guidance (NMFS 2018)

In 2015, a U.S. Navy technical report by Finneran (2015) recommended new auditory weighting functions. The overall shape of the auditory weighting functions is similar to human A-weighting functions, which follows the sensitivity of the human ear at low sound levels. This frequency-weighting function is expressed as:

$$G(f) = K + 10\log_{10}\left[\left(\frac{(f/f_{lo})^{2a}}{\left[1+(f/f_{lo})^2\right]^a\left[1+(f/f_{hi})^2\right]^b}\right)\right] ($$

Finneran (2015) proposed five functional hearing groups for marine mammals in water: low-, mid-, and high-frequency cetaceans, phocid pinnipeds, and otariid pinnipeds. The parameters for these frequency-weighting functions were further modified the following year (Finneran 2016) and were adopted in NOAA's technical guidance that assesses noise impacts on marine mammals (NMFS, 2018). Table E-1 lists the frequency-weighting parameters for each hearing group; Figure E-1 shows the resulting frequency-weighting curves.

In 2017, the Criteria and Thresholds for US Navy Acoustic and Explosive Effects Analysis (Finneran et al. 2017) updated the auditory weighting functions to include sea turtles. The sea turtle weighting curve uses the same equation used for marine mammal auditory weighting functions (Equation **Error! Reference source not found.**). Parameters are provided in Table E-1.

Table E-1. Parameters for the auditory weighting functions recommended by NMFS (2018).

Hearing group	a	b	f_{lo} (Hz)	f_{hi} (kHz)	K (dB)
Low-frequency cetaceans	1.0	2	200	19,000	0.13
Mid-frequency cetaceans	1.6	2	8,800	110,000	1.20
High-frequency cetaceans	1.8	2	12,000	140,000	1.36
Phocid pinnipeds in water	1.0	2	1,900	30,000	0.75
Otariid pinnipeds in water	2.0	2	940	25,000	0.64
Sea turtles	1.4	2	77	440	2.35

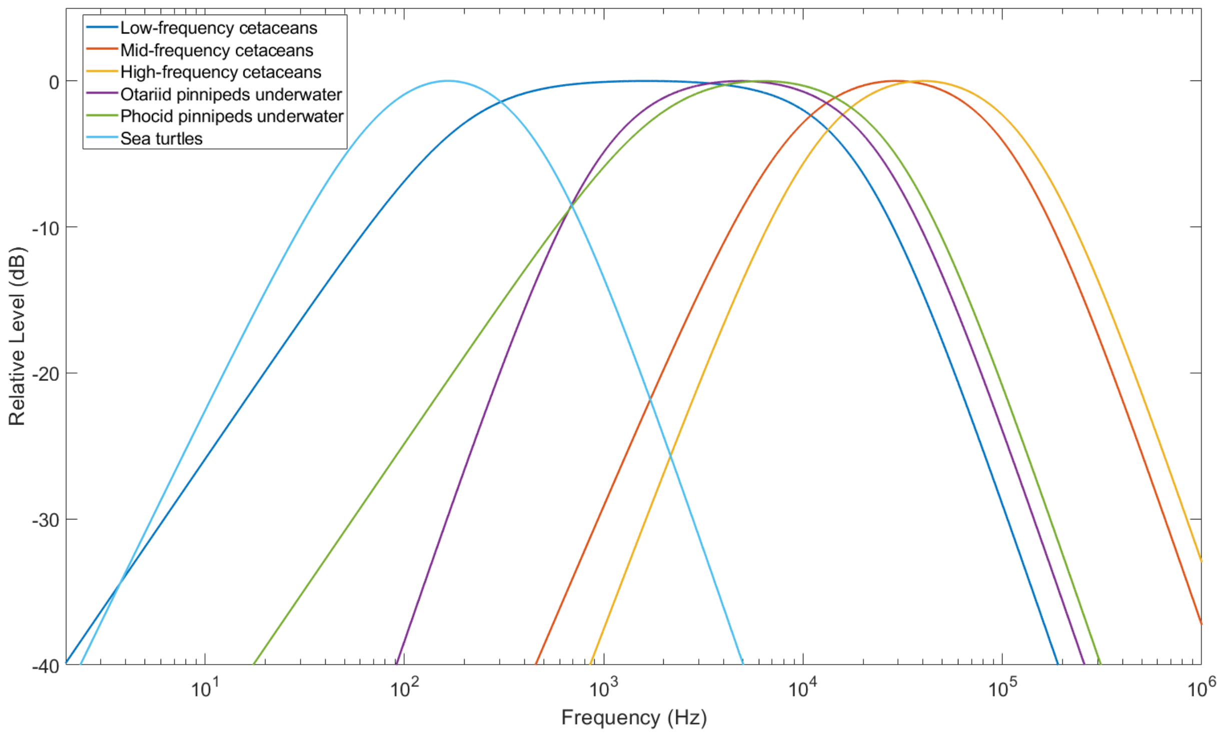

Figure E-1. Auditory weighting functions for the functional marine mammal hearing groups as recommended by NMFS (2018).

E.2. Southall et al. (2019) Frequency Weighting Functions

Auditory weighting functions for marine mammals—called M-weighting functions—were proposed by Southall et al. (2007). These M-weighting functions are applied in a similar way as A-weighting for noise level assessments for humans. Functions were defined for five hearing groups of marine mammals:

- Low-frequency (LF) cetaceans—mysticetes (baleen whales)
- Mid-frequency (MF) cetaceans—some odontocetes (toothed whales)
- High-frequency (HF) cetaceans—odontocetes specialized for using high-frequencies
- Pinnipeds in water (PW)—seals, sea lions, and walrus
- Pinnipeds in air (PA) (not addressed here)

The M-weighting functions have unity gain (0 dB) through the passband and their high- and low-frequency roll-offs are approximately –12 dB per octave. The amplitude response in the frequency domain of each M-weighting function is defined by:

$$G(f) = -20\log_{10}\left[\left(1+\frac{a^2}{f^2}\right)\left(1+\frac{f^2}{b^2}\right)\right]$$

Where $G(f)$ is the weighting function amplitude (in dB) at the frequency f (in Hz), and a and b are the estimated lower and upper hearing limits, respectively, which control the roll-off and passband of the weighting function. The parameters a and b are defined uniquely for each hearing group (Table E-2). Figure E-2 shows the auditory weighting functions.

Table E-2. Parameters for the auditory weighting functions recommended by Southall et al. (2007).

Functional hearing group	a (Hz)	b (Hz)
Low-frequency cetaceans	7	22,000
Mid-frequency cetaceans	150	160,000
High-frequency cetaceans	200	180,000
Pinnipeds in water	75	75,000

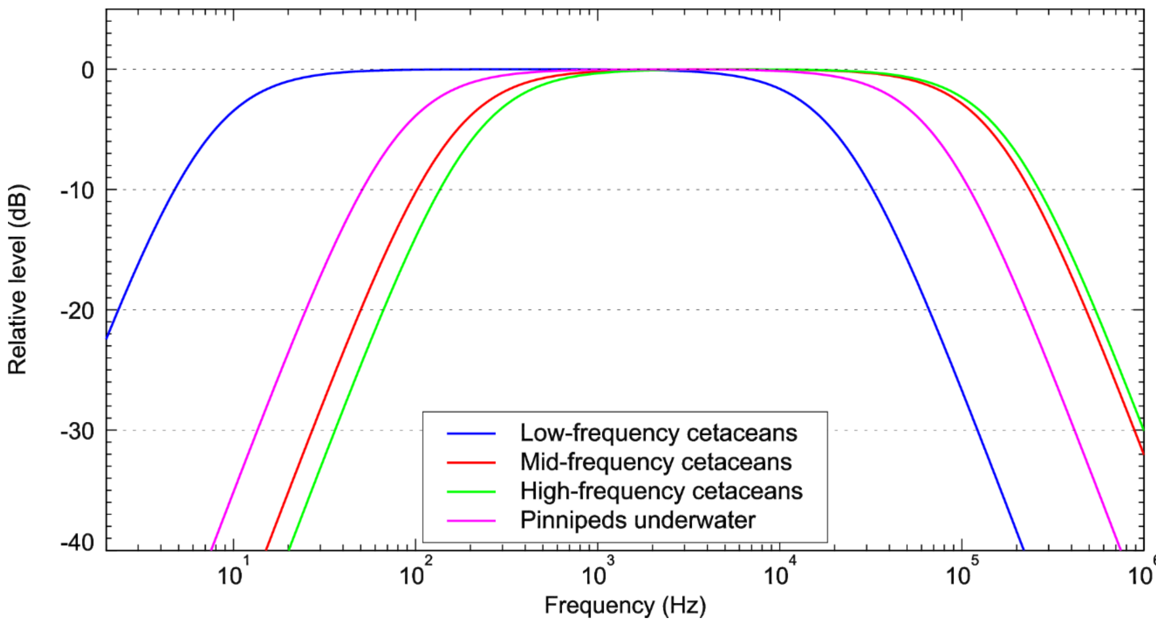

Figure E-2. Auditory weighting functions for the functional marine mammal hearing groups as recommended by Southall et al. (2007).

Appendix F. Source Models

F.1. Pile Driving Source Model (PDSM)

A physical model of pile vibration and near-field sound radiation is used to calculate source levels of piles. The physical model employed in this study computes the underwater vibration and sound radiation of a pile by solving the theoretical equations of motion for axial and radial vibrations of a cylindrical shell. These equations of motion are solved subject to boundary conditions, which describe the forcing function of the hammer at the top of the pile and the soil resistance at the base of the pile (Figure F-1). Damping of the pile vibration due to radiation loading is computed for Mach waves emanating from the pile wall. The equations of motion are discretised using the finite difference (FD) method and are solved on a discrete time and depth mesh.

To model the sound emissions from the piles, the force of the pile driving hammers also had to be modeled. The force at the top of each pile was computed using the GRLWEAP 2010 wave equation model (GRLWEAP, Pile Dynamics 2010), which includes a large database of simulated hammers—both impact and vibratory—based on the manufacturer's specifications. The forcing functions from GRLWEAP were used as inputs to the FD model to compute the resulting pile vibrations.

The sound radiating from the pile itself is simulated using a vertical array of discrete point sources. The point sources are centered on the pile axis. Their amplitudes and phases are derived using an inverse technique, such that their collective particle velocity, calculated using a near-field wave-number integration model, matches the particle velocity in the water at the pile wall. The sound field propagating away from the vertical source array is then calculated using a full-wave acoustic propagation model from which time-domain waveforms may be calculated (see Appendix G.2). MacGillivray (2014) describes the theory behind the physical model in more detail.

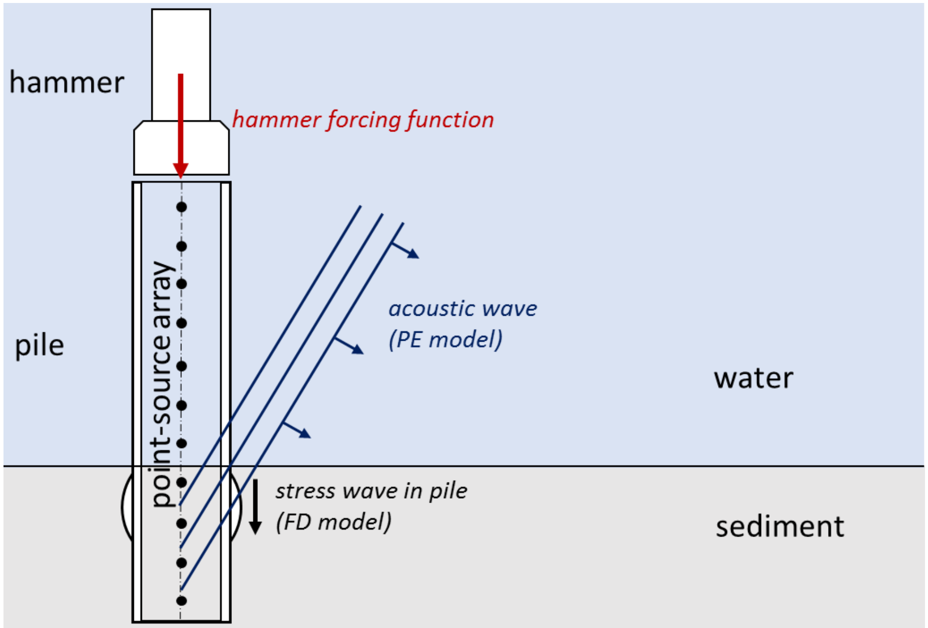

Figure F-1. Physical model geometry for impact driving of a cylindrical pile (vertical cross-section). The hammer forcing function is used with the finite difference (FD) model to compute the stress wave vibration in the pile. A vertical array of point sources is used with the parabolic equation (PE) model to compute the acoustic waves that the pile wall radiates.

Appendix G. Sound Propagation Modeling

G.1. Environmental Parameters

G.1.1. Bathymetry

A bathymetry grid for the acoustic propagation model was compiled based on the Shuttle Radar Topography Mission (SRTM) data referred to as SRTM-TOPO15+ (Becker et al. 2009).

G.1.2. Geoacoustics

In shallow water environments where there is increased interaction with the seafloor, the properties of the substrate have a large influence over the sound propagation. A simplified geoacoustic profile was developed from site specific seabed layering information provided by Empire Wind. This profile consisted of very fine grained to Coarse grained sediments. Tables G-1 to G-4 show the sediment layer geoacoustic property profile used in the modeling for locations L01through L09, OSS1, and OSS2 based on the sediment type and generic porosity-depth profile using a sediment grain-shearing model (NGI 2021, Buckingham 2005).

Table G-1. Locations L01, L04, L05 and L06: Estimated geoacoustic properties for summer conditions used for modeling, as a function of depth. Within an indicated depth range, the parameters vary linearly.

Depth below seafloor (m)	Material	Density (g/cm^3)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	Speed (m/s)	Attenuation (dB/λ)
0–7	Medium/fine sand	2.014–2.086	1,729.98–1764.6	0.88	300	3.65
7–19.9	Medium sand	2.086–2.014	1,764.6–1,729.98	0.88		
19.9–21.3	Medium/fine sand	2.014–1.879	1,729.98–1,666.8	0.88–0.96		
21.3–46.4	Fine/very fine sand	1.879–1.945	1,666.8–1,697.4	0.96–0.89		
46.4–65	Fine sand	1.945–1.879	1,697.4–1666.8	0.89–0.96		
65–500	Fine/very fine sand	1.879	1666.8	0.96		
>500		1.879	1666.8	0.96		

Table G-2. Locations L02, L03, L07, L08, and L09: Estimated geoacoustic properties for summer conditions used for modeling, as a function of depth. Within an indicated depth range, the parameters vary linearly.

Depth below seafloor (m)	Material	Density (g/cm³)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	Speed (m/s)	Attenuation (dB/λ)
0–3.3	Medium/fine sand	2.014–2.086	1,729.98–1764.6	0.88	300	3.65
3.3–3.8	Medium sand	2.086–1.945	1,764.6–1,697.42	0.88–0.89		
3.8–7.0	Fine sand	1.945–2.086	1,697.42–1,764.6	0.88		
7.0–16.3	Medium sand	2.086–1.945	1,764.6–1697.42	0.88–0.89		
16.3–33.4	Fine sand	1.945–1.817	1,697.42–1,638.2	0.89–1.05		
33.4–57.7	Very fine sand	1.817–2.014	1,638.2–1,729.98	1.05–0.88		
57.7–70	Medium/fine sand	2.014–1.879	1,729.98–1,666.8	0.88–0.96		
70–500	Fine/very fine sand	1.879	1,666.8	0.96		
>500	Fine/very fine sand	1.879	1666.8	0.96		

Table G-3. Location OSS1: Estimated geoacoustic properties for winter conditions used for modeling, as a function of depth. Within an indicated depth range, the parameters vary linearly.

Depth below seafloor (m)	Material	Density (g/cm³)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	Speed (m/s)	Attenuation (dB/λ)
0–2.5	Medium/fine sand	2.014–2.231	1,729.98–1,841.9	0.88–0.87	300	3.65
2.5–7.8	Coarse sand	2.231–1.879	1,841.9–1,666.8	0.87–0.96		
7.8–10.2	Fine/very fine sand	1.879–2.014	1,666.8–1,729.98	0.96–0.88		
10.2–14	Medium/fine sand	2.014–2.314	1,729.98–1,882.5	0.88–0.87		
14–23.2	Coarse/very coarse sand	2.314–1.945	1,882.5–1,697.4	0.87–0.89		
23.2–29	Fine sand	1.945–1.817	1,697.4–1,638.2	0.89–1.05		
29–56	Very fine sand	1.817–1.879	1,638.2–1,666.8	1.05–0.96		
56–74	Fine/very fine sand	1.879–1.817	1,666.8–1,638.2	0.96–1.05		
74–500	Very fine sand	1.817	1,638.2	1.05		
>500	Very fine sand	1.817	1,638.2	1.05		

Table G-4. Location OSS2: Estimated geoacoustic properties for winter conditions used for modeling, as a function of depth. Within an indicated depth range, the parameters vary linearly.

Depth below seafloor (m)	Material	Density (g/cm³)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	Speed (m/s)	Attenuation (dB/λ)
0–2.5	Medium/fine sand	2.014–2.086	1,729.98–1,764.6	0.88	300	3.65
2.5–16.3	Medium sand	2.086–1.879	1,764.6–1,666.8	0.87–0.96		
16.3–50.0	Fine/very fine sand	1.879–2.014	1,666.8–1,729.98	0.96–0.88		
50.0–75	Medium/fine sand	2.014–1.945	1,729.98–1,697.4	0.88–0.89		
75–500	Fine sand	1.945	1,697.4	0.89		
>500	Fine sand	1.945	1,697.4	0.89		

G.1.3. Sound Speed Profile

The speed of sound in sea water is a function of temperature, salinity, and pressure (depth) (Coppens 1981). Sound speed profiles were obtained from the US Navy's Generalized Digital Environmental Model (GDEM; NAVO 2003). Considering the greater area around the proposed construction site and deep waters beyond the lease area, the shape of the sound speed profiles do not change much in summer (Figure G-1) and winter (Figure G-2). Average profiles for summer and winter representative of the entire area were chosen as two different scenarios for performing the acoustic modeling The months used to obtain the summer and winter average profiles are shown in Figures G-3 and G-4 along with the corresponding averages used as input to the propagation model.

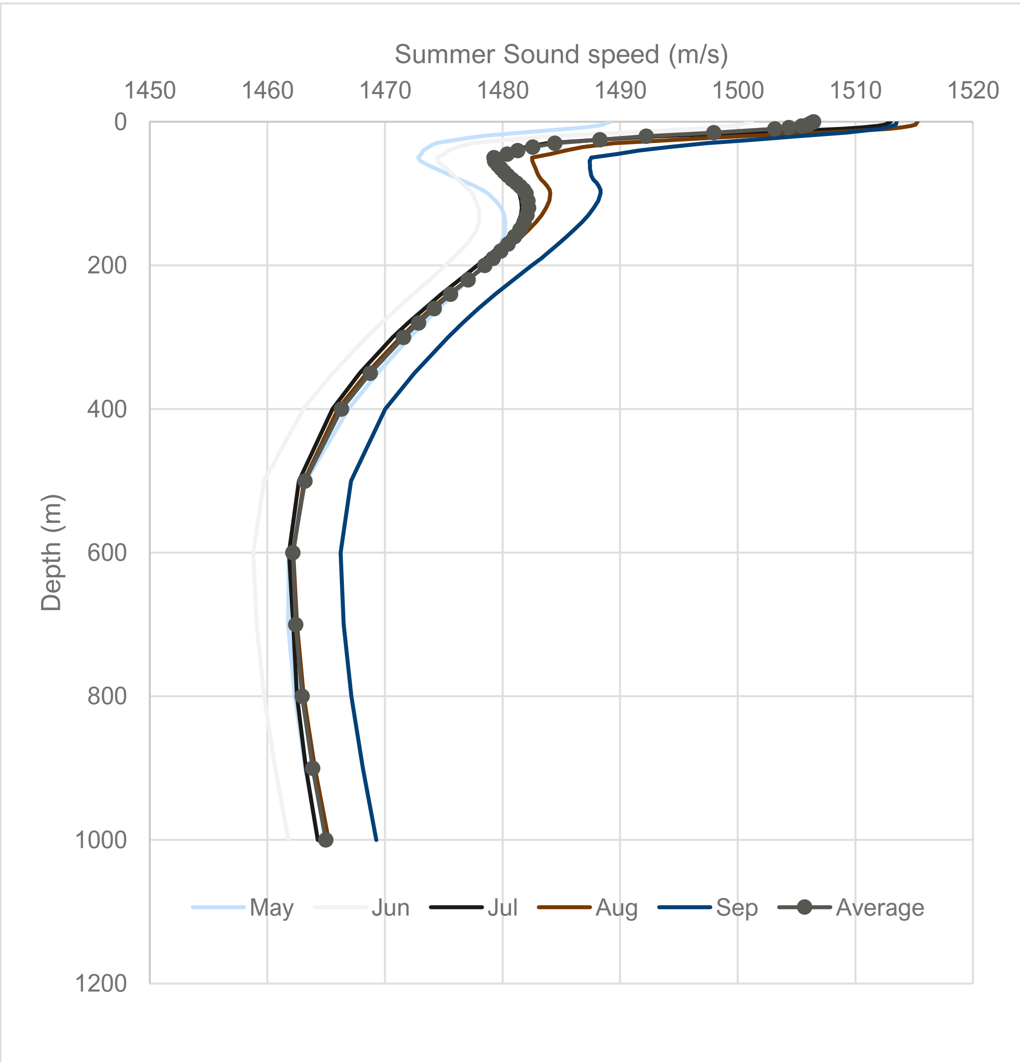

Figure G-1. Sound speed profiles up to 1000 m for the months of May through September and the average of these months (summer) used in the modeling for Empire Wind.

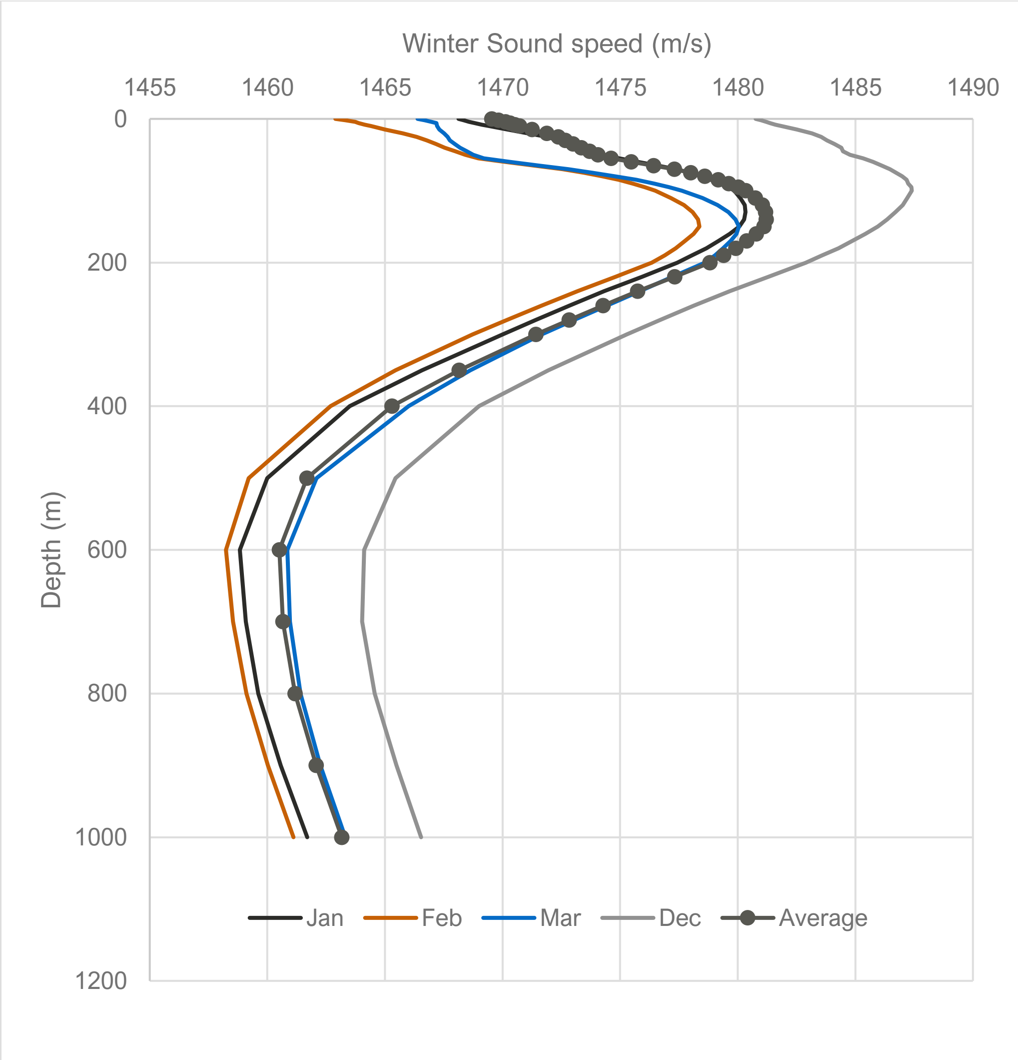

Figure G-2. Sound speed profiles up to 1000 m for the months of December through March and the average of these months (winter) used in the modeling for Empire Wind.

G.2. Sound Propagation with FWRAM

For impulsive sounds from impact pile driving, time-domain representations of the pressure waves generated in the water are required for calculating SPL and peak pressure level. Furthermore, the pile must be represented as a distributed source to accurately characterize vertical directivity effects in the near-field zone. For this study, synthetic pressure waveforms were computed using FWRAM, a full-wave acoustic propagation model based on the wide-angle parabolic equation (PE) algorithm (Collins 1993) FWRAM computes pressure waveforms as a function of range and depth via Fourier synthesis of transfer functions in closely-spaced frequency bands in range-varying marine acoustic environments. FWRAM employs an array starter method to accurately model sound propagation from a spatially distributed source (MacGillivray and Chapman 2012).

Synthetic pressure waveforms were modeled over the frequency range 10–1024 Hz, inside a 1 s window (e.g., Figure G-3). The synthetic pressure waveforms were post-processed, after applying a travel time correction, to calculate standard SPL and SEL metrics versus range and depth from the source. The acoustic field is extended to higher frequencies (up to 32,000 Hz) by applying a 20 dB/decade decay rate to match acoustic measurements of impact pile driving (Illingworth & Rodkin 2007), (Matuschek and Betke 2009).

Acoustic fields in three dimensions are generated by modeling propagation loss within two-dimensional (2-D) vertical planes aligned along radials covering a 360° swath from the source, an approach commonly referred to as N×2-D. These vertical radial planes are separated by an angular step size of $\Delta\theta$, yielding N = 360°/$\Delta\theta$ planes.

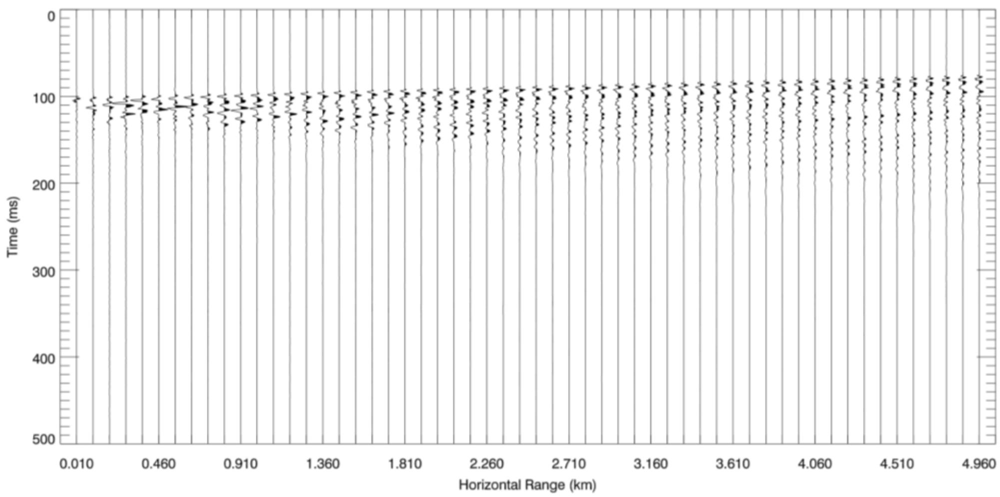

Figure G-3. Example of synthetic pressure waveforms computed by FWRAM at multiple range offsets. Amplitudes of the pressure traces have been normalised for display purposes.

G.3. Estimating Acoustic Distance to Threshold Levels

A maximum-over-depth approach is used to determine acoustic distances to the defined thresholds (distances to isopleths). That is, at each horizontal sampling distance, the maximum received level that occurs within the water column is used as the value at that distance. The distances to a threshold typically differ along different radii and may not be continuous because sound levels may drop below threshold at some distances and then exceed threshold at farther distances. Figure G-4 shows an example of an area with sound levels above threshold and two methods of reporting the injury or behavioral disruption distance: (1) R_{max}, the maximum distance at which the sound level was encountered in the modeled maximum-over-depth sound field, and (2) $R_{95\%}$, the maximum distance at which the sound level was encountered after the 5% farthest such points were excluded. $R_{95\%}$ is used because, regardless of the shape of the maximum-over-depth footprint, the predicted distance encompasses at least 95% of the horizontal area that would be exposed to sound at or above the specified level. The difference between R_{max} and $R_{95\%}$ depends on the source directivity and the heterogeneity of the acoustic environment. $R_{95\%}$ excludes ends of protruding areas or small isolated acoustic foci not representative of the nominal ensonification zone.

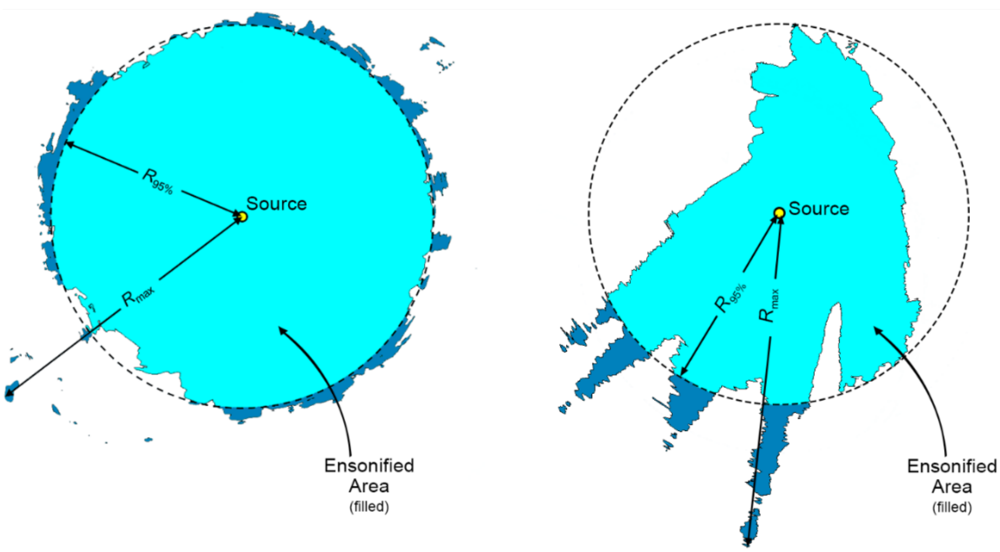

Figure G-4. Sample areas ensonified to an arbitrary sound level with R_{max} and $R_{95\%}$ distances shown for two different scenarios. (a) Largely symmetric sound level contour with small protrusions. (b) Strongly asymmetric sound level contour with long protrusions. Light blue indicates the ensonified areas bounded by $R_{95\%}$; darker blue indicates the areas outside this boundary which determine R_{max}.

G.4. Model Validation Information

Predictions from JASCO's propagation model (FWRAM) have been validated against experimental data from a number of underwater acoustic measurement programs conducted by JASCO globally, including the United States and Canadian Arctic, Canadian and southern United States waters, Greenland, Russia and Australia (Hannay and Racca 2005, Aerts et al. 2008, Funk et al. 2008, Ireland et al. 2009, O'Neill et al. 2010, Warner et al. 2010, Racca et al. 2012a, Racca et al. 2012b, Matthews and MacGillivray 2013, Martin et al. 2015, Racca et al. 2015, Martin et al. 2017a, Martin et al. 2017b, Warner et al. 2017, MacGillivray 2018, McPherson et al. 2018, McPherson and Martin 2018).

In addition, JASCO has conducted measurement programs associated with a significant number of anthropogenic activities which have included internal validation of the modeling (including McCrodan et al. 2011, Austin and Warner 2012, McPherson and Warner 2012, Austin and Bailey 2013, Austin et al. 2013, Zykov and MacDonnell 2013, Austin 2014, Austin et al. 2015, Austin and Li 2016, Martin and Popper 2016).

Appendix H. Acoustic Ranges

The following subsections contain tables of acoustic ranges (R_{max} and $R_{95\%}$ in km) to marine mammal (NMFS 2018), sea turtle (Finneran et al. 2017), and fish (FHWG 2008, Stadler and Woodbury 2009, Popper et al. 2014) injury thresholds. The acoustic ranges to behavioral thresholds for marine mammals (NOAA 2005, Wood et al. 2012), sea turtles (McCauley et al. 2000), and fish (Andersson et al. 2007, Wysocki et al. 2007, Mueller-Blenkle et al. 2010, Purser and Radford 2011) are also included. The acoustic ranges are shown for the following categories: Flat is unweighted, LF is low-frequency cetaceans, MF is mid-frequency cetaceans, HF is high-frequency cetaceans, PW is phocid pinnipeds in water, and TUW is turtles in water. TUW weighting functions are from the US Navy (Finneran et al. 2017), the rest are from the Technical Guidance (NMFS 2018). R_{max} is the maximum distance at which the sound level was encountered in the modeled maximum-over-depth sound field and $R_{95\%}$ is the maximum distance at which the sound level was encountered after the 5% farthest such points were excluded (Appendix G.3). The results for the jacket foundation assume a 2 dB post-piling shift.

H.1. Impact Pile Driving Single-Strike PK Acoustic Ranges

H.1.1. Monopile Foundation

H.1.1.1. 9.6 m Diameter Pile

Table H-1. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L01 with different energy levels at 0 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ									
		Summer					Winter				
		450	800	1400	1700	2300	450	800	1400	1700	2300
TUW	232	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	0.02	-	-	-	-	0.02
PW	218	-	-	-	0.02	0.04	-	-	-	0.02	0.03
HF	202	0.09	0.12	0.23	0.29	0.33	0.09	0.13	0.23	0.28	0.33

Table H-2. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L01 with different energy levels at 6 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ									
		Summer					Winter				
		450	800	1400	1700	2300	450	800	1400	1700	2300
TUW	232	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-
HF	202	0.05	0.06	0.09	0.10	0.12	0.05	0.06	0.09	0.11	0.12

Table H-3. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L01 with different energy levels at 10 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ									
		Summer					Winter				
		450	800	1400	1700	2300	450	800	1400	1700	2300
TUW	232	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-
HF	202	0.02	0.04	0.06	0.06	0.08	0.02	0.04	0.06	0.06	0.08

Table H-4. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L01 with different energy levels at 15 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ									
		Summer					Winter				
		450	800	1400	1700	2300	450	800	1400	1700	2300
TUW	232	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-
HF	202	-	-	0.02	0.03	0.05	-	-	0.02	0.03	0.05

Table H-5. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L02 with different energy levels at 0 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ									
		Summer					Winter				
		450	800	1400	1700	2300	450	800	1400	1700	2300
TUW	232	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	0.01	0.01	0.01	-	-	0.01	0.01	0.01
PW	218	-	0.01	0.01	0.01	0.04	-	0.01	0.01	0.01	0.02
HF	202	0.11	0.14	0.28	0.33	0.38	0.11	0.14	0.26	0.32	0.37

Table H-6. Monopile foundation ((9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L02 with different energy levels at 6 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ									
		Summer					Winter				
		450	800	1400	1700	2300	450	800	1400	1700	2300
TUW	232	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-
HF	202	0.05	0.08	0.11	0.12	0.13	0.05	0.08	0.11	0.12	0.14

Table H-7. Monopile foundation ((9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L02 with different energy levels at 10 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ									
		Summer					Winter				
		450	800	1400	1700	2300	450	800	1400	1700	2300
TUW	232	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-
HF	202	0.01	0.05	0.07	0.08	0.09	0.01	0.05	0.07	0.08	0.10

Table H-8. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L02 with different energy levels at 15 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ									
		Summer					Winter				
		450	800	1400	1700	2300	450	800	1400	1700	2300
TUW	232	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-
HF	202	-	0.01	0.01	0.02	0.05	-	0.01	0.01	0.01	0.05

Table H-9. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds (R95% in km) at location L03 with different energy levels at 0 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ									
		Summer					Winter				
		450	800	1400	1700	2300	450	800	1400	1700	2300
TUW	232	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	0.02	-	-	-	-	0.02
HF	202	0.12	0.15	0.30	0.37	0.41	0.13	0.16	0.25	0.35	0.39

Table H-10. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L03 with different energy levels at 6 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ									
		Summer					Winter				
		450	800	1400	1700	2300	450	800	1400	1700	2300
TUW	232	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-
HF	202	0.06	0.09	0.12	0.13	0.14	0.06	0.09	0.12	0.13	0.15

Table H-11. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds (R95% in km) at location L03 with different energy levels at 10 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ									
		Summer					Winter				
		450	800	1400	1700	2300	450	800	1400	1700	2300
TUW	232	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-
HF	202	-	0.06	0.07	0.09	0.10	-	0.05	0.08	0.09	0.11

Table H-12. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L03 with different energy levels at 15 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ									
		Summer					Winter				
		450	800	1400	1700	2300	450	800	1400	1700	2300
TUW	232	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-
HF	202	-	-	-	0.02	0.05	-	-	-	0.02	0.05

H.1.1.2. 11 m Diameter Pile

Table H-13. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location R3-L04 with different energy levels at 0 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	1100	2000	500	750	1100	2000
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
PW	218	0.01	0.01	0.01	0.04	0.01	0.01	0.01	0.03
HF	202	0.11	0.12	0.24	0.33	0.11	0.13	0.24	0.33

Table H-14. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location R3-L04 with different energy levels at 6 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	1100	2000	500	750	1100	2000
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	0.01	-	-	-	0.01
PW	218	-	-	-	0.01	-	-	-	0.01
HF	202	0.06	0.07	0.08	0.12	0.06	0.07	0.09	0.12

Table H-15. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location R3-L04 with different energy levels at 10 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	1100	2000	500	750	1100	2000
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-
HF	202	0.03	0.04	0.05	0.08	0.03	0.04	0.05	0.08

Table H-16. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location R3-L04 with different energy levels at 15 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	1100	2000	500	750	1100	2000
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-
HF	202	0.01	0.01	0.01	0.04	0.01	0.01	0.01	0.04

Table H-17. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location T1-L05 with different energy levels at 0 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	0.03	-	-	-	-	-	0.03
PW	218	-	-	-	-	0.03	0.05	-	-	-	-	0.02	0.05
HF	202	0.11	0.13	0.16	0.31	0.34	0.37	0.11	0.13	0.17	0.30	0.34	0.36

Table H-18. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location T1-L05 with different energy levels at 6 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-	-	-
HF	202	0.06	0.07	0.08	0.11	0.12	0.13	0.06	0.07	0.08	0.11	0.13	0.14

Table H-19. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location T1-L05 with different energy levels at 10 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-	-	-
HF	202	0.03	0.04	0.05	0.07	0.08	0.09	0.03	0.04	0.05	0.07	0.08	0.10

Table H-20. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location T1-L05 with different energy levels at 15 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-	-	-
HF	202	-	-	-	0.02	0.05	0.06	-	-	-	0.02	0.04	0.06

Table H-21. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location U3-L06 with different energy levels at 0 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		450	750	1000	1300	750	1000	1300	750
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-
HF	202	0.10	0.13	0.23	0.30	0.10	0.13	0.23	0.30

Table H-22. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location U3-L06 with different energy levels at 6 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		450	750	1000	1300	750	1000	1300	750
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-
HF	202	0.05	0.06	0.08	0.11	0.05	0.06	0.08	0.11

Table H-23. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location U3-L06 with different energy levels at 10 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		450	750	1000	1300	750	1000	1300	750
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-
HF	202	0.03	0.04	0.06	0.07	0.03	0.04	0.06	0.07

Table H-24. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location U3-L06 with different energy levels at 15 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		450	750	1000	1300	750	1000	1300	750
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-
HF	202	-	-	-	0.02	-	-	-	-

Table H-25. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location R3-L07 with different energy levels at 0 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	1100	2000	500	750	1100	2000
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	0.02	-	-	-	0.02
PW	218	-	-	-	0.04	-	-	-	0.03
HF	202	0.12	0.14	0.29	0.37	0.13	0.15	0.28	0.36

Table H-26. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location R3-L07 with different energy levels at 6 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	1100	2000	500	750	1100	2000
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-
HF	202	0.06	0.08	0.10	0.13	0.06	0.09	0.11	0.14

Table H-27. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location R3-L07 with different energy levels at 10 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	1100	2000	500	750	1100	2000
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-
HF	202	0.03	0.05	0.06	0.10	0.03	0.05	0.06	0.10

Table H-28. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location R3-L07 with different energy levels at 15 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	1100	2000	500	750	1100	2000
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-
HF	202	-	-	-	0.06	-	-	-	0.06

Table H-29. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location T1-L08 with different energy levels at 0 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	0.02	-	-	-	-	-	0.02
PW	218	-	-	-	-	0.02	0.06	-	-	-	-	0.02	0.05
HF	202	0.12	0.14	0.20	0.36	0.39	0.43	0.13	0.15	0.20	0.34	0.38	0.42

Table H-30. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location T1-L08 with different energy levels at 6 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-	-	-
HF	202	0.06	0.09	0.10	0.13	0.14	0.15	0.06	0.09	0.11	0.13	0.14	0.15

Table H-31. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location T1-L08 with different energy levels at 10 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-	-	-
HF	202	0.02	0.05	0.06	0.08	0.10	0.11	0.02	0.04	0.06	0.09	0.10	0.12

Table H-32. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location T1-L08 with different energy levels at 15 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-	-	-
HF	202	-	-	-	0.02	0.05	0.06	-	-	-	0.02	0.05	0.06

Table H-33. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location U3-L09 with different energy levels at 0 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		450	750	1000	1300	750	1000	1300	750
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
PW	218	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
HF	202	0.11	0.14	0.27	0.34	0.11	0.15	0.27	0.33

Table H-34. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location U3-L09 with different energy levels at 6 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		450	750	1000	1300	750	1000	1300	750
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	0.01	-	-	-	0.01
PW	218	-	-	-	0.01	-	-	-	0.01
HF	202	0.05	0.08	0.10	0.12	0.05	0.08	0.11	0.12

Table H-35. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location U3-L09 with different energy levels at 10 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		450	750	1000	1300	750	1000	1300	750
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-
HF	202	0.02	0.04	0.07	0.08	0.02	0.04	0.07	0.08

Table H-36. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location U3-L09 with different energy levels at 15 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		450	750	1000	1300	750	1000	1300	750
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-
HF	202	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

H.1.2. Monopile Foundation (Difficult-to-Drive)

Table H-37. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L01 with different energy levels at 0 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	0.02	0.06	-	-	-	-	0.02	0.06
PW	218	-	-	-	0.02	0.03	0.06	-	-	-	0.02	0.03	0.06
HF	202	0.09	0.12	0.23	0.29	0.32	0.57	0.09	0.13	0.23	0.28	0.32	0.57

Table H-38. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L01 with different energy levels at 6 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-	-	-
HF	202	0.05	0.06	0.09	0.10	0.12	0.27	0.05	0.06	0.09	0.11	0.12	0.26

Table H-39. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L01 with different energy levels at 10 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-	-	-
HF	202	0.02	0.04	0.06	0.06	0.08	0.12	0.02	0.04	0.06	0.06	0.08	0.12

Table H-40. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L01 with different energy levels at 15 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-	-	-
HF	202	-	-	0.02	0.03	0.05	0.06	-	-	0.02	0.03	0.05	0.07

Table H-41. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L02 with different energy levels at 0 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	0.01	0.01	0.01	0.07	-	-	0.01	0.01	0.01	0.07
PW	218	-	0.01	0.01	0.01	0.04	0.07	-	0.01	0.01	0.01	0.03	0.08
HF	202	0.11	0.14	0.28	0.33	0.38	0.66	0.11	0.14	0.26	0.32	0.36	0.63

Table H-42. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L02 with different energy levels at 6 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	0.01	-	-	-	-	-	0.01
PW	218	-	-	-	-	-	0.01	-	-	-	-	-	0.01
HF	202	0.05	0.08	0.11	0.12	0.13	0.33	0.05	0.08	0.11	0.12	0.14	0.35

Table H-43. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L02 with different energy levels at 10 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-	-	-
HF	202	0.01	0.05	0.07	0.08	0.09	0.14	0.01	0.05	0.07	0.08	0.09	0.15

Table H-44. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L02 with different energy levels at 15 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-	-	-
HF	202	-	0.01	0.01	0.02	0.05	0.09	-	0.01	0.01	0.01	0.05	0.09

Table H-45. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds (R95% in km) at location L03 with different energy levels at 0 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	0.07	-	-	-	-	-	0.07
PW	218	-	-	-	-	0.02	0.08	-	-	-	-	0.02	0.08
HF	202	0.12	0.15	0.30	0.37	0.41	0.68	0.13	0.16	0.25	0.35	0.40	0.61

Table H-46. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L03 with different energy levels at 6 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-	-	-
HF	202	0.06	0.09	0.12	0.13	0.14	0.35	0.06	0.09	0.12	0.13	0.15	0.34

Table H-47. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds (R95% in km) at location L03 with different energy levels at 10 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-	-	-
HF	202	-	0.06	0.07	0.09	0.11	0.15	-	0.05	0.08	0.09	0.11	0.17

Table H-48. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location L03 with different energy levels at 15 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ											
		Summer						Winter					
		450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
TUW	232	-	-	-	-	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-	-	-	-	-
HF	202	-	-	-	0.02	0.06	0.09	-	-	-	0.02	0.05	0.09

H.1.3. Jacket Foundation

Table H-49. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location OSS1 with different energy levels at 0 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	2000	3200	500	750	2000	3200
TUW	232	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MF	230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LF	219	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
PW	218	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01
HF	202	0.04	0.03	0.04	0.07	0.05	0.03	0.04	0.07

Table H-50. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location OSS1 with different energy levels at 6 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	2000	3200	500	750	2000	3200
TUW	232	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MF	230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LF	219	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PW	218	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HF	202	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.02

Table H-51. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location OSS1 with different energy levels at 10 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	2000	3200	500	750	2000	3200
TUW	232	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MF	230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LF	219	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PW	218	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HF	202	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01

Table H-52. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location OSS1 with different energy levels at 15 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	2000	3200	500	750	2000	3200
TUW	232	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MF	230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LF	219	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PW	218	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HF	202	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01

Table H-53. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location OSS2 with different energy levels at 0 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	1100	3200	500	750	1100	3200
TUW	232	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MF	230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LF	219	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PW	218	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HF	202	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.05

Table H-54. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location OSS2 with different energy levels at 6 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	1100	3200	500	750	1100	3200
TUW	232	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MF	230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LF	219	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PW	218	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HF	202	0.00	0.00	0.02	0.02	0.00	0.00	0.02	0.02

Table H-55. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location OSS2 with different energy levels at 10 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	1100	3200	500	750	1100	3200
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-
HF	202	-	-	-	-	-	-	-	-

Table H-56. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges to marine mammal and sea turtle injury thresholds ($R_{95\%}$ in km) at location OSS2 with different energy levels at 15 dB.

Faunal Group	Level (L_{pk})	Hammer energy in kJ							
		Summer				Winter			
		500	750	1100	3200	500	750	1100	3200
TUW	232	-	-	-	-	-	-	-	-
MF	230	-	-	-	-	-	-	-	-
LF	219	-	-	-	-	-	-	-	-
PW	218	-	-	-	-	-	-	-	-
HF	202	-	-	-	-	-	-	-	-

H.2. Impact Pile Driving Single-Strike SEL Ranges

H.2.1. Monopile Foundation

H.2.1.1. 9.6 m Diameter Pile

Table H-57. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.09	0.08	-	-	-	-	-	-	-	-	0.06	0.06	0.09	0.08	-	-	-	-	-	-	-	-	0.06	0.06
170	0.38	0.36	0.11	0.10	-	-	-	-	-	-	0.31	0.30	0.40	0.39	0.11	0.11	-	-	-	-	-	-	0.31	0.30
160	1.43	1.34	0.52	0.50	-	-	-	-	0.04	0.04	1.05	0.99	1.52	1.43	0.55	0.53	-	-	-	-	0.04	0.04	1.15	1.08
150	3.23	2.98	1.66	1.56	-	-	-	-	0.17	0.16	2.75	2.57	3.68	3.40	1.79	1.68	-	-	-	-	0.17	0.16	2.99	2.80
140	5.90	5.44	3.75	3.50	-	-	-	-	0.69	0.66	5.42	5.00	6.94	6.37	4.27	3.99	-	-	-	-	0.74	0.71	6.42	5.89
130	9.25	8.48	6.68	6.14	0.02	0.02	-	-	1.99	1.87	8.80	8.06	12.16	11.08	8.26	7.57	-	-	-	-	2.22	2.06	11.50	10.44
120	13.94	12.68	10.54	9.56	0.11	0.10	0.05	0.05	4.34	4.05	13.48	12.30	19.40	17.51	14.62	13.24	0.11	0.11	0.05	0.05	5.02	4.66	18.92	17.04

Table H-58. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.04	0.04	-	-	-	-	-	-	-	-	-	-	0.04	0.04	-	-	-	-	-	-	-	-	-	-
170	0.15	0.15	0.05	0.05	-	-	-	-	-	-	0.10	0.10	0.16	0.15	0.06	0.06	-	-	-	-	-	-	0.11	0.10
160	0.70	0.67	0.20	0.20	-	-	-	-	-	-	0.50	0.48	0.74	0.72	0.21	0.20	-	-	-	-	-	-	0.54	0.52
150	2.00	1.88	0.87	0.83	-	-	-	-	0.06	0.06	1.64	1.54	2.22	2.06	0.92	0.88	-	-	-	-	0.07	0.07	1.76	1.66
140	4.27	3.98	2.38	2.21	-	-	-	-	0.32	0.31	3.74	3.49	4.84	4.49	2.60	2.43	-	-	-	-	0.33	0.32	4.27	3.98
130	7.13	6.53	4.84	4.48	-	-	-	-	1.12	1.06	6.63	6.11	8.70	7.96	5.69	5.24	-	-	-	-	1.22	1.15	8.15	7.46
120	11.04	10.04	8.12	7.44	0.05	0.05	-	-	2.80	2.62	10.38	9.43	14.76	13.38	10.28	9.34	0.05	0.05	-	-	3.12	2.87	14.18	12.87

Table H-59. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.09	0.08	-	-	-	-	-	-	-	-	0.06	0.06	0.09	0.08	-	-	-	-	-	-	-	-	0.06	0.06
160	0.38	0.36	0.11	0.10	-	-	-	-	-	-	0.31	0.30	0.40	0.39	0.11	0.11	-	-	-	-	-	-	0.31	0.30
150	1.43	1.34	0.52	0.50	-	-	-	-	0.04	0.04	1.05	0.99	1.52	1.43	0.56	0.53	-	-	-	-	0.04	0.04	1.15	1.08
140	3.23	2.98	1.66	1.56	-	-	-	-	0.17	0.16	2.75	2.57	3.68	3.40	1.79	1.68	-	-	-	-	0.17	0.16	2.99	2.80
130	5.90	5.44	3.75	3.50	-	-	-	-	0.69	0.66	5.42	5.00	6.94	6.37	4.27	3.99	-	-	-	-	0.74	0.71	6.42	5.89
120	9.25	8.48	6.68	6.14	0.02	0.02	-	-	1.99	1.87	8.80	8.06	12.16	11.08	8.26	7.57	-	-	-	-	2.22	2.06	11.50	10.44

Table H-60. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02	0.05	0.05	-	-	-	-	-	-	-	-	-	-
160	0.18	0.17	0.06	0.06	-	-	-	-	-	-	0.11	0.11	0.19	0.18	0.06	0.06	-	-	-	-	-	-	0.12	0.11
150	0.80	0.76	0.26	0.26	-	-	-	-	-	-	0.58	0.57	0.85	0.81	0.27	0.26	-	-	-	-	-	-	0.61	0.59
140	2.23	2.07	0.97	0.92	-	-	-	-	0.07	0.07	1.80	1.69	2.44	2.27	1.02	0.96	-	-	-	-	0.08	0.08	1.93	1.81
130	4.53	4.21	2.57	2.41	-	-	-	-	0.35	0.34	4.02	3.75	5.16	4.77	2.81	2.62	-	-	-	-	0.37	0.36	4.59	4.27
120	7.47	6.85	5.13	4.74	-	-	-	-	1.27	1.20	6.96	6.40	9.16	8.37	6.06	5.58	-	-	-	-	1.37	1.29	8.62	7.88

Table H-61. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
180	0.12	0.12	0.05	0.05	-	-	-	-	-	-	0.09	0.09	0.12	0.12	0.05	0.05	-	-	-	-	-	-	0.09	0.09
170	0.62	0.60	0.19	0.18	-	-	-	-	-	-	0.49	0.47	0.65	0.63	0.19	0.18	-	-	-	-	-	-	0.51	0.49
160	1.94	1.82	0.84	0.80	-	-	-	-	0.06	0.06	1.63	1.53	2.10	1.95	0.88	0.84	-	-	-	-	0.06	0.06	1.74	1.64
150	4.20	3.92	2.37	2.18	-	-	-	-	0.29	0.28	3.73	3.46	4.74	4.40	2.57	2.39	-	-	-	-	0.30	0.29	4.19	3.90
140	7.01	6.45	4.72	4.39	-	-	-	-	1.09	1.04	6.51	6.00	8.54	7.76	5.48	5.07	-	-	-	-	1.17	1.12	7.92	7.22
130	10.74	9.76	7.90	7.22	0.04	0.04	-	-	2.77	2.58	9.98	9.14	14.22	12.95	9.84	8.99	0.03	0.03	-	-	3.01	2.80	13.62	12.42
120	15.49	14.12	12.26	11.19	0.17	0.16	0.06	0.06	5.33	4.94	14.94	13.62	23.52	20.75	17.34	15.62	0.17	0.17	0.09	0.09	6.32	5.83	22.71	20.03

Table H-62. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05
170	0.28	0.27	0.07	0.07	-	-	-	-	-	-	0.19	0.18	0.29	0.28	0.07	0.07	-	-	-	-	-	-	0.19	0.18
160	1.02	0.97	0.35	0.34	-	-	-	-	-	-	0.82	0.79	1.10	1.05	0.37	0.35	-	-	-	-	-	-	0.86	0.82
150	2.74	2.56	1.36	1.27	-	-	-	-	0.10	0.09	2.36	2.18	2.97	2.76	1.43	1.35	-	-	-	-	0.10	0.10	2.57	2.39
140	5.26	4.88	3.16	2.90	-	-	-	-	0.52	0.50	4.76	4.42	6.06	5.59	3.58	3.30	-	-	-	-	0.55	0.53	5.50	5.08
130	8.46	7.72	5.87	5.43	-	-	-	-	1.68	1.58	7.90	7.22	10.34	9.39	7.03	6.44	-	-	-	-	1.80	1.69	9.72	8.86
120	12.72	11.65	9.34	8.54	0.06	0.06	0.02	0.02	3.76	3.47	12.14	11.09	17.25	15.57	12.66	11.54	0.06	0.06	0.02	0.02	4.24	3.94	16.60	15.02

Table H-63. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
170	0.12	0.12	0.05	0.05	-	-	-	-	-	-	0.09	0.09	0.12	0.12	0.05	0.05	-	-	-	-	-	-	0.09	0.09
160	0.62	0.60	0.19	0.19	-	-	-	-	-	-	0.49	0.47	0.66	0.63	0.19	0.19	-	-	-	-	-	-	0.51	0.49
150	1.94	1.82	0.84	0.80	-	-	-	-	0.06	0.06	1.63	1.53	2.10	1.95	0.88	0.84	-	-	-	-	0.06	0.06	1.74	1.64
140	4.20	3.92	2.37	2.18	-	-	-	-	0.29	0.28	3.73	3.46	4.74	4.40	2.57	2.39	-	-	-	-	0.30	0.29	4.19	3.90
130	7.01	6.45	4.72	4.39	-	-	-	-	1.09	1.04	6.51	6.00	8.54	7.76	5.48	5.07	-	-	-	-	1.17	1.12	7.92	7.22
120	10.74	9.76	7.90	7.22	0.04	0.04	-	-	2.77	2.58	9.98	9.14	14.22	12.95	9.84	8.99	0.03	0.03	-	-	3.01	2.80	13.62	12.42

Table H-64. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05
160	0.31	0.30	0.08	0.08	-	-	-	-	-	-	0.22	0.20	0.32	0.31	0.09	0.08	-	-	-	-	-	-	0.24	0.22
150	1.19	1.13	0.41	0.40	-	-	-	-	-	-	0.93	0.89	1.27	1.21	0.46	0.43	-	-	-	-	-	-	0.97	0.92
140	2.92	2.72	1.50	1.41	-	-	-	-	0.11	0.11	2.56	2.39	3.26	3.00	1.60	1.50	-	-	-	-	0.11	0.11	2.77	2.59
130	5.54	5.13	3.44	3.17	-	-	-	-	0.59	0.57	5.04	4.67	6.42	5.91	3.89	3.60	-	-	-	-	0.61	0.59	5.84	5.40
120	8.82	8.03	6.17	5.70	-	-	-	-	1.84	1.72	8.28	7.55	11.02	10.03	7.48	6.85	-	-	-	-	1.95	1.83	10.24	9.29

Table H-65. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	-	-	-	-	-	-	-	-	0.04	0.04	0.06	0.06	-	-	-	-	-	-	-	-	0.03	0.03
180	0.25	0.24	0.06	0.06	-	-	-	-	-	-	0.16	0.16	0.26	0.25	0.06	0.06	-	-	-	-	-	-	0.16	0.16
170	1.00	0.95	0.33	0.32	-	-	-	-	-	-	0.80	0.77	1.06	1.00	0.35	0.34	-	-	-	-	-	-	0.83	0.80
160	2.75	2.55	1.32	1.25	-	-	-	-	0.09	0.08	2.36	2.17	2.97	2.76	1.39	1.32	-	-	-	-	0.09	0.09	2.56	2.37
150	5.28	4.90	3.18	2.89	-	-	-	-	0.49	0.48	4.77	4.44	6.10	5.63	3.62	3.31	-	-	-	-	0.53	0.51	5.52	5.11
140	8.50	7.77	5.92	5.49	0.05	0.05	0.02	0.02	1.70	1.60	7.94	7.27	10.54	9.57	7.20	6.60	0.06	0.06	0.03	0.03	1.84	1.73	9.84	9.01
130	12.84	11.78	9.52	8.74	0.29	0.28	0.11	0.10	4.05	3.73	12.24	11.21	18.12	16.30	13.44	12.30	0.22	0.22	0.12	0.12	4.94	4.65	17.39	15.67
120	18.05	16.29	14.79	13.45	1.18	1.12	0.56	0.54	7.60	6.95	17.39	15.75	31.23	27.98	26.55	23.58	1.51	1.41	0.72	0.68	12.90	11.69	29.30	26.09

Table H-66. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.08	0.08	0.02	0.02	-	-	-	-	-	-	0.06	0.06	0.09	0.08	0.02	0.02	-	-	-	-	-	-	0.06	0.06
170	0.47	0.45	0.11	0.11	-	-	-	-	-	-	0.32	0.31	0.48	0.46	0.11	0.11	-	-	-	-	-	-	0.33	0.32
160	1.61	1.51	0.63	0.60	-	-	-	-	0.04	0.04	1.32	1.25	1.71	1.61	0.67	0.64	-	-	-	-	0.04	0.04	1.38	1.31
150	3.76	3.44	1.94	1.81	-	-	-	-	0.17	0.17	3.19	2.91	4.19	3.87	2.06	1.91	-	-	-	-	0.18	0.17	3.64	3.33
140	6.43	5.94	4.26	3.93	-	-	-	-	0.89	0.84	5.91	5.48	7.70	7.04	4.86	4.50	-	-	-	-	0.89	0.85	7.07	6.48
130	9.84	9.02	7.24	6.66	0.10	0.10	0.05	0.05	2.51	2.33	9.36	8.57	13.25	12.13	9.22	8.41	0.10	0.10	0.06	0.06	2.86	2.64	12.64	11.57
120	14.71	13.43	11.66	10.62	0.45	0.43	0.29	0.28	5.33	4.88	14.14	12.91	22.74	20.12	17.37	15.61	0.64	0.60	0.22	0.21	7.15	6.56	21.44	18.97

Table H-67. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.05	0.05	-	-	-	-	-	-	-	-	0.04	0.04	0.06	0.06	-	-	-	-	-	-	-	-	0.03	0.03
170	0.25	0.24	0.06	0.06	-	-	-	-	-	-	0.16	0.16	0.26	0.25	0.06	0.06	-	-	-	-	-	-	0.16	0.16
160	1.00	0.95	0.33	0.32	-	-	-	-	-	-	0.80	0.77	1.06	1.00	0.35	0.34	-	-	-	-	-	-	0.83	0.80
150	2.75	2.55	1.32	1.25	-	-	-	-	0.09	0.09	2.36	2.17	2.97	2.76	1.39	1.32	-	-	-	-	0.09	0.09	2.56	2.37
140	5.28	4.90	3.18	2.89	-	-	-	-	0.49	0.48	4.77	4.44	6.10	5.63	3.62	3.31	-	-	-	-	0.53	0.51	5.52	5.11
130	8.50	7.77	5.92	5.49	0.05	0.05	0.02	0.02	1.70	1.60	7.94	7.27	10.54	9.57	7.20	6.60	0.06	0.06	0.03	0.03	1.84	1.73	9.84	9.01
120	12.84	11.78	9.52	8.74	0.29	0.28	0.11	0.10	4.05	3.73	12.24	11.21	18.12	16.30	13.44	12.30	0.22	0.22	0.12	0.12	4.94	4.65	17.39	15.67

Table H-68. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.02	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.10	0.09	0.03	0.03	-	-	-	-	-	-	0.07	0.07	0.10	0.10	0.03	0.03	-	-	-	-	-	-	0.07	0.07
160	0.51	0.49	0.14	0.14	-	-	-	-	-	-	0.42	0.40	0.54	0.51	0.14	0.13	-	-	-	-	-	-	0.45	0.43
150	1.78	1.66	0.74	0.71	-	-	-	-	0.05	0.05	1.47	1.39	1.88	1.77	0.75	0.73	-	-	-	-	0.05	0.05	1.55	1.46
140	4.01	3.70	2.12	1.95	-	-	-	-	0.23	0.22	3.49	3.19	4.48	4.14	2.31	2.14	-	-	-	-	0.23	0.22	3.96	3.63
130	6.74	6.21	4.50	4.17	-	-	-	-	0.98	0.94	6.21	5.75	8.16	7.44	5.19	4.82	-	-	-	-	1.00	0.95	7.52	6.89
120	10.28	9.37	7.64	7.01	0.10	0.10	0.06	0.06	2.72	2.51	9.70	8.89	13.92	12.71	9.70	8.86	0.11	0.10	0.06	0.06	3.12	2.84	13.32	12.18

Table H-69. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05
180	0.29	0.28	0.08	0.07	-	-	-	-	-	-	0.23	0.22	0.31	0.30	0.08	0.08	-	-	-	-	-	-	0.23	0.22
170	1.23	1.16	0.44	0.42	-	-	-	-	0.02	0.02	0.95	0.91	1.31	1.23	0.46	0.44	-	-	-	-	0.02	0.02	0.99	0.94
160	2.99	2.78	1.52	1.42	-	-	-	-	0.12	0.12	2.59	2.39	3.38	3.07	1.62	1.51	-	-	-	-	0.12	0.12	2.81	2.59
150	5.63	5.22	3.57	3.25	-	-	-	-	0.66	0.63	5.12	4.75	6.56	6.03	4.07	3.73	-	-	-	-	0.72	0.69	6.00	5.53
140	8.94	8.21	6.46	5.96	0.10	0.10	0.06	0.05	2.01	1.89	8.43	7.75	11.71	10.63	8.08	7.40	0.11	0.10	0.07	0.06	2.46	2.26	10.92	9.90
130	13.62	12.47	10.52	9.58	0.51	0.48	0.40	0.37	4.99	4.58	13.08	11.97	19.97	18.06	15.90	14.46	0.68	0.65	0.26	0.26	7.13	6.52	18.89	16.99
120	19.26	17.33	16.48	14.68	2.12	1.93	1.21	1.14	9.94	9.04	18.55	16.75	41.58	35.40	35.64	31.96	2.82	2.49	1.52	1.42	19.79	18.03	31.61	28.45

Table H-70. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
180	0.11	0.10	0.03	0.03	-	-	-	-	-	-	0.07	0.07	0.11	0.10	0.03	0.03	-	-	-	-	-	-	0.07	0.07
170	0.56	0.53	0.15	0.15	-	-	-	-	-	-	0.44	0.42	0.59	0.57	0.15	0.14	-	-	-	-	-	-	0.45	0.43
160	1.85	1.73	0.74	0.71	-	-	-	-	0.06	0.06	1.50	1.40	1.96	1.83	0.77	0.74	-	-	-	-	0.06	0.06	1.58	1.47
150	4.09	3.77	2.21	2.02	-	-	-	-	0.25	0.24	3.55	3.23	4.55	4.20	2.42	2.22	-	-	-	-	0.26	0.25	4.01	3.68
140	6.82	6.29	4.62	4.28	0.04	0.04	-	-	1.08	1.00	6.32	5.84	8.27	7.57	5.37	4.97	0.04	0.04	-	-	1.18	1.12	7.71	7.04
130	10.58	9.61	7.93	7.29	0.15	0.15	0.10	0.10	3.01	2.76	9.89	9.07	14.51	13.20	10.41	9.44	0.21	0.20	0.11	0.10	3.77	3.43	13.77	12.55
120	15.75	14.28	12.83	11.72	0.96	0.89	0.50	0.47	6.54	6.03	15.08	13.74	26.57	23.54	21.91	19.21	1.08	1.02	0.67	0.64	10.91	9.71	23.90	21.12

Table H-71. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05
170	0.29	0.28	0.08	0.07	-	-	-	-	-	-	0.23	0.22	0.31	0.30	0.08	0.08	-	-	-	-	-	-	0.23	0.22
160	1.23	1.16	0.44	0.42	-	-	-	-	0.02	0.02	0.95	0.91	1.31	1.23	0.46	0.44	-	-	-	-	0.02	0.02	0.99	0.94
150	2.99	2.78	1.52	1.42	-	-	-	-	0.12	0.12	2.59	2.39	3.38	3.07	1.62	1.51	-	-	-	-	0.12	0.12	2.81	2.59
140	5.63	5.22	3.57	3.25	-	-	-	-	0.66	0.63	5.12	4.75	6.56	6.03	4.07	3.73	-	-	-	-	0.72	0.69	6.00	5.53
130	8.94	8.21	6.46	5.96	0.10	0.10	0.06	0.05	2.01	1.89	8.43	7.75	11.71	10.63	8.08	7.40	0.11	0.10	0.07	0.06	2.46	2.26	10.92	9.90
120	13.62	12.47	10.52	9.58	0.51	0.48	0.40	0.37	4.99	4.58	13.08	11.97	19.97	18.06	15.90	14.46	0.68	0.65	0.26	0.26	7.13	6.52	18.89	16.99

Table H-72. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
170	0.12	0.12	0.05	0.05	-	-	-	-	-	-	0.08	0.08	0.12	0.12	0.04	0.04	-	-	-	-	-	-	0.09	0.08
160	0.67	0.65	0.19	0.18	-	-	-	-	-	-	0.46	0.44	0.71	0.68	0.19	0.18	-	-	-	-	-	-	0.48	0.46
150	1.99	1.86	0.89	0.85	-	-	-	-	0.06	0.06	1.65	1.54	2.16	2.00	0.92	0.88	-	-	-	-	0.06	0.06	1.75	1.63
140	4.32	4.00	2.43	2.21	-	-	-	-	0.37	0.35	3.82	3.50	4.83	4.48	2.64	2.43	-	-	-	-	0.31	0.30	4.30	3.96
130	7.16	6.57	4.90	4.54	0.05	0.05	0.02	0.02	1.23	1.15	6.63	6.12	8.73	7.99	5.74	5.31	0.06	0.06	0.02	0.02	1.41	1.33	8.17	7.48
120	11.16	10.16	8.34	7.67	0.28	0.27	0.11	0.10	3.29	2.99	10.41	9.47	15.32	13.91	11.37	10.30	0.24	0.23	0.13	0.12	4.36	3.99	14.50	13.19

Table H-73. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06
180	0.40	0.39	0.10	0.10	-	-	-	-	-	-	0.29	0.28	0.41	0.40	0.10	0.10	-	-	-	-	-	-	0.30	0.29
170	1.45	1.36	0.53	0.51	-	-	-	-	0.03	0.03	1.04	1.00	1.54	1.45	0.57	0.55	-	-	-	-	0.03	0.03	1.13	1.09
160	3.32	3.04	1.69	1.58	-	-	-	-	0.16	0.16	2.76	2.58	3.68	3.39	1.79	1.69	-	-	-	-	0.16	0.15	2.97	2.77
150	5.89	5.46	3.83	3.54	-	-	-	-	0.75	0.71	5.37	4.99	6.90	6.33	4.28	3.99	-	-	-	-	0.79	0.75	6.36	5.86
140	9.32	8.50	6.73	6.21	0.08	0.08	0.04	0.04	2.12	1.97	8.88	8.10	12.38	11.33	8.54	7.77	0.09	0.08	0.03	0.03	2.40	2.22	11.80	10.77
130	14.12	12.88	10.86	9.88	0.41	0.39	0.13	0.13	4.56	4.29	13.66	12.48	20.85	18.64	15.81	14.40	0.29	0.28	0.18	0.17	5.75	5.35	19.83	17.95
120	19.54	17.73	16.29	14.79	1.26	1.20	0.79	0.57	8.63	7.77	19.15	17.35	38.48	32.87	30.09	26.98	1.62	1.51	0.74	0.71	13.98	12.78	33.38	30.22

Table H-74. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
180	0.14	0.13	0.05	0.05	-	-	-	-	-	-	0.10	0.10	0.14	0.13	0.05	0.05	-	-	-	-	-	-	0.10	0.09
170	0.72	0.68	0.20	0.19	-	-	-	-	-	-	0.51	0.48	0.76	0.73	0.21	0.20	-	-	-	-	-	-	0.55	0.53
160	2.06	1.92	0.89	0.84	-	-	-	-	0.06	0.06	1.67	1.55	2.25	2.08	0.93	0.89	-	-	-	-	0.06	0.06	1.76	1.64
150	4.30	4.01	2.43	2.24	-	-	-	-	0.33	0.32	3.77	3.48	4.79	4.46	2.62	2.44	-	-	-	-	0.34	0.32	4.20	3.92
140	7.13	6.54	4.85	4.53	-	-	-	-	1.19	1.13	6.62	6.11	8.78	7.97	5.69	5.26	-	-	-	-	1.30	1.22	8.24	7.50
130	11.12	10.13	8.28	7.56	0.10	0.10	0.08	0.08	2.97	2.75	10.52	9.55	15.26	13.90	10.98	9.92	0.13	0.13	0.09	0.09	3.49	3.17	14.66	13.37
120	16.22	14.74	13.08	11.94	0.54	0.51	0.41	0.38	5.86	5.46	15.73	14.32	26.69	23.68	19.88	18.03	0.68	0.65	0.29	0.28	8.10	7.43	25.61	22.66

Table H-75. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06
170	0.40	0.39	0.10	0.10	-	-	-	-	-	-	0.29	0.28	0.41	0.40	0.10	0.10	-	-	-	-	-	-	0.30	0.29
160	1.45	1.36	0.53	0.51	-	-	-	-	0.03	0.03	1.04	1.00	1.54	1.45	0.57	0.55	-	-	-	-	0.03	0.03	1.13	1.09
150	3.32	3.04	1.69	1.58	-	-	-	-	0.16	0.16	2.76	2.58	3.68	3.39	1.79	1.69	-	-	-	-	0.16	0.15	2.97	2.77
140	5.89	5.46	3.83	3.54	-	-	-	-	0.75	0.71	5.37	4.99	6.90	6.33	4.28	3.99	-	-	-	-	0.79	0.75	6.36	5.86
130	9.32	8.50	6.73	6.21	0.08	0.08	0.04	0.04	2.12	1.97	8.88	8.10	12.38	11.33	8.54	7.77	0.09	0.09	0.03	0.03	2.40	2.22	11.80	10.77
120	14.12	12.88	10.86	9.88	0.41	0.39	0.13	0.13	4.56	4.29	13.66	12.48	20.85	18.64	15.81	14.40	0.29	0.28	0.18	0.17	5.75	5.35	19.83	17.95

Table H-76. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.04	0.04	-	-	-	-	-	-	-	-	0.02	0.02	0.04	0.04	-	-	-	-	-	-	-	-	-	-
170	0.17	0.16	0.06	0.06	-	-	-	-	-	-	0.11	0.11	0.18	0.17	0.06	0.06	-	-	-	-	-	-	0.11	0.11
160	0.83	0.79	0.25	0.24	-	-	-	-	-	-	0.60	0.57	0.88	0.83	0.26	0.25	-	-	-	-	-	-	0.63	0.60
150	2.30	2.12	0.96	0.92	-	-	-	-	0.07	0.07	1.82	1.70	2.47	2.29	1.02	0.96	-	-	-	-	0.07	0.07	1.93	1.80
140	4.54	4.24	2.62	2.44	-	-	-	-	0.38	0.37	4.03	3.74	5.11	4.74	2.82	2.63	-	-	-	-	0.38	0.36	4.50	4.21
130	7.50	6.86	5.15	4.79	0.02	0.02	-	-	1.34	1.27	6.96	6.40	9.24	8.41	6.10	5.62	0.02	0.02	-	-	1.44	1.36	8.76	7.95
120	11.66	10.66	8.68	7.91	0.12	0.11	0.09	0.09	3.23	2.95	11.10	10.10	16.12	14.63	11.76	10.69	0.15	0.14	0.09	0.09	3.78	3.53	15.46	14.08

Table H-77. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	-	-	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-	-	-
180	0.10	0.09	0.01	0.01	-	-	-	-	-	-	0.07	0.07	0.11	0.10	0.01	0.01	-	-	-	-	-	-	0.07	0.07
170	0.44	0.42	0.12	0.11	-	-	-	-	-	-	0.33	0.32	0.46	0.45	0.12	0.12	-	-	-	-	-	-	0.33	0.31
160	1.61	1.54	0.55	0.52	-	-	-	-	0.04	0.04	1.23	1.17	1.72	1.63	0.59	0.56	-	-	-	-	0.02	0.02	1.30	1.24
150	3.88	3.68	1.88	1.79	-	-	-	-	0.19	0.18	3.15	2.99	4.30	4.08	1.99	1.90	-	-	-	-	0.18	0.16	3.52	3.36
140	7.26	6.73	4.39	4.15	-	-	-	-	0.79	0.76	6.50	6.05	8.88	8.21	4.94	4.66	-	-	-	-	0.83	0.79	7.90	7.32
130	12.35	11.26	8.18	7.59	0.01	0.01	-	-	2.35	2.23	11.36	10.35	16.25	14.73	10.32	9.45	0.01	0.01	-	-	2.54	2.41	15.25	13.83
120	18.15	16.43	13.74	12.54	0.12	0.12	0.04	0.04	5.08	4.79	17.30	15.72	27.33	24.40	19.20	17.31	0.13	0.12	0.05	0.05	5.88	5.49	26.26	23.47

Table H-78. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.04	0.04	-	-	-	-	-	-	-	-	0.01	0.01	0.04	0.04	-	-	-	-	-	-	-	-	0.01	0.01
170	0.16	0.16	0.06	0.06	-	-	-	-	-	-	0.12	0.11	0.15	0.15	0.05	0.05	-	-	-	-	-	-	0.12	0.11
160	0.79	0.76	0.23	0.22	-	-	-	-	-	-	0.52	0.50	0.83	0.79	0.23	0.22	-	-	-	-	-	-	0.57	0.55
150	2.36	2.25	0.96	0.91	-	-	-	-	0.08	0.08	1.86	1.77	2.53	2.43	1.02	0.97	-	-	-	-	0.08	0.08	1.97	1.88
140	5.08	4.78	2.71	2.59	-	-	-	-	0.35	0.33	4.38	4.15	5.86	5.47	2.90	2.77	-	-	-	-	0.34	0.33	4.96	4.68
130	9.02	8.34	5.72	5.35	-	-	-	-	1.29	1.22	8.20	7.62	11.60	10.56	6.76	6.28	-	-	-	-	1.37	1.30	10.29	9.43
120	14.55	13.23	9.94	9.21	0.05	0.05	0.01	0.01	3.25	3.08	13.73	12.51	19.79	17.80	13.74	12.50	0.05	0.05	0.01	0.01	3.63	3.45	18.84	17.01

Table H-79. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.01	0.01	-	-	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-	-	-
170	0.10	0.09	0.01	0.01	-	-	-	-	-	-	0.07	0.07	0.10	0.10	0.01	0.01	-	-	-	-	-	-	0.07	0.07
160	0.44	0.42	0.12	0.11	-	-	-	-	-	-	0.33	0.32	0.46	0.45	0.12	0.12	-	-	-	-	-	-	0.33	0.31
150	1.61	1.54	0.55	0.52	-	-	-	-	0.04	0.04	1.23	1.17	1.72	1.63	0.59	0.56	-	-	-	-	0.02	0.02	1.30	1.24
140	3.88	3.68	1.88	1.79	-	-	-	-	0.19	0.18	3.15	2.99	4.30	4.08	1.99	1.90	-	-	-	-	0.18	0.16	3.52	3.36
130	7.26	6.73	4.39	4.15	-	-	-	-	0.79	0.76	6.50	6.05	8.88	8.21	4.94	4.66	-	-	-	-	0.83	0.79	7.90	7.32
120	12.35	11.26	8.18	7.59	0.01	0.01	-	-	2.35	2.23	11.36	10.35	16.25	14.73	10.32	9.45	0.01	0.01	-	-	2.54	2.41	15.25	13.83

Table H-80. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.05	0.05	-	-	-	-	-	-	-	-	0.01	0.01	0.05	0.05	-	-	-	-	-	-	-	-	0.01	0.01
160	0.20	0.19	0.07	0.07	-	-	-	-	-	-	0.13	0.12	0.20	0.19	0.07	0.07	-	-	-	-	-	-	0.13	0.13
150	0.90	0.86	0.26	0.25	-	-	-	-	-	-	0.63	0.61	0.94	0.91	0.28	0.25	-	-	-	-	-	-	0.67	0.65
140	2.57	2.46	1.08	1.03	-	-	-	-	0.09	0.09	2.02	1.92	2.75	2.64	1.17	1.12	-	-	-	-	0.09	0.09	2.21	2.10
130	5.40	5.08	2.91	2.78	-	-	-	-	0.38	0.37	4.70	4.44	6.32	5.87	3.19	3.03	-	-	-	-	0.39	0.38	5.40	5.06
120	9.44	8.73	6.08	5.68	-	-	-	-	1.43	1.36	8.67	8.03	12.39	11.28	7.30	6.75	-	-	-	-	1.53	1.45	11.21	10.20

Table H-81. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	-	-	-	-	-	-	-	-	0.01	0.01	0.02	0.02	-	-	-	-	-	-	-	-	0.01	0.01
180	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.11	0.11	0.14	0.13	0.05	0.05	-	-	-	-	-	-	0.11	0.11
170	0.70	0.67	0.21	0.20	-	-	-	-	-	-	0.48	0.47	0.73	0.69	0.21	0.20	-	-	-	-	-	-	0.52	0.49
160	2.24	2.13	0.94	0.90	-	-	-	-	0.07	0.07	1.83	1.74	2.42	2.31	0.98	0.94	-	-	-	-	0.07	0.07	1.92	1.83
150	5.00	4.73	2.67	2.55	-	-	-	-	0.31	0.30	4.37	4.13	5.78	5.41	2.84	2.71	-	-	-	-	0.31	0.30	4.90	4.63
140	8.99	8.32	5.62	5.29	-	-	-	-	1.24	1.18	8.15	7.56	11.44	10.39	6.62	6.19	-	-	-	-	1.31	1.25	10.05	9.27
130	14.45	13.13	9.84	9.10	0.03	0.03	-	-	3.17	3.00	13.54	12.35	19.54	17.55	13.48	12.26	0.03	0.03	-	-	3.50	3.33	18.56	16.73
120	20.65	18.35	15.88	14.40	0.18	0.17	0.05	0.05	6.38	5.98	19.57	17.62	32.88	28.94	24.37	21.59	0.17	0.16	0.05	0.05	7.76	7.21	31.91	28.12

Table H-82. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	-	-	-	-	-	-	-	-	0.05	0.05	0.07	0.07	-	-	-	-	-	-	-	-	0.05	0.05
170	0.31	0.29	0.09	0.09	-	-	-	-	-	-	0.21	0.20	0.31	0.30	0.09	0.09	-	-	-	-	-	-	0.21	0.20
160	1.18	1.13	0.39	0.38	-	-	-	-	0.01	0.01	0.93	0.89	1.26	1.19	0.41	0.40	-	-	-	-	0.01	0.01	0.96	0.92
150	3.15	2.99	1.52	1.44	-	-	-	-	0.11	0.11	2.67	2.55	3.51	3.34	1.59	1.51	-	-	-	-	0.11	0.11	2.84	2.71
140	6.42	6.02	3.74	3.56	-	-	-	-	0.54	0.52	5.68	5.35	7.68	7.13	4.12	3.92	-	-	-	-	0.58	0.56	6.70	6.26
130	11.05	10.03	7.14	6.66	-	-	-	-	1.89	1.79	9.89	9.15	14.44	13.10	8.91	8.24	-	-	-	-	1.97	1.88	13.38	12.17
120	16.71	15.16	12.41	11.31	0.07	0.07	0.01	0.01	4.37	4.14	15.84	14.37	24.70	21.92	16.92	15.36	0.07	0.07	0.01	0.01	4.86	4.60	23.57	20.82

Table H-83. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.03	0.03	-	-	-	-	-	-	-	-	0.01	0.01	0.02	0.02	-	-	-	-	-	-	-	-	0.01	0.01
170	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.11	0.10	0.14	0.13	0.05	0.05	-	-	-	-	-	-	0.11	0.11
160	0.70	0.67	0.21	0.20	-	-	-	-	-	-	0.48	0.47	0.73	0.69	0.21	0.20	-	-	-	-	-	-	0.52	0.49
150	2.24	2.13	0.94	0.90	-	-	-	-	0.07	0.07	1.83	1.74	2.42	2.31	0.98	0.94	-	-	-	-	0.07	0.07	1.92	1.83
140	5.00	4.73	2.67	2.55	-	-	-	-	0.31	0.30	4.37	4.13	5.78	5.41	2.84	2.71	-	-	-	-	0.31	0.30	4.90	4.63
130	8.99	8.32	5.62	5.29	-	-	-	-	1.24	1.18	8.15	7.56	11.44	10.39	6.62	6.19	-	-	-	-	1.31	1.25	10.05	9.27
120	14.45	13.13	9.84	9.10	0.03	0.03	-	-	3.17	3.00	13.54	12.35	19.54	17.55	13.48	12.26	0.03	0.03	-	-	3.50	3.33	18.56	16.73

Table H-84. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.08	0.08	0.01	0.01	-	-	-	-	-	-	0.06	0.06	0.08	0.08	0.01	0.01	-	-	-	-	-	-	0.06	0.06
160	0.35	0.34	0.10	0.09	-	-	-	-	-	-	0.23	0.22	0.35	0.34	0.10	0.09	-	-	-	-	-	-	0.23	0.22
150	1.35	1.29	0.45	0.43	-	-	-	-	0.01	0.01	1.01	0.96	1.42	1.35	0.47	0.45	-	-	-	-	0.01	0.01	1.08	1.02
140	3.47	3.30	1.68	1.60	-	-	-	-	0.12	0.12	2.87	2.74	3.85	3.67	1.77	1.68	-	-	-	-	0.12	0.12	3.09	2.94
130	6.79	6.36	4.05	3.84	-	-	-	-	0.64	0.61	6.06	5.68	8.23	7.63	4.47	4.24	-	-	-	-	0.67	0.65	7.20	6.70
120	11.69	10.63	7.60	7.07	-	-	-	-	2.04	1.94	10.52	9.58	15.23	13.78	9.48	8.77	-	-	-	-	2.22	2.10	14.17	12.86

Table H-85. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	-	-	-	-	-	-	-	-	0.04	0.04	0.06	0.06	-	-	-	-	-	-	-	-	0.04	0.04
180	0.28	0.28	0.08	0.08	-	-	-	-	-	-	0.19	0.18	0.29	0.28	0.08	0.08	-	-	-	-	-	-	0.18	0.18
170	1.10	1.05	0.38	0.36	-	-	-	-	0.01	0.01	0.92	0.88	1.18	1.12	0.39	0.38	-	-	-	-	0.01	0.01	0.95	0.91
160	3.05	2.90	1.49	1.42	-	-	-	-	0.11	0.11	2.61	2.50	3.37	3.21	1.56	1.49	-	-	-	-	0.11	0.11	2.77	2.65
150	6.30	5.92	3.69	3.50	-	-	-	-	0.56	0.53	5.54	5.23	7.45	6.92	4.02	3.83	-	-	-	-	0.59	0.57	6.48	6.07
140	10.80	9.80	7.00	6.55	0.01	0.01	-	-	1.89	1.80	9.73	9.01	14.10	12.81	8.67	8.05	0.01	0.01	-	-	1.97	1.88	13.03	11.89
130	16.48	14.97	12.28	11.19	0.09	0.08	0.04	0.04	4.39	4.15	15.65	14.20	24.36	21.60	16.68	15.15	0.09	0.09	0.04	0.04	4.89	4.63	23.19	20.46
120	24.15	21.43	18.42	16.63	0.47	0.45	0.16	0.15	8.21	7.61	23.14	20.45	39.82	35.07	30.19	26.74	0.43	0.41	0.19	0.19	10.52	9.63	38.64	33.92

Table H-86. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	-	-	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-	-	-
180	0.10	0.10	0.01	0.01	-	-	-	-	-	-	0.08	0.08	0.11	0.10	0.01	0.01	-	-	-	-	-	-	0.08	0.08
170	0.45	0.44	0.12	0.12	-	-	-	-	-	-	0.36	0.35	0.51	0.47	0.13	0.12	-	-	-	-	-	-	0.38	0.36
160	1.80	1.72	0.68	0.65	-	-	-	-	0.05	0.05	1.46	1.39	1.89	1.81	0.70	0.68	-	-	-	-	0.04	0.04	1.52	1.45
150	4.30	4.08	2.22	2.10	-	-	-	-	0.21	0.20	3.68	3.49	4.77	4.53	2.36	2.25	-	-	-	-	0.20	0.19	4.02	3.82
140	7.95	7.39	4.88	4.60	-	-	-	-	0.96	0.92	7.04	6.59	9.61	8.89	5.49	5.19	-	-	-	-	1.00	0.95	8.68	8.05
130	13.14	12.00	8.85	8.21	0.02	0.02	0.01	0.01	2.71	2.59	12.23	11.14	17.42	15.72	11.54	10.51	0.03	0.03	0.01	0.01	2.87	2.75	16.32	14.80
120	18.99	17.12	14.59	13.25	0.14	0.14	0.07	0.06	5.67	5.34	18.18	16.40	29.58	26.21	21.23	18.73	0.18	0.17	0.07	0.07	6.66	6.25	28.50	25.31

Table H-87. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	-	-	-	-	-	-	-	-	0.04	0.04	0.06	0.06	-	-	-	-	-	-	-	-	0.04	0.04
170	0.28	0.28	0.08	0.08	-	-	-	-	-	-	0.19	0.18	0.29	0.28	0.08	0.08	-	-	-	-	-	-	0.18	0.18
160	1.10	1.05	0.38	0.36	-	-	-	-	0.01	0.01	0.92	0.88	1.18	1.12	0.39	0.38	-	-	-	-	0.01	0.01	0.96	0.91
150	3.05	2.90	1.49	1.42	-	-	-	-	0.11	0.11	2.61	2.50	3.37	3.21	1.56	1.49	-	-	-	-	0.11	0.11	2.77	2.65
140	6.30	5.92	3.69	3.50	-	-	-	-	0.56	0.53	5.54	5.23	7.45	6.92	4.02	3.83	-	-	-	-	0.59	0.57	6.48	6.07
130	10.80	9.80	7.00	6.55	0.01	0.01	-	-	1.89	1.80	9.73	9.01	14.10	12.81	8.67	8.05	0.01	0.01	-	-	1.97	1.88	13.03	11.89
120	16.48	14.97	12.28	11.19	0.09	0.08	0.04	0.04	4.39	4.15	15.65	14.20	24.36	21.60	16.68	15.15	0.09	0.09	0.04	0.04	4.89	4.63	23.19	20.46

Table H-88. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.01	0.01	-	-	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-	-	-
170	0.11	0.11	0.02	0.02	-	-	-	-	-	-	0.09	0.09	0.12	0.11	0.02	0.02	-	-	-	-	-	-	0.09	0.09
160	0.59	0.57	0.17	0.16	-	-	-	-	-	-	0.41	0.39	0.62	0.59	0.15	0.14	-	-	-	-	-	-	0.42	0.41
150	1.95	1.87	0.82	0.77	-	-	-	-	0.06	0.05	1.62	1.54	2.07	1.97	0.88	0.85	-	-	-	-	0.05	0.05	1.69	1.61
140	4.59	4.35	2.43	2.31	-	-	-	-	0.23	0.22	3.99	3.78	5.16	4.89	2.57	2.46	-	-	-	-	0.26	0.23	4.37	4.14
130	8.39	7.79	5.18	4.90	-	-	-	-	1.08	1.01	7.50	6.99	10.19	9.36	5.94	5.60	-	-	-	-	1.14	1.09	9.25	8.57
120	13.68	12.47	9.30	8.62	0.04	0.04	0.01	0.01	2.91	2.77	12.79	11.68	18.34	16.51	12.39	11.30	0.04	0.04	0.01	0.01	3.13	2.99	17.27	15.62

Table H-89. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.07	-	-	-	-	-	-	-	-	0.05	0.05	0.07	0.07	-	-	-	-	-	-	-	-	0.05	0.05
180	0.34	0.33	0.09	0.09	-	-	-	-	-	-	0.22	0.21	0.35	0.34	0.09	0.09	-	-	-	-	-	-	0.22	0.21
170	1.37	1.32	0.49	0.46	-	-	-	-	0.01	0.01	0.97	0.93	1.43	1.37	0.50	0.48	-	-	-	-	0.01	0.01	1.01	0.96
160	3.44	3.27	1.65	1.56	-	-	-	-	0.12	0.11	2.78	2.66	3.77	3.59	1.72	1.64	-	-	-	-	0.12	0.12	2.95	2.82
150	6.69	6.27	3.96	3.76	-	-	-	-	0.61	0.59	5.90	5.55	8.01	7.43	4.38	4.14	-	-	-	-	0.65	0.63	6.99	6.53
140	11.49	10.50	7.58	7.06	0.02	0.02	0.01	0.01	2.01	1.91	10.40	9.56	15.27	13.88	9.53	8.83	0.02	0.02	0.01	0.01	2.20	2.09	14.33	13.06
130	17.44	15.82	13.14	12.06	0.13	0.13	0.05	0.05	4.66	4.40	16.68	15.18	26.85	23.96	18.79	16.95	0.15	0.15	0.05	0.05	5.34	5.04	25.84	23.05
120	25.66	22.97	19.72	17.80	0.53	0.51	0.44	0.42	8.85	8.23	24.95	22.30	43.87	39.48	33.72	29.93	0.78	0.75	0.28	0.27	12.44	11.42	42.19	37.60

Table H-90. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	-	-	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-	-	-
180	0.12	0.11	0.02	0.02	-	-	-	-	-	-	0.09	0.08	0.12	0.12	0.02	0.02	-	-	-	-	-	-	0.09	0.09
170	0.62	0.59	0.15	0.15	-	-	-	-	-	-	0.47	0.42	0.64	0.62	0.14	0.14	-	-	-	-	-	-	0.49	0.44
160	2.01	1.92	0.85	0.81	-	-	-	-	0.05	0.05	1.62	1.55	2.17	2.06	0.88	0.84	-	-	-	-	0.05	0.05	1.69	1.62
150	4.64	4.39	2.39	2.28	-	-	-	-	0.23	0.22	3.95	3.74	5.18	4.89	2.54	2.43	-	-	-	-	0.25	0.23	4.35	4.11
140	8.39	7.82	5.19	4.91	-	-	-	-	1.03	0.97	7.54	7.03	10.30	9.47	6.04	5.67	-	-	-	-	1.08	1.03	9.39	8.72
130	13.80	12.61	9.44	8.79	0.05	0.05	0.02	0.02	2.88	2.74	12.98	11.92	19.06	17.17	12.93	11.84	0.05	0.05	0.02	0.02	3.11	2.98	18.15	16.39
120	2-	18.05	15.60	14.25	0.21	0.21	0.12	0.11	6.08	5.70	19.38	17.50	32.68	28.95	24.42	21.68	0.25	0.24	0.14	0.14	7.53	7.00	31.49	27.93

Table H-91. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	-	-	-	-	-	-	-	-	0.05	0.05	0.07	0.07	-	-	-	-	-	-	-	-	0.05	0.05
170	0.34	0.33	0.09	0.09	-	-	-	-	-	-	0.22	0.21	0.35	0.34	0.09	0.09	-	-	-	-	-	-	0.22	0.21
160	1.37	1.32	0.49	0.46	-	-	-	-	0.01	0.01	0.97	0.93	1.43	1.37	0.50	0.48	-	-	-	-	0.01	0.01	1.01	0.96
150	3.44	3.27	1.65	1.56	-	-	-	-	0.12	0.11	2.78	2.66	3.77	3.59	1.72	1.64	-	-	-	-	0.12	0.12	2.95	2.82
140	6.69	6.27	3.96	3.76	-	-	-	-	0.61	0.59	5.90	5.55	8.01	7.43	4.38	4.14	-	-	-	-	0.65	0.63	6.99	6.53
130	11.49	10.50	7.58	7.06	0.02	0.02	0.01	0.01	2.01	1.91	10.40	9.56	15.27	13.88	9.53	8.83	0.02	0.02	0.01	0.01	2.20	2.09	14.33	13.06
120	17.44	15.81	13.14	12.06	0.13	0.13	0.05	0.05	4.66	4.40	16.68	15.18	26.85	23.96	18.79	16.95	0.15	0.15	0.05	0.05	5.34	5.04	25.84	23.05

Table H-92. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.02	0.02	-	-	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01
170	0.13	0.12	0.04	0.04	-	-	-	-	-	-	0.10	0.09	0.13	0.13	0.04	0.04	-	-	-	-	-	-	0.10	0.10
160	0.71	0.67	0.19	0.19	-	-	-	-	-	-	0.54	0.52	0.74	0.70	0.19	0.18	-	-	-	-	-	-	0.56	0.54
150	2.25	2.15	0.92	0.87	-	-	-	-	0.07	0.07	1.79	1.71	2.40	2.30	0.96	0.91	-	-	-	-	0.07	0.07	1.87	1.78
140	4.94	4.68	2.62	2.49	-	-	-	-	0.30	0.29	4.24	4.01	5.58	5.26	2.77	2.65	-	-	-	-	0.31	0.30	4.72	4.45
130	8.84	8.21	5.54	5.23	-	-	-	-	1.22	1.15	8.01	7.46	11.21	10.22	6.54	6.12	0.01	0.01	-	-	1.30	1.24	9.96	9.24
120	14.36	13.11	9.87	9.18	0.05	0.05	0.02	0.02	3.11	2.95	13.58	12.44	19.98	17.97	13.80	12.61	0.05	0.05	0.02	0.02	3.49	3.32	19.14	17.25

Table H-93. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.09	0.08	0.01	0.01	-	-	-	-	-	-	0.07	0.07	0.09	0.09	0.01	0.01	-	-	-	-	-	-	0.07	0.06
180	0.47	0.45	0.12	0.11	-	-	-	-	-	-	0.32	0.31	0.48	0.46	0.12	0.12	-	-	-	-	-	-	0.32	0.31
170	1.64	1.57	0.56	0.54	-	-	-	-	0.01	0.01	1.26	1.20	1.72	1.65	0.61	0.57	-	-	-	-	0.01	0.01	1.32	1.26
160	3.84	3.64	1.91	1.81	-	-	-	-	0.18	0.18	3.01	2.88	4.14	3.93	2.00	1.91	-	-	-	-	0.15	0.15	3.30	3.14
150	6.95	6.50	4.26	4.05	-	-	-	-	0.82	0.79	6.10	5.72	8.16	7.56	4.65	4.40	-	-	-	-	0.87	0.83	7.12	6.57
140	11.79	10.72	7.80	7.25	0.01	0.01	-	-	2.39	2.27	10.70	9.71	15.26	13.83	9.56	8.83	0.01	0.01	0.01	0.01	2.57	2.45	14.30	12.99
130	17.59	15.97	13.41	12.22	0.11	0.10	0.04	0.04	4.96	4.70	16.91	15.34	26.94	24.04	18.77	17.05	0.11	0.11	0.04	0.04	5.64	5.28	25.90	23.17
120	25.85	23.15	19.80	17.96	0.58	0.55	0.20	0.19	8.96	8.28	25.17	22.51	46.12	41.46	35.56	31.30	0.75	0.72	0.26	0.25	12.04	11.01	44.70	39.93

Table H-94. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	-	-	-	-	-	-	-	-	0.01	0.01	0.02	0.02	-	-	-	-	-	-	-	-	0.01	0.01
180	0.14	0.14	0.05	0.05	-	-	-	-	-	-	0.11	0.11	0.15	0.14	0.05	0.04	-	-	-	-	-	-	0.11	0.11
170	0.80	0.77	0.23	0.22	-	-	-	-	-	-	0.54	0.52	0.83	0.80	0.22	0.22	-	-	-	-	-	-	0.57	0.55
160	2.36	2.26	0.98	0.94	-	-	-	-	0.08	0.08	1.84	1.75	2.51	2.40	1.04	1.00	-	-	-	-	0.08	0.07	1.93	1.85
150	4.95	4.68	2.69	2.57	-	-	-	-	0.35	0.34	4.18	3.98	5.48	5.15	2.87	2.73	-	-	-	-	0.36	0.35	4.56	4.32
140	8.66	8.01	5.47	5.15	-	-	-	-	1.34	1.28	7.72	7.18	10.41	9.50	6.22	5.79	-	-	-	-	1.43	1.36	9.40	8.69
130	14.02	12.75	9.64	8.91	0.05	0.04	0.01	0.01	3.23	3.08	13.24	12.06	18.89	17.12	12.96	11.83	0.05	0.04	0.01	0.01	3.61	3.43	17.97	16.34
120	20.17	18.20	15.92	14.42	0.22	0.21	0.07	0.07	6.32	5.93	19.47	17.66	33.35	29.34	24.70	22.06	0.25	0.25	0.09	0.09	7.54	6.97	32.27	28.40

Table H-95. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.09	0.08	0.01	0.01	-	-	-	-	-	-	0.07	0.07	0.09	0.09	0.01	0.01	-	-	-	-	-	-	0.07	0.06
170	0.47	0.45	0.12	0.11	-	-	-	-	-	-	0.32	0.31	0.48	0.46	0.12	0.12	-	-	-	-	-	-	0.32	0.31
160	1.64	1.57	0.56	0.54	-	-	-	-	0.01	0.01	1.26	1.20	1.72	1.65	0.61	0.57	-	-	-	-	0.01	0.01	1.32	1.26
150	3.84	3.64	1.91	1.81	-	-	-	-	0.18	0.18	3.01	2.88	4.14	3.93	2.00	1.91	-	-	-	-	0.15	0.15	3.30	3.14
140	6.95	6.50	4.26	4.05	-	-	-	-	0.82	0.79	6.10	5.72	8.16	7.56	4.65	4.40	-	-	-	-	0.87	0.83	7.12	6.57
130	11.79	10.72	7.80	7.25	0.01	0.01	-	-	2.39	2.27	10.70	9.71	15.26	13.83	9.56	8.83	0.01	0.01	0.01	0.01	2.57	2.45	14.30	12.99
120	17.59	15.97	13.41	12.22	0.11	0.10	0.04	0.04	4.96	4.70	16.91	15.34	26.94	24.04	18.77	17.05	0.11	0.11	0.04	0.04	5.64	5.28	25.90	23.17

Table H-96. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.04	0.04	-	-	-	-	-	-	-	-	0.01	0.01	0.04	0.04	-	-	-	-	-	-	-	-	0.01	0.01
170	0.17	0.16	0.06	0.06	-	-	-	-	-	-	0.12	0.12	0.17	0.16	0.06	0.06	-	-	-	-	-	-	0.13	0.12
160	0.89	0.86	0.28	0.27	-	-	-	-	-	-	0.66	0.62	0.94	0.90	0.29	0.27	-	-	-	-	-	-	0.70	0.67
150	2.57	2.47	1.16	1.10	-	-	-	-	0.09	0.09	2.00	1.91	2.73	2.61	1.22	1.16	-	-	-	-	0.09	0.09	2.16	2.05
140	5.25	4.96	2.88	2.75	-	-	-	-	0.42	0.39	4.47	4.24	5.88	5.49	3.11	2.94	-	-	-	-	0.45	0.44	4.90	4.63
130	9.08	8.39	5.82	5.46	-	-	-	-	1.49	1.41	8.20	7.60	11.27	10.25	6.70	6.20	-	-	-	-	1.60	1.52	9.95	9.20
120	14.60	13.25	10.12	9.31	0.05	0.05	0.01	0.01	3.56	3.38	13.83	12.58	19.85	17.93	13.86	12.60	0.05	0.05	0.01	0.01	3.92	3.71	18.99	17.21

Table H-97. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.11	0.11	-	-	-	-	-	-	-	-	0.08	0.08	0.11	0.11	-	-	-	-	-	-	-	-	0.08	0.08
170	0.48	0.46	0.12	0.12	-	-	-	-	-	-	0.34	0.33	0.50	0.48	0.13	0.13	-	-	-	-	-	-	0.34	0.33
160	1.72	1.65	0.59	0.56	-	-	-	-	0.02	0.02	1.31	1.25	1.82	1.75	0.62	0.60	-	-	-	-	0.02	0.02	1.37	1.32
150	4.19	3.99	1.97	1.89	-	-	-	-	0.20	0.19	3.44	3.27	4.62	4.39	2.12	2.03	-	-	-	-	0.15	0.15	3.79	3.61
140	7.90	7.35	4.66	4.42	-	-	-	-	0.82	0.80	6.89	6.45	9.59	8.83	5.19	4.91	-	-	-	-	0.86	0.83	8.43	7.81
130	13.48	12.22	8.70	8.07	-	-	-	-	2.48	2.37	12.40	11.26	17.74	15.85	11.26	10.12	-	-	-	-	2.64	2.53	16.51	14.72
120	19.62	17.64	14.79	13.31	0.09	0.09	-	-	5.35	5.04	18.66	16.79	29.55	26.16	20.40	18.14	0.10	0.09	-	-	6.06	5.70	28.23	25.00

Table H-98. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.05	0.05	-	-	-	-	-	-	-	-	-	-	0.05	0.05	-	-	-	-	-	-	-	-	-	-
170	0.18	0.17	0.07	0.06	-	-	-	-	-	-	0.12	0.12	0.16	0.16	0.07	0.06	-	-	-	-	-	-	0.13	0.13
160	0.85	0.81	0.24	0.24	-	-	-	-	-	-	0.57	0.55	0.88	0.85	0.24	0.23	-	-	-	-	-	-	0.60	0.58
150	2.55	2.44	1.00	0.96	-	-	-	-	0.09	0.09	1.96	1.88	2.71	2.59	1.06	1.02	-	-	-	-	0.09	0.09	2.11	2.01
140	5.48	5.17	2.86	2.74	-	-	-	-	0.36	0.35	4.69	4.44	6.26	5.89	3.08	2.93	-	-	-	-	0.36	0.35	5.25	4.97
130	9.72	8.99	6.05	5.68	-	-	-	-	1.35	1.30	8.78	8.16	12.80	11.53	7.05	6.59	-	-	-	-	1.43	1.37	11.37	10.23
120	15.87	14.29	10.91	9.89	0.02	0.02	-	-	3.46	3.30	14.85	13.38	21.87	19.22	14.78	13.17	0.02	0.02	-	-	3.81	3.63	20.08	17.97

Table H-99. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.11	0.11	-	-	-	-	-	-	-	-	0.08	0.08	0.11	0.11	-	-	-	-	-	-	-	-	0.08	0.08
160	0.48	0.46	0.12	0.12	-	-	-	-	-	-	0.34	0.33	0.50	0.48	0.13	0.13	-	-	-	-	-	-	0.34	0.33
150	1.72	1.65	0.59	0.56	-	-	-	-	0.02	0.02	1.31	1.25	1.82	1.75	0.62	0.60	-	-	-	-	0.02	0.02	1.37	1.32
140	4.19	3.99	1.97	1.89	-	-	-	-	0.20	0.19	3.44	3.28	4.62	4.39	2.12	2.03	-	-	-	-	0.15	0.15	3.79	3.61
130	7.90	7.35	4.66	4.42	-	-	-	-	0.82	0.80	6.89	6.45	9.59	8.83	5.19	4.91	-	-	-	-	0.86	0.83	8.43	7.81
120	13.48	12.22	8.70	8.07	-	-	-	-	2.48	2.37	12.40	11.26	17.74	15.85	11.26	10.12	-	-	-	-	2.64	2.53	16.51	14.72

Table H-100. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.06	0.06	-	-	-	-	-	-	-	-	0.02	0.02	0.06	0.06	-	-	-	-	-	-	-	-	0.02	0.02
160	0.22	0.21	0.07	0.07	-	-	-	-	-	-	0.13	0.13	0.22	0.21	0.07	0.07	-	-	-	-	-	-	0.14	0.13
150	0.95	0.91	0.27	0.26	-	-	-	-	-	-	0.67	0.64	0.98	0.94	0.27	0.26	-	-	-	-	-	-	0.72	0.69
140	2.76	2.64	1.18	1.13	-	-	-	-	0.09	0.09	2.19	2.10	2.93	2.80	1.25	1.20	-	-	-	-	0.09	0.09	2.36	2.26
130	5.84	5.49	3.10	2.95	-	-	-	-	0.41	0.40	5.01	4.74	6.72	6.31	3.44	3.27	-	-	-	-	0.41	0.40	5.69	5.36
120	10.26	9.38	6.41	6.02	-	-	-	-	1.51	1.45	9.27	8.58	13.59	12.21	7.67	7.13	-	-	-	-	1.60	1.54	12.26	11.03

Table H-101. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
180	0.14	0.14	0.06	0.06	-	-	-	-	-	-	0.12	0.11	0.15	0.14	0.06	0.06	-	-	-	-	-	-	0.12	0.12
170	0.76	0.74	0.23	0.22	-	-	-	-	-	-	0.53	0.51	0.79	0.76	0.23	0.22	-	-	-	-	-	-	0.55	0.54
160	2.44	2.32	0.99	0.95	-	-	-	-	0.08	0.08	1.93	1.84	2.58	2.47	1.04	0.98	-	-	-	-	0.08	0.08	2.02	1.93
150	5.38	5.07	2.84	2.71	-	-	-	-	0.34	0.33	4.62	4.38	6.11	5.74	3.00	2.87	-	-	-	-	0.34	0.34	5.12	4.84
140	9.62	8.90	5.98	5.61	-	-	-	-	1.35	1.30	8.66	8.05	12.46	11.24	6.86	6.44	-	-	-	-	1.43	1.37	10.92	9.83
130	15.67	14.12	10.74	9.73	0.05	0.05	0.02	0.02	3.51	3.34	14.61	13.17	21.12	18.66	14.40	12.86	0.05	0.05	0.02	0.02	3.88	3.68	19.55	17.51
120	23.06	20.35	17.17	15.44	0.32	0.31	0.10	0.10	6.94	6.47	21.57	18.99	34.99	30.93	25.90	22.94	0.26	0.26	0.11	0.11	8.47	7.86	33.62	29.60

Table H-102. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.08	0.08	-	-	-	-	-	-	-	-	0.06	0.06	0.08	0.08	-	-	-	-	-	-	-	-	0.05	0.05
170	0.33	0.32	0.10	0.09	-	-	-	-	-	-	0.23	0.22	0.33	0.32	0.10	0.10	-	-	-	-	-	-	0.22	0.21
160	1.28	1.23	0.43	0.41	-	-	-	-	-	-	0.95	0.91	1.34	1.29	0.45	0.43	-	-	-	-	-	-	0.99	0.94
150	3.44	3.27	1.61	1.54	-	-	-	-	0.12	0.12	2.82	2.69	3.77	3.59	1.71	1.64	-	-	-	-	0.13	0.13	2.97	2.85
140	6.89	6.44	4.01	3.81	-	-	-	-	0.60	0.57	6.02	5.65	8.19	7.62	4.36	4.14	-	-	-	-	0.63	0.61	6.96	6.52
130	12.15	11.05	7.65	7.11	-	-	-	-	2.01	1.92	10.81	9.81	15.62	13.95	9.34	8.60	-	-	-	-	2.19	2.11	14.31	12.80
120	18.16	16.33	13.38	12.12	0.09	0.09	0.05	0.05	4.73	4.47	17.06	15.37	26.33	23.40	18.08	16.13	0.10	0.09	0.04	0.04	5.28	4.99	24.95	22.07

Table H-103. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
170	0.14	0.14	0.06	0.06	-	-	-	-	-	-	0.12	0.11	0.15	0.14	0.06	0.06	-	-	-	-	-	-	0.12	0.12
160	0.76	0.74	0.23	0.22	-	-	-	-	-	-	0.53	0.51	0.79	0.76	0.23	0.22	-	-	-	-	-	-	0.55	0.54
150	2.44	2.32	0.99	0.95	-	-	-	-	0.08	0.08	1.93	1.84	2.58	2.47	1.04	0.98	-	-	-	-	0.08	0.08	2.02	1.93
140	5.38	5.07	2.84	2.71	-	-	-	-	0.34	0.33	4.62	4.38	6.11	5.74	3.00	2.87	-	-	-	-	0.34	0.34	5.12	4.84
130	9.62	8.90	5.98	5.61	-	-	-	-	1.35	1.30	8.66	8.05	12.46	11.24	6.86	6.44	-	-	-	-	1.43	1.37	10.92	9.83
120	15.67	14.12	10.74	9.73	0.05	0.05	0.02	0.02	3.51	3.34	14.61	13.17	21.12	18.66	14.40	12.86	0.05	0.05	0.02	0.02	3.88	3.68	19.55	17.51

Table H-104. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.06	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.06
160	0.38	0.37	0.11	0.11	-	-	-	-	-	-	0.24	0.24	0.38	0.37	0.11	0.11	-	-	-	-	-	-	0.24	0.24
150	1.44	1.39	0.48	0.47	-	-	-	-	-	-	1.13	1.09	1.52	1.46	0.50	0.48	-	-	-	-	-	-	1.19	1.14
140	3.77	3.58	1.79	1.72	-	-	-	-	0.13	0.13	3.04	2.89	4.12	3.92	1.88	1.81	-	-	-	-	0.14	0.13	3.33	3.17
130	7.34	6.83	4.30	4.09	-	-	-	-	0.71	0.68	6.41	6.01	8.78	8.14	4.70	4.46	-	-	-	-	0.76	0.73	7.55	7.04
120	12.74	11.59	8.12	7.55	0.02	0.02	-	-	2.29	2.18	11.51	10.46	16.44	14.68	9.93	9.12	0.02	0.02	-	-	2.45	2.34	15.16	13.52

Table H-105. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.06	-	-	-	-	-	-	-	-	0.03	0.03	0.07	0.06	-	-	-	-	-	-	-	-	0.03	0.03
180	0.31	0.30	0.09	0.09	-	-	-	-	-	-	0.20	0.20	0.31	0.30	0.09	0.09	-	-	-	-	-	-	0.20	0.19
170	1.24	1.18	0.39	0.38	-	-	-	-	-	-	0.94	0.90	1.29	1.23	0.40	0.39	-	-	-	-	-	-	0.96	0.89
160	3.30	3.14	1.56	1.49	-	-	-	-	0.12	0.11	2.73	2.61	3.60	3.42	1.63	1.56	-	-	-	-	0.12	0.11	2.86	2.74
150	6.70	6.26	3.88	3.68	-	-	-	-	0.57	0.55	5.82	5.46	7.90	7.34	4.19	3.98	-	-	-	-	0.61	0.59	6.69	6.27
140	11.78	10.74	7.39	6.87	0.05	0.05	-	-	1.96	1.88	10.38	9.50	15.35	13.73	9.15	8.47	0.04	0.04	0.02	0.02	2.13	2.04	14.07	12.62
130	17.86	16.08	13.15	11.95	0.18	0.17	0.10	0.10	4.75	4.45	16.80	15.14	26.67	23.71	18.42	16.50	0.24	0.24	0.12	0.12	5.45	5.15	25.25	22.36
120	26.11	23.36	19.79	17.78	0.92	0.89	0.50	0.48	9.27	8.55	25.10	22.33	45.12	40.60	34.62	30.60	0.98	0.95	0.73	0.70	13.96	12.57	42.86	38.37

Table H-106. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.12	0.11	-	-	-	-	-	-	-	-	0.08	0.08	0.12	0.11	0.02	0.02	-	-	-	-	-	-	0.09	0.09
170	0.48	0.47	0.13	0.13	-	-	-	-	-	-	0.38	0.37	0.51	0.49	0.13	0.13	-	-	-	-	-	-	0.39	0.38
160	1.90	1.82	0.74	0.71	-	-	-	-	0.04	0.04	1.53	1.47	1.97	1.89	0.76	0.73	-	-	-	-	0.03	0.03	1.60	1.53
150	4.55	4.31	2.33	2.21	-	-	-	-	0.22	0.21	3.88	3.67	5.02	4.75	2.46	2.35	-	-	-	-	0.20	0.20	4.16	3.97
140	8.49	7.89	5.09	4.80	-	-	-	-	1.05	1.01	7.46	6.93	10.30	9.39	5.68	5.34	-	-	-	-	1.08	1.02	9.10	8.42
130	14.17	12.84	9.29	8.63	0.07	0.07	0.05	0.05	2.86	2.72	13.07	11.89	18.90	16.94	12.60	11.37	0.08	0.08	0.04	0.04	3.18	3.01	17.71	15.83
120	20.71	18.35	15.73	14.15	0.47	0.46	0.16	0.16	6.22	5.79	19.47	17.48	32.71	28.91	24.06	21.31	0.37	0.35	0.23	0.22	7.78	7.29	31.07	27.44

Table H-107. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.06	-	-	-	-	-	-	-	-	0.03	0.03	0.07	0.06	-	-	-	-	-	-	-	-	0.03	0.03
170	0.31	0.30	0.09	0.09	-	-	-	-	-	-	0.20	0.20	0.31	0.30	0.09	0.09	-	-	-	-	-	-	0.20	0.19
160	1.24	1.18	0.39	0.38	-	-	-	-	-	-	0.94	0.90	1.29	1.23	0.40	0.39	-	-	-	-	-	-	0.96	0.89
150	3.30	3.14	1.56	1.49	-	-	-	-	0.12	0.11	2.73	2.61	3.60	3.42	1.63	1.56	-	-	-	-	0.12	0.11	2.86	2.74
140	6.70	6.26	3.88	3.68	-	-	-	-	0.57	0.55	5.82	5.46	7.90	7.34	4.19	3.98	-	-	-	-	0.61	0.59	6.69	6.27
130	11.78	10.74	7.39	6.87	0.05	0.05	-	-	1.96	1.88	10.38	9.50	15.35	13.73	9.15	8.47	0.04	0.04	0.02	0.02	2.13	2.04	14.07	12.62
120	17.86	16.08	13.15	11.95	0.18	0.17	0.10	0.10	4.75	4.45	16.80	15.14	26.67	23.71	18.42	16.50	0.24	0.24	0.12	0.12	5.45	5.15	25.25	22.36

Table H-108. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.12	0.12	0.02	0.02	-	-	-	-	-	-	0.09	0.09	0.13	0.13	0.02	0.02	-	-	-	-	-	-	0.10	0.09
160	0.63	0.60	0.18	0.17	-	-	-	-	-	-	0.44	0.42	0.67	0.64	0.14	0.14	-	-	-	-	-	-	0.46	0.44
150	2.09	1.99	0.79	0.76	-	-	-	-	0.06	0.06	1.68	1.61	2.24	2.14	0.82	0.79	-	-	-	-	0.06	0.06	1.76	1.69
140	4.88	4.61	2.53	2.42	-	-	-	-	0.24	0.24	4.16	3.95	5.43	5.12	2.68	2.56	-	-	-	-	0.23	0.23	4.50	4.28
130	8.94	8.30	5.44	5.11	-	-	-	-	1.19	1.14	7.94	7.38	11.22	10.14	6.16	5.78	-	-	-	-	1.23	1.18	9.70	8.95
120	14.77	13.35	9.76	9.04	0.09	0.09	0.05	0.05	3.10	2.95	13.69	12.42	19.80	17.75	13.52	12.15	0.10	0.10	0.04	0.04	3.60	3.40	18.64	16.69

Table H-109. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.08	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.08	0.07	-	-	-	-	-	-	-	-	0.06	0.06
180	0.37	0.36	0.10	0.10	-	-	-	-	-	-	0.23	0.23	0.38	0.37	0.11	0.10	-	-	-	-	-	-	0.23	0.22
170	1.46	1.40	0.44	0.43	-	-	-	-	-	-	1.11	1.06	1.52	1.46	0.46	0.44	-	-	-	-	-	-	1.15	1.10
160	3.68	3.50	1.71	1.64	-	-	-	-	0.13	0.13	2.89	2.76	3.95	3.76	1.80	1.73	-	-	-	-	0.13	0.13	3.04	2.90
150	7.04	6.57	4.09	3.88	-	-	-	-	0.67	0.64	6.08	5.70	8.18	7.61	4.40	4.18	-	-	-	-	0.72	0.69	6.90	6.47
140	12.19	11.20	7.88	7.29	0.03	0.03	-	-	2.14	2.04	10.98	10.07	15.83	14.20	9.45	8.78	0.04	0.04	-	-	2.32	2.23	14.68	13.17
130	18.54	16.70	13.83	12.60	0.16	0.15	0.10	0.06	4.88	4.60	17.62	15.96	27.95	24.90	19.17	17.25	0.23	0.22	0.10	0.10	5.50	5.21	26.67	23.78
120	27.31	24.49	21.32	18.88	0.80	0.77	0.48	0.47	9.40	8.67	26.51	23.76	46.52	42.12	35.39	31.41	0.94	0.91	0.39	0.37	13.35	12.19	44.76	40.23

Table H-110. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.13	0.12	0.02	0.02	-	-	-	-	-	-	0.09	0.09	0.13	0.13	0.02	0.02	-	-	-	-	-	-	0.10	0.10
170	0.66	0.64	0.14	0.14	-	-	-	-	-	-	0.44	0.42	0.69	0.66	0.16	0.15	-	-	-	-	-	-	0.45	0.44
160	2.15	2.05	0.90	0.85	-	-	-	-	0.07	0.06	1.68	1.61	2.29	2.19	0.93	0.89	-	-	-	-	0.06	0.06	1.77	1.69
150	4.88	4.61	2.52	2.40	-	-	-	-	0.25	0.24	4.07	3.87	5.34	5.04	2.65	2.53	-	-	-	-	0.26	0.25	4.37	4.15
140	8.86	8.21	5.35	5.04	-	-	-	-	1.17	1.12	7.86	7.27	10.67	9.72	5.94	5.59	-	-	-	-	1.22	1.17	9.35	8.69
130	14.61	13.28	9.76	9.05	0.06	0.06	0.03	0.03	3.01	2.87	13.64	12.45	19.61	17.60	13.13	11.88	0.06	0.06	0.03	0.03	3.38	3.20	18.54	16.67
120	21.94	19.34	16.52	14.96	0.46	0.45	0.14	0.14	6.38	5.95	20.70	18.43	34.25	30.42	25.18	22.38	0.33	0.32	0.21	0.20	7.72	7.23	32.81	29.08

Table H-111. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.08	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.08	0.07	-	-	-	-	-	-	-	-	0.06	0.06
170	0.37	0.36	0.10	0.10	-	-	-	-	-	-	0.23	0.23	0.38	0.37	0.11	0.10	-	-	-	-	-	-	0.23	0.22
160	1.46	1.40	0.44	0.43	-	-	-	-	-	-	1.11	1.06	1.52	1.46	0.46	0.44	-	-	-	-	-	-	1.15	1.10
150	3.68	3.50	1.71	1.64	-	-	-	-	0.13	0.13	2.89	2.76	3.95	3.76	1.80	1.73	-	-	-	-	0.13	0.13	3.04	2.90
140	7.04	6.57	4.09	3.88	-	-	-	-	0.67	0.64	6.08	5.70	8.18	7.61	4.40	4.18	-	-	-	-	0.72	0.69	6.90	6.47
130	12.19	11.20	7.88	7.29	0.03	0.03	-	-	2.14	2.04	10.98	10.07	15.83	14.20	9.45	8.78	0.04	0.04	-	-	2.32	2.23	14.68	13.17
120	18.54	16.71	13.83	12.60	0.16	0.15	0.10	0.06	4.88	4.60	17.62	15.96	27.95	24.90	19.17	17.25	0.23	0.22	0.10	0.10	5.50	5.21	26.67	23.78

Table H-112. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
170	0.14	0.13	0.04	0.04	-	-	-	-	-	-	0.11	0.11	0.14	0.14	0.03	0.03	-	-	-	-	-	-	0.11	0.11
160	0.74	0.71	0.21	0.20	-	-	-	-	-	-	0.52	0.48	0.76	0.73	0.20	0.19	-	-	-	-	-	-	0.56	0.53
150	2.40	2.28	1.00	0.96	-	-	-	-	0.08	0.07	1.87	1.78	2.53	2.41	1.04	1.00	-	-	-	-	0.07	0.07	1.94	1.86
140	5.21	4.91	2.72	2.60	-	-	-	-	0.33	0.31	4.37	4.15	5.74	5.40	2.86	2.73	-	-	-	-	0.34	0.33	4.71	4.47
130	9.28	8.61	5.70	5.37	-	-	-	-	1.29	1.23	8.34	7.71	11.57	10.52	6.41	6.02	-	-	-	-	1.37	1.31	9.96	9.22
120	15.22	13.81	10.36	9.51	0.07	0.06	0.05	0.05	3.34	3.17	14.29	12.99	20.91	18.52	14.09	12.68	0.10	0.09	0.04	0.04	3.72	3.53	19.55	17.56

Table H-113. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.07	0.10	0.09	-	-	-	-	-	-	-	-	0.07	0.07
180	0.42	0.41	0.12	0.11	-	-	-	-	-	-	0.32	0.30	0.44	0.42	0.12	0.12	-	-	-	-	-	-	0.33	0.31
170	1.65	1.59	0.61	0.59	-	-	-	-	0.02	0.02	1.26	1.21	1.74	1.67	0.64	0.62	-	-	-	-	0.02	0.02	1.32	1.26
160	4.07	3.87	1.95	1.86	-	-	-	-	0.14	0.14	3.27	3.11	4.38	4.17	2.04	1.95	-	-	-	-	0.15	0.15	3.53	3.36
150	7.70	7.14	4.50	4.27	-	-	-	-	0.78	0.75	6.66	6.22	8.98	8.36	4.90	4.65	-	-	-	-	0.91	0.87	7.80	7.27
140	13.07	11.97	8.58	7.95	0.06	0.06	0.02	0.02	2.49	2.37	11.99	11.02	17.23	15.47	10.69	9.74	0.05	0.05	0.02	0.02	2.66	2.55	16.12	14.45
130	19.51	17.57	14.84	13.44	0.21	0.20	0.10	0.10	5.38	5.07	18.73	16.87	30.27	26.88	21.32	18.82	0.28	0.27	0.14	0.14	6.27	5.90	28.91	25.70
120	28.59	25.62	22.96	20.37	1.08	1.02	0.51	0.50	10.16	9.36	27.78	24.90	50.19	45.42	38.78	34.64	1.05	0.98	0.80	0.76	15.33	13.88	47.80	43.24

Table H-114. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
180	0.14	0.14	0.05	0.05	-	-	-	-	-	-	0.11	0.11	0.15	0.14	0.04	0.04	-	-	-	-	-	-	0.12	0.11
170	0.76	0.73	0.22	0.21	-	-	-	-	-	-	0.60	0.57	0.79	0.76	0.22	0.21	-	-	-	-	-	-	0.62	0.60
160	2.47	2.36	1.06	1.02	-	-	-	-	0.08	0.08	1.93	1.84	2.60	2.49	1.09	1.05	-	-	-	-	0.08	0.07	2.00	1.91
150	5.33	5.02	2.79	2.67	-	-	-	-	0.36	0.34	4.49	4.26	5.91	5.55	2.93	2.80	-	-	-	-	0.37	0.36	4.87	4.62
140	9.46	8.78	5.87	5.52	-	-	-	-	1.34	1.29	8.54	7.91	11.99	10.90	6.65	6.24	-	-	-	-	1.46	1.40	10.47	9.56
130	15.50	14.06	10.70	9.81	0.10	0.09	0.05	0.05	3.48	3.30	14.60	13.25	21.78	19.14	14.63	13.12	0.10	0.10	0.05	0.05	3.88	3.67	20.12	18.02
120	23.45	20.80	17.60	15.91	0.49	0.47	0.18	0.17	6.99	6.52	22.37	19.74	37.08	33.05	27.52	24.49	0.41	0.40	0.27	0.26	8.92	8.33	35.46	31.47

Table H-115. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.07	0.10	0.09	-	-	-	-	-	-	-	-	0.07	0.07
170	0.42	0.41	0.12	0.11	-	-	-	-	-	-	0.32	0.30	0.44	0.42	0.12	0.12	-	-	-	-	-	-	0.33	0.31
160	1.65	1.59	0.61	0.59	-	-	-	-	0.02	0.02	1.26	1.21	1.74	1.67	0.64	0.62	-	-	-	-	0.02	0.02	1.32	1.26
150	4.07	3.87	1.95	1.86	-	-	-	-	0.14	0.14	3.27	3.11	4.38	4.17	2.04	1.95	-	-	-	-	0.15	0.15	3.53	3.36
140	7.70	7.14	4.50	4.27	-	-	-	-	0.78	0.75	6.66	6.22	8.98	8.36	4.90	4.65	-	-	-	-	0.91	0.87	7.80	7.27
130	13.07	11.97	8.58	7.95	0.06	0.06	0.02	0.02	2.49	2.37	11.99	11.02	17.23	15.47	10.69	9.74	0.05	0.05	0.02	0.02	2.66	2.55	16.12	14.45
120	19.51	17.57	14.84	13.44	0.21	0.20	0.10	0.10	5.38	5.07	18.73	16.87	30.27	26.88	21.32	18.82	0.28	0.27	0.14	0.14	6.27	5.90	28.91	25.70

Table H-116. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
170	0.18	0.17	0.07	0.06	-	-	-	-	-	-	0.12	0.12	0.16	0.16	0.06	0.06	-	-	-	-	-	-	0.13	0.13
160	0.94	0.91	0.24	0.24	-	-	-	-	-	-	0.67	0.64	0.96	0.93	0.25	0.24	-	-	-	-	-	-	0.70	0.67
150	2.69	2.57	1.18	1.13	-	-	-	-	0.09	0.09	2.11	2.01	2.82	2.69	1.23	1.18	-	-	-	-	0.09	0.09	2.25	2.14
140	5.68	5.34	3.00	2.86	-	-	-	-	0.41	0.40	4.82	4.56	6.34	5.95	3.25	3.09	-	-	-	-	0.42	0.41	5.27	4.98
130	9.86	9.16	6.26	5.87	-	-	-	-	1.53	1.47	9.02	8.35	12.84	11.64	7.20	6.73	0.02	0.02	-	-	1.62	1.55	11.47	10.42
120	16.14	14.63	11.44	10.50	0.10	0.10	0.06	0.06	3.79	3.58	15.25	13.82	23.28	20.53	15.60	13.98	0.11	0.10	0.05	0.05	4.21	4.00	21.76	19.13

H.2.1.2. 11 m Diameter Pile

Table H-117. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
180	0.11	0.11	0.03	0.03	-	-	-	-	-	-	0.08	0.07	0.11	0.11	0.03	0.03	-	-	-	-	-	-	0.08	0.08
170	0.60	0.58	0.14	0.14	-	-	-	-	-	-	0.40	0.39	0.63	0.60	0.13	0.13	-	-	-	-	-	-	0.42	0.40
160	1.85	1.75	0.70	0.67	-	-	-	-	0.05	0.05	1.38	1.31	1.94	1.84	0.73	0.70	-	-	-	-	0.05	0.05	1.45	1.37
150	4.07	3.79	1.96	1.85	-	-	-	-	0.20	0.20	3.23	3.01	4.47	4.16	2.11	1.98	-	-	-	-	0.21	0.20	3.66	3.39
140	6.95	6.33	4.35	4.04	-	-	-	-	0.89	0.85	6.22	5.68	8.42	7.59	5.01	4.62	-	-	-	-	0.94	0.90	7.60	6.85
130	11.33	9.99	7.75	7.01	0.01	0.01	-	-	2.43	2.27	10.35	9.18	15.06	13.56	10.20	9.07	0.01	0.01	-	-	2.60	2.45	14.46	13.00
120	16.29	14.70	12.94	11.57	0.10	0.10	0.03	0.03	5.01	4.62	15.72	14.19	25.63	22.92	18.72	16.85	0.12	0.11	0.03	0.03	6.05	5.52	24.96	22.25

Table H-118. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.05	0.05	-	-	-	-	-	-	-	-	0.03	0.03	0.05	0.05	-	-	-	-	-	-	-	-	0.03	0.03
170	0.24	0.24	0.06	0.06	-	-	-	-	-	-	0.14	0.13	0.25	0.24	0.07	0.07	-	-	-	-	-	-	0.13	0.13
160	0.98	0.94	0.28	0.27	-	-	-	-	-	-	0.69	0.66	1.02	0.97	0.29	0.28	-	-	-	-	-	-	0.72	0.69
150	2.61	2.45	1.11	1.06	-	-	-	-	0.08	0.08	1.97	1.86	2.78	2.62	1.18	1.12	-	-	-	-	0.08	0.08	2.11	1.98
140	5.12	4.73	2.77	2.60	-	-	-	-	0.41	0.39	4.37	4.06	5.83	5.33	2.97	2.79	-	-	-	-	0.42	0.41	4.99	4.60
130	8.46	7.66	5.58	5.10	-	-	-	-	1.41	1.33	7.69	6.95	10.83	9.51	6.73	6.11	-	-	-	-	1.49	1.41	9.85	8.82
120	13.33	11.97	9.50	8.53	0.05	0.05	0.01	0.01	3.28	3.04	12.73	11.36	18.39	16.56	13.51	12.10	0.05	0.05	0.01	0.01	3.73	3.47	17.84	16.04

Table H-119. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
170	0.11	0.11	0.03	0.03	-	-	-	-	-	-	0.08	0.07	0.11	0.11	0.03	0.03	-	-	-	-	-	-	0.08	0.08
160	0.60	0.58	0.14	0.14	-	-	-	-	-	-	0.40	0.39	0.63	0.60	0.13	0.13	-	-	-	-	-	-	0.42	0.40
150	1.85	1.75	0.70	0.67	-	-	-	-	0.05	0.05	1.38	1.31	1.94	1.84	0.73	0.70	-	-	-	-	0.05	0.05	1.45	1.37
140	4.07	3.79	1.96	1.85	-	-	-	-	0.20	0.20	3.23	3.01	4.47	4.16	2.11	1.98	-	-	-	-	0.21	0.20	3.66	3.39
130	6.95	6.33	4.35	4.04	-	-	-	-	0.89	0.85	6.22	5.68	8.42	7.59	5.01	4.62	-	-	-	-	0.94	0.90	7.60	6.85
120	11.33	9.99	7.74	7.01	0.01	0.01	-	-	2.43	2.27	10.35	9.18	15.06	13.56	10.20	9.07	0.01	0.01	-	-	2.60	2.45	14.46	13.00

Table H-120. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.06	0.06	-	-	-	-	-	-	-	-	0.04	0.04	0.06	0.06	-	-	-	-	-	-	-	-	0.04	0.04
160	0.28	0.27	0.07	0.07	-	-	-	-	-	-	0.16	0.16	0.28	0.27	0.07	0.07	-	-	-	-	-	-	0.16	0.16
150	1.12	1.07	0.36	0.35	-	-	-	-	0.01	0.01	0.77	0.74	1.18	1.13	0.37	0.36	-	-	-	-	0.01	0.01	0.80	0.77
140	2.80	2.62	1.25	1.19	-	-	-	-	0.09	0.08	2.18	2.04	2.97	2.80	1.32	1.25	-	-	-	-	0.09	0.09	2.34	2.21
130	5.41	4.98	2.95	2.77	-	-	-	-	0.44	0.43	4.65	4.30	6.19	5.66	3.30	3.06	-	-	-	-	0.46	0.45	5.38	4.94
120	8.87	8.00	5.91	5.39	-	-	-	-	1.56	1.47	8.11	7.33	11.63	10.24	7.21	6.52	-	-	-	-	1.63	1.55	10.69	9.39

Table H-121. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	-	-	-	-	-	-	-	-	0.01	0.01	0.03	0.03	-	-	-	-	-	-	-	-	0.01	0.01
180	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.10	0.09	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.10	0.09
170	0.68	0.65	0.19	0.19	-	-	-	-	-	-	0.46	0.44	0.72	0.68	0.19	0.19	-	-	-	-	-	-	0.50	0.47
160	2.00	1.89	0.85	0.81	-	-	-	-	0.07	0.07	1.63	1.54	2.18	2.04	0.90	0.85	-	-	-	-	0.07	0.07	1.73	1.64
150	4.45	4.13	2.38	2.23	-	-	-	-	0.29	0.28	3.83	3.56	5.03	4.63	2.57	2.42	-	-	-	-	0.30	0.29	4.31	4.00
140	7.69	6.98	4.99	4.60	-	-	-	-	1.12	1.05	6.98	6.38	9.51	8.52	5.86	5.34	-	-	-	-	1.19	1.13	8.75	7.88
130	12.56	11.22	8.73	7.88	0.02	0.02	-	-	2.81	2.64	11.85	10.49	16.54	14.89	11.85	10.45	0.02	0.02	-	-	3.05	2.85	15.88	14.28
120	17.55	15.85	13.99	12.59	0.14	0.13	0.03	0.03	5.72	5.23	16.97	15.33	27.44	24.53	19.98	18.00	0.12	0.12	0.04	0.04	6.80	6.21	26.79	23.94

Table H-122. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05	0.07	0.07	-	-	-	-	-	-	-	-	0.05	0.05
170	0.29	0.28	0.08	0.08	-	-	-	-	-	-	0.19	0.18	0.30	0.29	0.08	0.08	-	-	-	-	-	-	0.19	0.19
160	1.11	1.05	0.38	0.37	-	-	-	-	0.01	0.01	0.83	0.79	1.18	1.12	0.39	0.38	-	-	-	-	0.01	0.01	0.87	0.83
150	2.82	2.66	1.37	1.29	-	-	-	-	0.11	0.10	2.37	2.22	3.05	2.86	1.43	1.36	-	-	-	-	0.11	0.11	2.55	2.40
140	5.65	5.17	3.24	3.01	-	-	-	-	0.51	0.48	4.99	4.61	6.54	5.97	3.66	3.40	-	-	-	-	0.54	0.52	5.84	5.33
130	9.35	8.41	6.32	5.76	-	-	-	-	1.69	1.59	8.69	7.84	12.39	11.00	7.74	6.99	-	-	-	-	1.80	1.71	11.56	10.16
120	14.40	12.99	10.74	9.45	0.07	0.07	0.01	0.01	3.90	3.62	13.83	12.44	19.82	17.85	14.75	13.27	0.07	0.07	0.01	0.01	4.39	4.07	19.26	17.33

Table H-123. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.03	0.03	-	-	-	-	-	-	-	-	0.01	0.01	0.03	0.03	-	-	-	-	-	-	-	-	0.01	0.01
170	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.10	0.09	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.10	0.09
160	0.68	0.65	0.19	0.19	-	-	-	-	-	-	0.46	0.44	0.72	0.68	0.19	0.19	-	-	-	-	-	-	0.50	0.47
150	2.00	1.89	0.85	0.81	-	-	-	-	0.07	0.07	1.63	1.54	2.18	2.04	0.90	0.85	-	-	-	-	0.07	0.07	1.73	1.64
140	4.45	4.13	2.38	2.23	-	-	-	-	0.29	0.28	3.83	3.56	5.03	4.63	2.57	2.42	-	-	-	-	0.30	0.29	4.31	4.00
130	7.69	6.98	4.99	4.60	-	-	-	-	1.12	1.05	6.98	6.38	9.51	8.52	5.86	5.34	-	-	-	-	1.19	1.13	8.75	7.88
120	12.56	11.22	8.73	7.88	0.02	0.02	-	-	2.81	2.64	11.85	10.49	16.54	14.89	11.85	10.45	0.02	0.02	-	-	3.05	2.85	15.88	14.28

Table H-124. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.07	0.07	0.01	0.01	-	-	-	-	-	-	0.06	0.06	0.07	0.07	0.01	0.01	-	-	-	-	-	-	0.06	0.06
160	0.33	0.32	0.09	0.08	-	-	-	-	-	-	0.22	0.21	0.35	0.33	0.09	0.09	-	-	-	-	-	-	0.23	0.22
150	1.25	1.19	0.42	0.40	-	-	-	-	0.01	0.01	0.95	0.90	1.34	1.26	0.43	0.42	-	-	-	-	0.01	0.01	0.98	0.94
140	3.01	2.83	1.51	1.42	-	-	-	-	0.11	0.11	2.56	2.41	3.39	3.16	1.60	1.51	-	-	-	-	0.12	0.11	2.75	2.60
130	5.96	5.45	3.55	3.29	-	-	-	-	0.61	0.58	5.32	4.88	6.94	6.33	3.99	3.70	-	-	-	-	0.64	0.61	6.26	5.70
120	9.74	8.76	6.65	6.07	-	-	-	-	1.85	1.74	9.12	8.21	13.03	11.64	8.31	7.49	-	-	-	-	1.96	1.85	12.32	10.91

Table H-125. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	-	-	-	-	-	-	-	-	0.03	0.03	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02
180	0.18	0.18	0.06	0.06	-	-	-	-	-	-	0.13	0.12	0.18	0.18	0.07	0.07	-	-	-	-	-	-	0.12	0.11
170	0.85	0.81	0.28	0.27	-	-	-	-	-	-	0.64	0.61	0.89	0.85	0.28	0.27	-	-	-	-	-	-	0.67	0.64
160	2.41	2.27	1.08	1.02	-	-	-	-	0.08	0.08	1.94	1.83	2.60	2.45	1.15	1.09	-	-	-	-	0.08	0.08	2.07	1.94
150	4.98	4.60	2.76	2.60	-	-	-	-	0.39	0.37	4.38	4.06	5.74	5.24	2.97	2.79	-	-	-	-	0.40	0.39	5.00	4.60
140	8.47	7.66	5.61	5.13	-	-	-	-	1.39	1.31	7.75	7.03	10.83	9.50	6.67	6.08	-	-	-	-	1.47	1.39	9.83	8.80
130	13.40	12.05	9.53	8.56	0.04	0.04	-	-	3.27	3.04	12.80	11.45	18.17	16.34	13.26	11.87	0.04	0.04	-	-	3.71	3.44	17.55	15.77
120	18.52	16.75	14.89	13.44	0.18	0.17	0.04	0.04	6.33	5.76	17.98	16.25	30.13	26.83	23.12	20.49	0.18	0.17	0.03	0.03	7.84	7.08	29.55	26.30

Table H-126. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	-	-	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-	-	-
180	0.08	0.08	0.01	0.01	-	-	-	-	-	-	0.06	0.06	0.08	0.08	0.01	0.01	-	-	-	-	-	-	0.06	0.06
170	0.36	0.35	0.10	0.09	-	-	-	-	-	-	0.27	0.26	0.37	0.36	0.10	0.09	-	-	-	-	-	-	0.27	0.26
160	1.37	1.30	0.49	0.46	-	-	-	-	0.03	0.03	1.06	0.99	1.45	1.38	0.51	0.49	-	-	-	-	0.03	0.03	1.12	1.06
150	3.28	3.05	1.65	1.55	-	-	-	-	0.15	0.14	2.74	2.59	3.69	3.43	1.76	1.65	-	-	-	-	0.14	0.14	2.95	2.79
140	6.25	5.70	3.81	3.54	-	-	-	-	0.69	0.66	5.61	5.14	7.38	6.68	4.28	3.98	-	-	-	-	0.73	0.70	6.62	6.05
130	10.14	9.06	6.95	6.34	-	-	-	-	1.97	1.87	9.48	8.52	13.62	12.21	8.82	7.95	-	-	-	-	2.16	2.01	12.95	11.55
120	15.28	13.82	11.87	10.51	0.07	0.07	0.01	0.01	4.43	4.09	14.69	13.26	22.54	19.96	16.41	14.76	0.08	0.07	0.01	0.01	5.06	4.66	21.70	19.20

Table H-127. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.05	0.05	-	-	-	-	-	-	-	-	0.03	0.03	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02
170	0.18	0.18	0.06	0.06	-	-	-	-	-	-	0.13	0.12	0.18	0.18	0.07	0.07	-	-	-	-	-	-	0.12	0.11
160	0.85	0.81	0.28	0.27	-	-	-	-	-	-	0.64	0.61	0.89	0.85	0.28	0.27	-	-	-	-	-	-	0.67	0.64
150	2.41	2.27	1.08	1.02	-	-	-	-	0.08	0.08	1.94	1.83	2.60	2.45	1.15	1.09	-	-	-	-	0.08	0.08	2.07	1.94
140	4.98	4.60	2.76	2.60	-	-	-	-	0.39	0.37	4.38	4.06	5.74	5.24	2.97	2.79	-	-	-	-	0.40	0.39	5.00	4.60
130	8.47	7.66	5.61	5.13	-	-	-	-	1.39	1.31	7.75	7.03	10.83	9.50	6.67	6.08	-	-	-	-	1.47	1.39	9.83	8.80
120	13.40	12.05	9.53	8.56	0.04	0.04	-	-	3.27	3.04	12.80	11.45	18.17	16.34	13.26	11.87	0.04	0.04	-	-	3.71	3.44	17.55	15.77

Table H-128. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.01	0.01	-	-	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-	-	-
170	0.09	0.08	0.01	0.01	-	-	-	-	-	-	0.07	0.07	0.09	0.09	0.01	0.01	-	-	-	-	-	-	0.07	0.07
160	0.41	0.39	0.11	0.11	-	-	-	-	-	-	0.31	0.30	0.45	0.42	0.11	0.11	-	-	-	-	-	-	0.32	0.31
150	1.52	1.44	0.58	0.55	-	-	-	-	0.04	0.04	1.19	1.13	1.62	1.53	0.61	0.58	-	-	-	-	0.04	0.04	1.25	1.20
140	3.57	3.33	1.80	1.70	-	-	-	-	0.17	0.17	2.93	2.76	4.01	3.73	1.92	1.81	-	-	-	-	0.17	0.16	3.26	3.04
130	6.56	5.99	4.10	3.81	-	-	-	-	0.78	0.75	5.94	5.43	7.87	7.12	4.63	4.28	-	-	-	-	0.83	0.78	7.07	6.44
120	10.80	9.51	7.36	6.68	-	-	-	-	2.19	2.05	9.88	8.88	14.26	12.82	9.42	8.46	-	-	-	-	2.38	2.23	13.62	12.20

Table H-129. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.07	0.01	0.01	-	-	-	-	-	-	0.06	0.06	0.07	0.07	0.01	0.01	-	-	-	-	-	-	0.06	0.06
180	0.37	0.36	0.09	0.09	-	-	-	-	-	-	0.24	0.23	0.38	0.37	0.10	0.09	-	-	-	-	-	-	0.25	0.24
170	1.31	1.25	0.48	0.46	-	-	-	-	0.01	0.01	1.00	0.94	1.39	1.32	0.48	0.46	-	-	-	-	0.01	0.01	1.05	0.99
160	3.12	2.90	1.57	1.48	-	-	-	-	0.13	0.12	2.63	2.47	3.49	3.23	1.67	1.58	-	-	-	-	0.12	0.12	2.81	2.64
150	6.02	5.52	3.67	3.40	-	-	-	-	0.66	0.63	5.38	4.95	7.04	6.39	4.08	3.79	-	-	-	-	0.69	0.66	6.34	5.79
140	9.85	8.89	6.87	6.24	-	-	-	-	1.91	1.79	9.31	8.40	13.38	11.99	8.65	7.78	-	-	-	-	2.05	1.92	12.79	11.40
130	15.24	13.76	11.85	10.55	0.08	0.07	0.02	0.02	4.29	3.98	14.76	13.32	22.42	19.87	16.37	14.72	0.08	0.08	0.02	0.02	4.85	4.48	21.65	19.16
120	21.53	19.14	17.42	15.69	0.36	0.34	0.09	0.09	7.84	7.07	20.85	18.61	35.32	32.02	28.11	25.11	0.39	0.38	0.09	0.09	10.14	9.04	34.73	31.34

Table H-130. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	-	-	-	-	-	-	-	-	0.01	0.01	0.02	0.02	-	-	-	-	-	-	-	-	0.01	0.01
180	0.12	0.11	0.04	0.04	-	-	-	-	-	-	0.08	0.08	0.12	0.11	0.04	0.04	-	-	-	-	-	-	0.09	0.09
170	0.64	0.62	0.18	0.18	-	-	-	-	-	-	0.45	0.42	0.66	0.64	0.18	0.18	-	-	-	-	-	-	0.47	0.45
160	1.92	1.81	0.79	0.75	-	-	-	-	0.06	0.06	1.54	1.45	2.03	1.91	0.85	0.81	-	-	-	-	0.06	0.06	1.63	1.54
150	4.25	3.96	2.24	2.10	-	-	-	-	0.27	0.25	3.62	3.36	4.72	4.38	2.43	2.28	-	-	-	-	0.27	0.26	4.04	3.75
140	7.43	6.72	4.80	4.44	-	-	-	-	1.05	0.98	6.78	6.17	9.12	8.20	5.57	5.10	-	-	-	-	1.12	1.06	8.42	7.59
130	12.25	10.95	8.59	7.75	0.01	0.01	-	-	2.71	2.53	11.61	10.31	16.37	14.72	11.64	10.26	0.01	0.01	-	-	2.89	2.72	15.79	14.19
120	17.49	15.78	13.96	12.60	0.12	0.11	0.03	0.03	5.52	5.07	17.05	15.37	27.39	24.49	19.94	17.95	0.12	0.12	0.03	0.03	6.57	5.99	26.79	23.95

Table H-131. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	0.01	0.01	-	-	-	-	-	-	0.06	0.06	0.07	0.07	0.01	0.01	-	-	-	-	-	-	0.06	0.06
170	0.37	0.36	0.09	0.09	-	-	-	-	-	-	0.24	0.23	0.38	0.37	0.10	0.09	-	-	-	-	-	-	0.25	0.24
160	1.31	1.25	0.48	0.46	-	-	-	-	0.01	0.01	1.00	0.94	1.39	1.32	0.48	0.46	-	-	-	-	0.01	0.01	1.05	0.99
150	3.12	2.90	1.57	1.48	-	-	-	-	0.13	0.12	2.63	2.47	3.49	3.23	1.67	1.58	-	-	-	-	0.12	0.12	2.81	2.64
140	6.02	5.52	3.67	3.40	-	-	-	-	0.66	0.63	5.38	4.95	7.04	6.39	4.08	3.79	-	-	-	-	0.69	0.66	6.34	5.79
130	9.85	8.89	6.87	6.24	-	-	-	-	1.90	1.79	9.31	8.40	13.38	11.99	8.65	7.78	-	-	-	-	2.05	1.92	12.79	11.40
120	15.24	13.76	11.85	10.55	0.08	0.07	0.02	0.02	4.29	3.98	14.76	13.32	22.42	19.87	16.37	14.72	0.08	0.08	0.02	0.02	4.85	4.48	21.65	19.16

Table H-132. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.03	0.03	-	-	-	-	-	-	-	-	0.01	0.01	0.03	0.03	-	-	-	-	-	-	-	-	0.01	0.01
170	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.10	0.09	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.11	0.10
160	0.71	0.68	0.20	0.20	-	-	-	-	-	-	0.50	0.48	0.74	0.72	0.21	0.20	-	-	-	-	-	-	0.52	0.50
150	2.09	1.95	0.92	0.87	-	-	-	-	0.07	0.07	1.69	1.60	2.26	2.12	0.97	0.92	-	-	-	-	0.07	0.07	1.80	1.70
140	4.52	4.20	2.47	2.31	-	-	-	-	0.32	0.31	3.91	3.63	5.07	4.68	2.65	2.49	-	-	-	-	0.35	0.33	4.35	4.04
130	7.83	7.08	5.12	4.72	-	-	-	-	1.17	1.10	7.17	6.49	9.67	8.67	6.00	5.48	-	-	-	-	1.25	1.19	9.01	8.11
120	12.76	11.45	9.03	8.15	0.01	0.01	-	-	2.89	2.71	12.18	10.89	17.22	15.48	12.44	11.06	0.01	0.01	-	-	3.18	2.94	16.64	14.95

Table H-133. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
180	0.11	0.11	0.03	0.03	-	-	-	-	-	-	0.08	0.08	0.11	0.11	0.03	0.03	-	-	-	-	-	-	0.08	0.08
170	0.59	0.57	0.14	0.14	-	-	-	-	-	-	0.41	0.40	0.61	0.60	0.13	0.13	-	-	-	-	-	-	0.42	0.41
160	1.87	1.78	0.70	0.68	-	-	-	-	0.06	0.06	1.38	1.32	1.95	1.86	0.74	0.71	-	-	-	-	0.06	0.06	1.45	1.39
150	4.08	3.81	1.97	1.88	-	-	-	-	0.20	0.19	3.24	3.01	4.48	4.17	2.12	2.01	-	-	-	-	0.20	0.19	3.61	3.38
140	6.91	6.42	4.32	4.04	-	-	-	-	0.90	0.86	6.16	5.73	8.35	7.72	4.92	4.59	-	-	-	-	0.93	0.90	7.49	6.93
130	11.09	10.17	7.67	7.10	-	-	-	-	2.42	2.28	10.10	9.30	14.86	13.60	9.80	9.04	-	-	-	-	2.59	2.45	14.13	12.97
120	16.35	14.95	12.68	11.67	0.09	0.08	-	-	4.90	4.57	15.77	14.43	25.00	22.64	18.03	16.46	0.10	0.09	-	-	5.74	5.34	24.25	21.95

Table H-134. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	-	-	-	-	-	-	-	-	0.03	0.03	0.06	0.06	-	-	-	-	-	-	-	-	0.03	0.03
170	0.24	0.23	0.06	0.06	-	-	-	-	-	-	0.14	0.13	0.24	0.24	0.06	0.06	-	-	-	-	-	-	0.13	0.12
160	0.98	0.95	0.27	0.26	-	-	-	-	-	-	0.70	0.67	1.03	0.99	0.28	0.27	-	-	-	-	-	-	0.73	0.70
150	2.62	2.48	1.11	1.06	-	-	-	-	0.08	0.08	1.97	1.88	2.79	2.64	1.17	1.12	-	-	-	-	0.09	0.08	2.12	2.01
140	5.12	4.77	2.77	2.62	-	-	-	-	0.42	0.41	4.34	4.06	5.78	5.37	2.95	2.80	-	-	-	-	0.44	0.42	4.94	4.60
130	8.44	7.81	5.50	5.11	-	-	-	-	1.4	1.34	7.64	7.08	10.48	9.58	6.56	6.09	-	-	-	-	1.48	1.42	9.65	8.90
120	13.19	12.14	9.36	8.65	0.04	0.04	-	-	3.25	3.02	12.52	11.53	18.14	16.55	12.95	11.91	0.03	0.03	-	-	3.63	3.39	17.48	15.97

Table H-135. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
170	0.11	0.11	0.03	0.03	-	-	-	-	-	-	0.08	0.08	0.11	0.11	0.03	0.03	-	-	-	-	-	-	0.08	0.08
160	0.59	0.57	0.14	0.14	-	-	-	-	-	-	0.41	0.40	0.61	0.60	0.13	0.13	-	-	-	-	-	-	0.42	0.41
150	1.87	1.78	0.70	0.68	-	-	-	-	0.06	0.06	1.38	1.32	1.95	1.86	0.74	0.71	-	-	-	-	0.06	0.06	1.45	1.39
140	4.08	3.81	1.97	1.88	-	-	-	-	0.20	0.19	3.24	3.01	4.48	4.17	2.12	2.01	-	-	-	-	0.20	0.19	3.61	3.38
130	6.91	6.42	4.32	4.04	-	-	-	-	0.90	0.86	6.16	5.73	8.35	7.72	4.92	4.59	-	-	-	-	0.93	0.90	7.49	6.93
120	11.09	10.17	7.67	7.10	-	-	-	-	2.42	2.28	10.10	9.30	14.86	13.60	9.80	9.04	-	-	-	-	2.59	2.45	14.13	12.97

Table H-136. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.06	0.06	-	-	-	-	-	-	-	-	0.04	0.04	0.06	0.06	-	-	-	-	-	-	-	-	0.04	0.04
160	0.27	0.27	0.07	0.07	-	-	-	-	-	-	0.17	0.16	0.28	0.27	0.07	0.07	-	-	-	-	-	-	0.16	0.16
150	1.13	1.08	0.34	0.32	-	-	-	-	-	-	0.78	0.75	1.19	1.14	0.35	0.33	-	-	-	-	-	-	0.82	0.78
140	2.80	2.65	1.26	1.20	-	-	-	-	0.09	0.09	2.18	2.06	2.98	2.82	1.32	1.26	-	-	-	-	0.10	0.09	2.36	2.23
130	5.40	5.02	2.95	2.79	-	-	-	-	0.46	0.44	4.62	4.31	6.14	5.70	3.27	3.05	-	-	-	-	0.48	0.46	5.30	4.94
120	8.82	8.16	5.82	5.41	-	-	-	-	1.56	1.48	8.06	7.46	11.27	10.31	7.01	6.51	-	-	-	-	1.64	1.57	10.27	9.40

Table H-137. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.04	0.04	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
180	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.10	0.10	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.10	0.10
170	0.73	0.70	0.20	0.19	-	-	-	-	-	-	0.50	0.48	0.76	0.73	0.20	0.19	-	-	-	-	-	-	0.53	0.51
160	2.13	2.01	0.90	0.86	-	-	-	-	0.06	0.06	1.70	1.62	2.30	2.18	0.93	0.89	-	-	-	-	0.07	0.07	1.80	1.71
150	4.54	4.24	2.44	2.31	-	-	-	-	0.29	0.28	3.88	3.62	5.10	4.74	2.62	2.48	-	-	-	-	0.30	0.29	4.32	4.03
140	7.72	7.14	4.96	4.62	-	-	-	-	1.17	1.12	6.92	6.43	9.41	8.69	5.78	5.37	-	-	-	-	1.24	1.18	8.66	8.01
130	12.31	11.31	8.62	7.95	0.02	0.02	-	-	2.84	2.69	11.49	10.53	16.54	15.09	11.50	10.56	0.02	0.02	-	-	3.08	2.88	15.86	14.47
120	17.48	15.99	13.77	12.65	0.13	0.13	0.03	0.03	5.62	5.24	16.89	15.45	27.83	25.06	20.11	18.28	0.13	0.13	0.03	0.03	6.75	6.27	27.10	24.44

Table H-138. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05
170	0.30	0.29	0.08	0.08	-	-	-	-	-	-	0.19	0.19	0.31	0.30	0.09	0.08	-	-	-	-	-	-	0.19	0.19
160	1.19	1.14	0.41	0.39	-	-	-	-	-	-	0.88	0.84	1.26	1.20	0.42	0.41	-	-	-	-	-	-	0.92	0.88
150	2.92	2.76	1.42	1.35	-	-	-	-	0.11	0.11	2.43	2.30	3.20	2.99	1.49	1.42	-	-	-	-	0.11	0.11	2.60	2.47
140	5.68	5.28	3.29	3.07	-	-	-	-	0.52	0.50	4.98	4.64	6.55	6.09	3.67	3.43	-	-	-	-	0.56	0.54	5.78	5.37
130	9.27	8.56	6.23	5.79	-	-	-	-	1.74	1.65	8.57	7.92	12.11	11.12	7.67	7.10	-	-	-	-	1.84	1.75	11.19	10.26
120	14.27	13.10	10.36	9.47	0.06	0.06	-	-	3.90	3.65	13.60	12.49	19.91	18.15	14.69	13.44	0.06	0.06	-	-	4.36	4.07	19.36	17.64

Table H-139. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.04	0.04	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
170	0.14	0.13	0.05	0.05	-	-	-	-	-	-	0.10	0.10	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.10	0.10
160	0.73	0.70	0.20	0.19	-	-	-	-	-	-	0.50	0.48	0.76	0.73	0.20	0.19	-	-	-	-	-	-	0.53	0.51
150	2.13	2.01	0.90	0.86	-	-	-	-	0.06	0.06	1.70	1.62	2.30	2.18	0.93	0.89	-	-	-	-	0.07	0.07	1.80	1.71
140	4.54	4.24	2.44	2.31	-	-	-	-	0.29	0.28	3.88	3.62	5.10	4.74	2.62	2.48	-	-	-	-	0.30	0.29	4.32	4.03
130	7.72	7.14	4.96	4.62	-	-	-	-	1.17	1.12	6.92	6.43	9.41	8.69	5.78	5.37	-	-	-	-	1.24	1.18	8.66	8.01
120	12.31	11.31	8.62	7.95	0.02	0.02	-	-	2.84	2.69	11.49	10.53	16.54	15.09	11.50	10.56	0.02	0.02	-	-	3.08	2.88	15.86	14.47

Table H-140. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06
160	0.34	0.33	0.09	0.09	-	-	-	-	-	-	0.23	0.23	0.35	0.34	0.09	0.09	-	-	-	-	-	-	0.24	0.24
150	1.33	1.27	0.46	0.44	-	-	-	-	-	-	0.98	0.94	1.40	1.34	0.48	0.46	-	-	-	-	-	-	1.02	0.98
140	3.16	2.95	1.55	1.48	-	-	-	-	0.11	0.11	2.63	2.49	3.52	3.29	1.66	1.58	-	-	-	-	0.12	0.12	2.81	2.66
130	5.98	5.56	3.58	3.35	-	-	-	-	0.62	0.59	5.28	4.92	6.95	6.45	3.98	3.73	-	-	-	-	0.65	0.62	6.18	5.74
120	9.64	8.89	6.58	6.10	-	-	-	-	1.90	1.80	8.99	8.29	12.80	11.76	8.22	7.61	-	-	-	-	1.98	1.90	11.98	11.01

Table H-141. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02
180	0.17	0.17	0.06	0.06	-	-	-	-	-	-	0.11	0.11	0.17	0.17	0.06	0.06	-	-	-	-	-	-	0.12	0.12
170	0.85	0.82	0.26	0.25	-	-	-	-	-	-	0.63	0.60	0.89	0.86	0.27	0.26	-	-	-	-	-	-	0.65	0.63
160	2.44	2.32	1.05	1.01	-	-	-	-	0.08	0.08	1.92	1.83	2.61	2.48	1.12	1.07	-	-	-	-	0.08	0.08	2.04	1.93
150	4.96	4.63	2.72	2.57	-	-	-	-	0.37	0.35	4.28	4.01	5.62	5.23	2.90	2.75	-	-	-	-	0.38	0.36	4.84	4.52
140	8.37	7.74	5.44	5.07	-	-	-	-	1.36	1.29	7.62	7.04	10.31	9.43	6.47	6.00	-	-	-	-	1.43	1.37	9.54	8.80
130	13.15	12.09	9.34	8.62	0.04	0.04	-	-	3.17	2.95	12.48	11.47	18.01	16.42	12.84	11.80	0.03	0.03	-	-	3.55	3.33	17.37	15.85
120	18.57	16.96	14.83	13.60	0.18	0.18	0.05	0.05	6.16	5.72	18.05	16.48	30.41	27.13	22.73	20.53	0.18	0.18	0.05	0.05	7.65	7.07	29.64	26.52

Table H-142. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.08	0.07	-	-	-	-	-	-	-	-	0.06	0.06
170	0.35	0.34	0.10	0.09	-	-	-	-	-	-	0.26	0.25	0.36	0.35	0.10	0.09	-	-	-	-	-	-	0.26	0.26
160	1.39	1.33	0.49	0.47	-	-	-	-	0.02	0.02	1.04	0.99	1.47	1.40	0.51	0.49	-	-	-	-	-	-	1.10	1.06
150	3.30	3.09	1.62	1.55	-	-	-	-	0.12	0.12	2.72	2.57	3.68	3.44	1.73	1.64	-	-	-	-	0.12	0.12	2.91	2.75
140	6.17	5.74	3.72	3.48	-	-	-	-	0.67	0.64	5.46	5.09	7.23	6.69	4.14	3.88	-	-	-	-	0.72	0.70	6.43	5.97
130	9.88	9.12	6.81	6.32	-	-	-	-	1.95	1.86	9.26	8.55	13.24	12.16	8.60	7.94	-	-	-	-	2.10	1.98	12.50	11.48
120	15.22	13.92	11.52	10.56	0.07	0.07	0.02	0.02	4.30	4.02	14.59	13.37	22.33	20.12	16.18	14.76	0.07	0.07	0.02	0.02	4.88	4.56	21.48	19.33

Table H-143. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02
170	0.17	0.17	0.06	0.06	-	-	-	-	-	-	0.11	0.11	0.17	0.17	0.06	0.06	-	-	-	-	-	-	0.12	0.12
160	0.85	0.82	0.26	0.25	-	-	-	-	-	-	0.63	0.60	0.89	0.86	0.27	0.26	-	-	-	-	-	-	0.65	0.63
150	2.44	2.32	1.05	1.01	-	-	-	-	0.08	0.08	1.92	1.83	2.61	2.48	1.12	1.07	-	-	-	-	0.08	0.08	2.04	1.93
140	4.96	4.63	2.72	2.57	-	-	-	-	0.37	0.35	4.28	4.01	5.62	5.23	2.90	2.75	-	-	-	-	0.38	0.36	4.84	4.52
130	8.37	7.74	5.44	5.07	-	-	-	-	1.36	1.29	7.62	7.04	10.31	9.43	6.47	6.00	-	-	-	-	1.43	1.37	9.54	8.80
120	13.15	12.09	9.34	8.62	0.04	0.04	-	-	3.17	2.95	12.48	11.47	18.01	16.42	12.84	11.80	0.03	0.03	-	-	3.55	3.33	17.37	15.85

Table H-144. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.09	0.08	-	-	-	-	-	-	-	-	0.06	0.06	0.09	0.08	-	-	-	-	-	-	-	-	0.06	0.06
160	0.45	0.43	0.11	0.11	-	-	-	-	-	-	0.30	0.29	0.48	0.46	0.11	0.11	-	-	-	-	-	-	0.31	0.30
150	1.54	1.47	0.54	0.52	-	-	-	-	0.04	0.04	1.19	1.14	1.63	1.56	0.57	0.55	-	-	-	-	0.03	0.03	1.26	1.20
140	3.60	3.37	1.78	1.69	-	-	-	-	0.16	0.16	2.91	2.75	4.00	3.74	1.87	1.79	-	-	-	-	0.16	0.16	3.18	2.97
130	6.49	6.03	4.00	3.74	-	-	-	-	0.77	0.74	5.78	5.39	7.73	7.14	4.48	4.18	-	-	-	-	0.81	0.77	6.87	6.37
120	10.42	9.53	7.21	6.67	-	-	-	-	2.14	2.01	9.66	8.91	13.94	12.79	9.16	8.45	-	-	-	-	2.34	2.19	13.23	12.15

Table H-145. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05
180	0.28	0.28	0.08	0.08	-	-	-	-	-	-	0.19	0.18	0.29	0.28	0.08	0.08	-	-	-	-	-	-	0.19	0.18
170	1.16	1.11	0.41	0.40	-	-	-	-	-	-	0.82	0.78	1.23	1.18	0.43	0.42	-	-	-	-	-	-	0.91	0.87
160	2.90	2.74	1.39	1.32	-	-	-	-	0.10	0.10	2.39	2.27	3.14	2.94	1.47	1.40	-	-	-	-	0.11	0.11	2.58	2.44
150	5.66	5.27	3.28	3.06	-	-	-	-	0.50	0.48	4.98	4.65	6.51	6.06	3.67	3.42	-	-	-	-	0.54	0.51	5.76	5.37
140	9.31	8.60	6.28	5.85	-	-	-	-	1.72	1.64	8.67	8.02	12.19	11.16	7.68	7.11	-	-	-	-	1.83	1.74	11.32	10.34
130	14.46	13.25	10.56	9.67	0.07	0.07	0.02	0.02	3.94	3.68	13.84	12.70	19.90	18.09	14.59	13.32	0.07	0.07	0.02	0.02	4.40	4.11	19.27	17.51
120	20.02	18.24	16.28	14.87	0.37	0.35	0.12	0.12	7.12	6.62	19.52	17.79	32.80	29.14	25.05	22.67	0.31	0.30	0.12	0.12	9.08	8.41	31.88	28.35

Table H-146. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.10	0.10	0.02	0.02	-	-	-	-	-	-	0.07	0.07	0.11	0.10	0.02	0.02	-	-	-	-	-	-	0.08	0.08
170	0.51	0.49	0.13	0.13	-	-	-	-	-	-	0.40	0.39	0.54	0.52	0.13	0.12	-	-	-	-	-	-	0.42	0.41
160	1.76	1.68	0.70	0.67	-	-	-	-	0.05	0.05	1.36	1.30	1.87	1.77	0.73	0.70	-	-	-	-	0.05	0.05	1.45	1.39
150	4.00	3.73	1.98	1.89	-	-	-	-	0.20	0.20	3.26	3.05	4.40	4.11	2.16	2.04	-	-	-	-	0.20	0.19	3.66	3.41
140	6.93	6.45	4.40	4.12	-	-	-	-	0.92	0.88	6.26	5.84	8.44	7.79	4.98	4.65	-	-	-	-	0.95	0.92	7.63	7.06
130	11.33	10.38	7.86	7.28	0.02	0.02	-	-	2.46	2.33	10.44	9.56	15.05	13.72	9.87	9.11	0.02	0.02	-	-	2.66	2.51	14.31	13.07
120	16.63	15.19	12.93	11.89	0.12	0.12	0.05	0.05	5.06	4.72	16.04	14.67	24.98	22.56	18.01	16.38	0.12	0.12	0.03	0.03	5.88	5.48	24.09	21.72

Table H-147. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05
170	0.28	0.28	0.08	0.08	-	-	-	-	-	-	0.19	0.18	0.29	0.28	0.08	0.08	-	-	-	-	-	-	0.19	0.18
160	1.16	1.11	0.41	0.40	-	-	-	-	-	-	0.82	0.78	1.23	1.18	0.43	0.42	-	-	-	-	-	-	0.91	0.87
150	2.90	2.74	1.39	1.32	-	-	-	-	0.10	0.10	2.39	2.27	3.14	2.94	1.47	1.40	-	-	-	-	0.11	0.11	2.57	2.44
140	5.66	5.27	3.28	3.06	-	-	-	-	0.50	0.48	4.98	4.65	6.51	6.06	3.67	3.42	-	-	-	-	0.54	0.51	5.76	5.37
130	9.31	8.60	6.28	5.85	-	-	-	-	1.72	1.64	8.67	8.02	12.19	11.16	7.68	7.11	-	-	-	-	1.83	1.74	11.32	10.34
120	14.46	13.25	10.56	9.67	0.07	0.07	0.02	0.02	3.94	3.67	13.84	12.70	19.90	18.09	14.59	13.32	0.07	0.07	0.02	0.02	4.40	4.11	19.27	17.51

Table H-148. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
170	0.11	0.11	0.04	0.04	-	-	-	-	-	-	0.09	0.08	0.12	0.11	0.03	0.03	-	-	-	-	-	-	0.09	0.08
160	0.61	0.59	0.17	0.16	-	-	-	-	-	-	0.45	0.44	0.65	0.62	0.16	0.16	-	-	-	-	-	-	0.47	0.45
150	1.91	1.82	0.75	0.73	-	-	-	-	0.06	0.06	1.51	1.44	2.01	1.92	0.79	0.75	-	-	-	-	0.06	0.06	1.59	1.52
140	4.26	3.98	2.20	2.07	-	-	-	-	0.23	0.23	3.56	3.34	4.72	4.40	2.40	2.25	-	-	-	-	0.24	0.24	3.98	3.72
130	7.33	6.79	4.68	4.38	-	-	-	-	1.02	0.97	6.61	6.16	8.94	8.25	5.36	5.00	-	-	-	-	1.07	1.02	8.18	7.56
120	11.91	10.93	8.29	7.67	0.02	0.02	-	-	2.66	2.51	11.08	10.15	15.83	14.41	10.66	9.74	0.02	0.02	-	-	2.86	2.70	15.09	13.76

Table H-149. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06
180	0.39	0.38	0.09	0.09	-	-	-	-	-	-	0.26	0.24	0.41	0.40	0.10	0.09	-	-	-	-	-	-	0.26	0.25
170	1.39	1.33	0.46	0.45	-	-	-	-	-	-	1.03	0.99	1.47	1.40	0.48	0.47	-	-	-	-	-	-	1.10	1.06
160	3.30	3.07	1.61	1.54	-	-	-	-	0.12	0.12	2.70	2.56	3.64	3.40	1.71	1.64	-	-	-	-	0.12	0.12	2.89	2.73
150	6.14	5.71	3.76	3.50	-	-	-	-	0.67	0.65	5.48	5.09	7.15	6.63	4.16	3.88	-	-	-	-	0.71	0.68	6.40	5.96
140	9.87	9.13	6.82	6.35	-	-	-	-	1.95	1.86	9.31	8.61	13.26	12.15	8.55	7.90	-	-	-	-	2.10	1.99	12.52	11.48
130	15.31	14.00	11.56	10.61	0.07	0.07	-	-	4.34	4.05	14.72	13.47	21.95	19.69	15.87	14.46	0.07	0.07	-	-	4.88	4.54	20.89	18.79
120	21.58	19.43	17.16	15.67	0.35	0.34	0.08	0.08	7.72	7.16	20.72	18.71	35.07	31.06	27.08	24.39	0.32	0.31	0.07	0.07	9.87	9.13	34.03	30.16

Table H-150. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
180	0.12	0.12	0.05	0.05	-	-	-	-	-	-	0.09	0.08	0.12	0.12	0.05	0.05	-	-	-	-	-	-	0.10	0.09
170	0.68	0.65	0.18	0.18	-	-	-	-	-	-	0.46	0.44	0.71	0.68	0.18	0.18	-	-	-	-	-	-	0.48	0.46
160	1.99	1.90	0.79	0.76	-	-	-	-	0.06	0.06	1.58	1.51	2.16	2.04	0.88	0.84	-	-	-	-	0.06	0.06	1.69	1.61
150	4.40	4.10	2.31	2.19	-	-	-	-	0.26	0.26	3.74	3.49	4.88	4.54	2.50	2.37	-	-	-	-	0.27	0.26	4.14	3.87
140	7.53	6.98	4.86	4.53	-	-	-	-	1.08	1.02	6.80	6.34	9.19	8.49	5.58	5.19	-	-	-	-	1.15	1.10	8.47	7.83
130	12.21	11.21	8.53	7.89	-	-	-	-	2.76	2.60	11.44	10.50	16.28	14.82	11.15	10.19	-	-	-	-	2.94	2.78	15.55	14.17
120	17.52	16.00	13.75	12.62	0.11	0.11	0.02	0.02	5.52	5.14	16.96	15.49	26.89	24.21	19.36	17.61	0.11	0.11	0.02	0.02	6.52	6.07	25.97	23.44

Table H-151. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06
170	0.39	0.38	0.09	0.09	-	-	-	-	-	-	0.26	0.24	0.41	0.40	0.10	0.09	-	-	-	-	-	-	0.26	0.25
160	1.39	1.33	0.46	0.45	-	-	-	-	-	-	1.03	0.99	1.47	1.40	0.48	0.47	-	-	-	-	-	-	1.10	1.06
150	3.30	3.07	1.61	1.54	-	-	-	-	0.12	0.12	2.70	2.56	3.64	3.40	1.71	1.64	-	-	-	-	0.12	0.12	2.89	2.73
140	6.14	5.71	3.76	3.50	-	-	-	-	0.67	0.65	5.48	5.09	7.15	6.63	4.16	3.88	-	-	-	-	0.71	0.68	6.40	5.96
130	9.87	9.13	6.82	6.35	-	-	-	-	1.95	1.86	9.31	8.61	13.26	12.15	8.55	7.90	-	-	-	-	2.10	1.99	12.52	11.48
120	15.31	14.00	11.56	10.61	0.07	0.07	-	-	4.34	4.05	14.72	13.47	21.95	19.69	15.87	14.46	0.07	0.07	-	-	4.88	4.54	20.89	18.79

Table H-152. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.04	0.04	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
170	0.14	0.14	0.06	0.06	-	-	-	-	-	-	0.11	0.11	0.14	0.14	0.06	0.06	-	-	-	-	-	-	0.11	0.11
160	0.74	0.72	0.21	0.20	-	-	-	-	-	-	0.52	0.50	0.77	0.74	0.21	0.20	-	-	-	-	-	-	0.55	0.53
150	2.22	2.09	0.95	0.91	-	-	-	-	0.06	0.06	1.75	1.67	2.39	2.25	0.99	0.95	-	-	-	-	0.07	0.07	1.86	1.76
140	4.66	4.35	2.54	2.40	-	-	-	-	0.31	0.30	4.02	3.75	5.22	4.85	2.71	2.56	-	-	-	-	0.31	0.30	4.46	4.17
130	7.95	7.36	5.16	4.81	-	-	-	-	1.22	1.16	7.20	6.68	9.68	8.94	6.00	5.57	-	-	-	-	1.29	1.23	9.02	8.34
120	12.72	11.69	8.95	8.28	-	-	-	-	2.94	2.78	12.05	11.06	17.08	15.55	11.97	10.96	-	-	-	-	3.22	3.02	16.37	14.90

Table H-153. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.09	0.08	-	-	-	-	-	-	-	-	0.06	0.06	0.09	0.08	-	-	-	-	-	-	-	-	0.06	0.06
180	0.44	0.43	0.11	0.11	-	-	-	-	-	-	0.32	0.31	0.46	0.44	0.11	0.11	-	-	-	-	-	-	0.33	0.32
170	1.59	1.52	0.59	0.56	-	-	-	-	0.04	0.04	1.20	1.16	1.68	1.61	0.64	0.62	-	-	-	-	0.03	0.03	1.29	1.23
160	3.66	3.41	1.82	1.73	-	-	-	-	0.18	0.17	2.92	2.76	4.00	3.74	1.91	1.82	-	-	-	-	0.17	0.17	3.18	2.99
150	6.48	6.02	4.08	3.79	-	-	-	-	0.80	0.76	5.82	5.40	7.72	7.15	4.54	4.21	-	-	-	-	0.85	0.82	6.94	6.44
140	10.44	9.59	7.28	6.74	-	-	-	-	2.23	2.08	9.74	9.01	14.23	13.05	9.34	8.63	-	-	-	-	2.39	2.25	13.62	12.47
130	15.93	14.58	12.28	11.29	0.08	0.08	0.02	0.02	4.66	4.34	15.39	14.09	24.50	22.05	17.50	16.00	0.09	0.08	0.02	0.02	5.36	4.97	23.70	21.33
120	22.88	20.60	18.00	16.45	0.43	0.41	0.11	0.10	8.24	7.63	22.15	19.91	39.43	34.74	30.77	27.33	0.44	0.43	0.12	0.12	11.34	10.32	38.47	33.90

Table H-154. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.04	0.04	-	-	-	-	-	-	-	-	-	-	0.04	0.04	-	-	-	-	-	-	-	-	-	-
180	0.16	0.15	0.06	0.06	-	-	-	-	-	-	0.11	0.11	0.15	0.15	0.06	0.06	-	-	-	-	-	-	0.11	0.11
170	0.81	0.77	0.24	0.23	-	-	-	-	-	-	0.58	0.55	0.86	0.82	0.25	0.24	-	-	-	-	-	-	0.63	0.60
160	2.29	2.16	0.98	0.93	-	-	-	-	0.07	0.07	1.79	1.71	2.45	2.31	1.03	0.99	-	-	-	-	0.07	0.07	1.88	1.80
150	4.72	4.38	2.58	2.44	-	-	-	-	0.33	0.32	4.06	3.78	5.26	4.88	2.75	2.60	-	-	-	-	0.37	0.34	4.50	4.19
140	7.96	7.37	5.20	4.83	-	-	-	-	1.27	1.22	7.23	6.70	9.76	9.02	6.12	5.67	-	-	-	-	1.35	1.28	9.16	8.47
130	12.75	11.74	9.00	8.34	0.02	0.02	-	-	2.98	2.81	12.12	11.14	17.55	16.03	12.44	11.40	0.02	0.02	-	-	3.30	3.09	16.92	15.46
120	18.24	16.66	14.45	13.26	0.17	0.16	0.04	0.04	5.90	5.47	17.72	16.20	29.84	26.59	21.98	19.78	0.17	0.16	0.03	0.03	7.24	6.69	29.06	25.96

Table H-155. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.09	0.08	-	-	-	-	-	-	-	-	0.06	0.06	0.09	0.08	-	-	-	-	-	-	-	-	0.06	0.06
170	0.44	0.43	0.11	0.11	-	-	-	-	-	-	0.32	0.31	0.46	0.44	0.11	0.11	-	-	-	-	-	-	0.33	0.32
160	1.59	1.52	0.59	0.56	-	-	-	-	0.04	0.04	1.20	1.16	1.68	1.61	0.64	0.62	-	-	-	-	0.03	0.03	1.29	1.23
150	3.66	3.41	1.82	1.73	-	-	-	-	0.18	0.17	2.92	2.76	4.00	3.74	1.91	1.82	-	-	-	-	0.17	0.17	3.18	2.99
140	6.48	6.03	4.08	3.79	-	-	-	-	0.80	0.76	5.82	5.40	7.72	7.15	4.54	4.21	-	-	-	-	0.85	0.82	6.94	6.44
130	10.44	9.59	7.28	6.74	-	-	-	-	2.23	2.08	9.74	9.01	14.23	13.05	9.34	8.63	-	-	-	-	2.39	2.25	13.62	12.47
120	15.93	14.58	12.28	11.29	0.08	0.08	0.02	0.02	4.66	4.34	15.39	14.09	24.50	22.05	17.50	16.00	0.09	0.08	0.02	0.02	5.36	4.97	23.70	21.33

Table H-156. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02
170	0.18	0.18	0.06	0.06	-	-	-	-	-	-	0.14	0.13	0.20	0.20	0.06	0.06	-	-	-	-	-	-	0.12	0.12
160	0.93	0.89	0.28	0.27	-	-	-	-	-	-	0.67	0.65	0.96	0.92	0.28	0.27	-	-	-	-	-	-	0.70	0.67
150	2.50	2.36	1.08	1.03	-	-	-	-	0.08	0.08	1.94	1.86	2.66	2.51	1.17	1.12	-	-	-	-	0.08	0.08	2.08	1.97
140	4.98	4.63	2.76	2.61	-	-	-	-	0.42	0.40	4.32	4.03	5.62	5.21	2.94	2.78	-	-	-	-	0.43	0.42	4.86	4.51
130	8.36	7.74	5.52	5.12	-	-	-	-	1.42	1.35	7.67	7.10	10.46	9.57	6.56	6.09	-	-	-	-	1.49	1.42	9.72	8.96
120	13.25	12.19	9.42	8.72	0.04	0.04	-	-	3.26	3.03	12.66	11.65	18.43	16.83	13.22	12.11	0.04	0.04	-	-	3.60	3.38	17.83	16.28

Table H-157. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
180	0.11	0.10	0.03	0.03	-	-	-	-	-	-	0.07	0.07	0.11	0.10	0.02	0.02	-	-	-	-	-	-	0.08	0.07
170	0.56	0.54	0.13	0.13	-	-	-	-	-	-	0.38	0.36	0.58	0.56	0.12	0.12	-	-	-	-	-	-	0.39	0.38
160	1.81	1.73	0.67	0.65	-	-	-	-	0.05	0.05	1.35	1.30	1.90	1.81	0.71	0.68	-	-	-	-	0.05	0.05	1.42	1.36
150	4.07	3.82	1.96	1.86	-	-	-	-	0.19	0.19	3.25	3.04	4.47	4.18	2.09	1.97	-	-	-	-	0.19	0.18	3.61	3.37
140	7.06	6.50	4.36	4.06	-	-	-	-	0.88	0.84	6.24	5.78	8.41	7.71	4.87	4.54	-	-	-	-	0.92	0.88	7.44	6.84
130	11.33	10.29	7.71	7.08	0.02	0.02	-	-	2.41	2.27	10.21	9.32	14.68	13.35	9.66	8.85	-	-	-	-	2.58	2.45	13.87	12.62
120	16.41	14.93	12.63	11.54	0.11	0.10	0.03	0.03	4.95	4.62	15.70	14.27	24.50	22.16	17.69	16.06	0.11	0.10	0.03	0.03	5.71	5.33	23.58	21.32

Table H-158. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.05	0.05	-	-	-	-	-	-	-	-	0.03	0.03	0.05	0.05	-	-	-	-	-	-	-	-	0.03	0.03
170	0.22	0.21	0.06	0.06	-	-	-	-	-	-	0.13	0.13	0.23	0.22	0.06	0.06	-	-	-	-	-	-	0.12	0.12
160	0.95	0.91	0.27	0.27	-	-	-	-	-	-	0.66	0.64	0.98	0.95	0.27	0.27	-	-	-	-	-	-	0.70	0.67
150	2.59	2.45	1.09	1.04	-	-	-	-	0.08	0.08	1.95	1.86	2.74	2.60	1.15	1.10	-	-	-	-	0.08	0.08	2.10	1.98
140	5.15	4.81	2.77	2.61	-	-	-	-	0.40	0.39	4.38	4.10	5.80	5.39	2.94	2.78	-	-	-	-	0.42	0.40	4.91	4.58
130	8.60	7.90	5.52	5.13	-	-	-	-	1.38	1.32	7.74	7.11	10.50	9.51	6.48	6.00	-	-	-	-	1.46	1.39	9.57	8.76
120	13.32	12.19	9.37	8.61	0.05	0.05	-	-	3.28	3.05	12.54	11.46	17.86	16.22	12.71	11.56	0.05	0.05	-	-	3.68	3.42	17.08	15.52

Table H-159. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
170	0.11	0.10	0.03	0.03	-	-	-	-	-	-	0.07	0.07	0.11	0.10	0.02	0.02	-	-	-	-	-	-	0.08	0.07
160	0.56	0.54	0.13	0.13	-	-	-	-	-	-	0.38	0.36	0.58	0.56	0.12	0.12	-	-	-	-	-	-	0.39	0.38
150	1.81	1.73	0.67	0.65	-	-	-	-	0.05	0.05	1.35	1.30	1.90	1.81	0.71	0.68	-	-	-	-	0.05	0.05	1.42	1.36
140	4.07	3.82	1.96	1.86	-	-	-	-	0.19	0.19	3.25	3.04	4.47	4.18	2.09	1.97	-	-	-	-	0.19	0.18	3.61	3.37
130	7.06	6.50	4.36	4.06	-	-	-	-	0.88	0.84	6.24	5.78	8.41	7.71	4.87	4.54	-	-	-	-	0.92	0.88	7.44	6.84
120	11.33	10.29	7.71	7.08	0.02	0.02	-	-	2.41	2.27	10.21	9.32	14.68	13.35	9.66	8.85	-	-	-	-	2.57	2.45	13.87	12.62

Table H-160. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.06	0.06	-	-	-	-	-	-	-	-	0.04	0.04	0.06	0.06	-	-	-	-	-	-	-	-	0.04	0.04
160	0.27	0.26	0.07	0.07	-	-	-	-	-	-	0.16	0.16	0.27	0.26	0.07	0.07	-	-	-	-	-	-	0.16	0.16
150	1.08	1.03	0.32	0.31	-	-	-	-	-	-	0.75	0.72	1.13	1.08	0.33	0.31	-	-	-	-	-	-	0.78	0.75
140	2.77	2.62	1.22	1.17	-	-	-	-	0.09	0.08	2.16	2.04	2.94	2.79	1.29	1.23	-	-	-	-	0.09	0.09	2.33	2.20
130	5.46	5.07	2.96	2.78	-	-	-	-	0.44	0.43	4.67	4.35	6.18	5.73	3.25	3.04	-	-	-	-	0.46	0.44	5.26	4.91
120	8.99	8.25	5.86	5.43	-	-	-	-	1.53	1.46	8.15	7.49	11.28	10.21	6.93	6.40	-	-	-	-	1.61	1.54	10.11	9.22

Table H-161. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.04	0.04	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
180	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.10	0.10	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.11	0.10
170	0.74	0.71	0.20	0.19	-	-	-	-	-	-	0.48	0.47	0.76	0.73	0.20	0.19	-	-	-	-	-	-	0.50	0.49
160	2.16	2.04	0.88	0.83	-	-	-	-	0.06	0.06	1.69	1.60	2.33	2.21	0.92	0.89	-	-	-	-	0.07	0.07	1.78	1.70
150	4.64	4.34	2.45	2.30	-	-	-	-	0.29	0.28	3.96	3.69	5.21	4.86	2.62	2.48	-	-	-	-	0.30	0.29	4.40	4.12
140	8.05	7.39	5.08	4.74	-	-	-	-	1.15	1.10	7.22	6.65	9.78	8.95	5.93	5.53	-	-	-	-	1.22	1.16	9.05	8.28
130	12.84	11.72	9.00	8.24	0.02	0.02	-	-	2.86	2.69	12.12	11.02	17.21	15.63	12.06	10.94	0.02	0.02	-	-	3.11	2.91	16.45	14.95
120	18.25	16.60	14.39	13.10	0.12	0.12	0.02	0.02	5.78	5.37	17.67	16.06	28.50	25.70	20.79	18.74	0.12	0.12	0.02	0.02	6.92	6.41	27.72	25.04

Table H-162. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05
170	0.31	0.30	0.08	0.08	-	-	-	-	-	-	0.19	0.19	0.31	0.30	0.09	0.08	-	-	-	-	-	-	0.19	0.19
160	1.20	1.15	0.41	0.40	-	-	-	-	-	-	0.86	0.82	1.26	1.21	0.43	0.41	-	-	-	-	-	-	0.91	0.87
150	2.96	2.80	1.39	1.33	-	-	-	-	0.11	0.10	2.43	2.30	3.28	3.07	1.47	1.41	-	-	-	-	0.11	0.11	2.62	2.47
140	5.85	5.44	3.34	3.12	-	-	-	-	0.50	0.48	5.09	4.76	6.77	6.27	3.73	3.50	-	-	-	-	0.54	0.52	5.94	5.53
130	9.63	8.82	6.45	5.98	-	-	-	-	1.72	1.63	8.96	8.20	12.68	11.53	7.98	7.33	-	-	-	-	1.82	1.74	11.84	10.72
120	14.87	13.54	11.03	9.96	0.06	0.06	-	-	3.96	3.70	14.22	12.95	20.87	18.81	15.15	13.78	0.06	0.06	-	-	4.43	4.14	19.91	18.13

Table H-163. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.04	0.04	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
170	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.10	0.10	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.11	0.10
160	0.74	0.71	0.20	0.19	-	-	-	-	-	-	0.48	0.47	0.76	0.73	0.20	0.19	-	-	-	-	-	-	0.50	0.49
150	2.16	2.04	0.88	0.83	-	-	-	-	0.06	0.06	1.69	1.60	2.33	2.21	0.92	0.89	-	-	-	-	0.07	0.07	1.78	1.70
140	4.64	4.34	2.45	2.30	-	-	-	-	0.29	0.28	3.96	3.69	5.21	4.86	2.62	2.48	-	-	-	-	0.30	0.29	4.40	4.12
130	8.05	7.38	5.08	4.74	-	-	-	-	1.15	1.10	7.22	6.65	9.78	8.95	5.93	5.53	-	-	-	-	1.22	1.16	9.05	8.28
120	12.84	11.72	9.00	8.24	0.02	0.02	-	-	2.86	2.69	12.12	11.02	17.21	15.63	12.06	10.94	0.02	0.02	-	-	3.11	2.91	16.45	14.95

Table H-164. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06
160	0.36	0.34	0.09	0.08	-	-	-	-	-	-	0.22	0.21	0.37	0.36	0.10	0.09	-	-	-	-	-	-	0.24	0.23
150	1.33	1.28	0.45	0.44	-	-	-	-	-	-	0.98	0.93	1.41	1.35	0.47	0.45	-	-	-	-	-	-	1.01	0.97
140	3.25	3.03	1.54	1.47	-	-	-	-	0.11	0.11	2.64	2.50	3.61	3.38	1.62	1.55	-	-	-	-	0.12	0.12	2.83	2.68
130	6.18	5.73	3.65	3.41	-	-	-	-	0.62	0.59	5.42	5.05	7.23	6.66	4.07	3.81	-	-	-	-	0.65	0.63	6.38	5.92
120	9.99	9.16	6.82	6.31	-	-	-	-	1.88	1.78	9.37	8.58	13.35	12.15	8.57	7.85	-	-	-	-	1.98	1.88	12.57	11.43

Table H-165. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02
180	0.18	0.18	0.06	0.06	-	-	-	-	-	-	0.12	0.11	0.20	0.19	0.06	0.06	-	-	-	-	-	-	0.12	0.12
170	0.89	0.86	0.26	0.26	-	-	-	-	-	-	0.64	0.62	0.94	0.90	0.27	0.26	-	-	-	-	-	-	0.66	0.64
160	2.49	2.36	1.02	0.97	-	-	-	-	0.08	0.08	1.92	1.82	2.66	2.52	1.08	1.03	-	-	-	-	0.08	0.08	2.04	1.92
150	5.08	4.75	2.75	2.60	-	-	-	-	0.40	0.38	4.37	4.10	5.79	5.39	2.94	2.78	-	-	-	-	0.41	0.40	4.95	4.64
140	8.68	7.96	5.57	5.21	-	-	-	-	1.36	1.30	7.91	7.27	10.94	9.89	6.68	6.21	-	-	-	-	1.43	1.37	9.92	9.09
130	13.59	12.43	9.63	8.84	0.03	0.03	-	-	3.27	3.04	12.91	11.82	18.67	16.98	13.34	12.16	0.03	0.03	-	-	3.64	3.41	17.99	16.35
120	19.10	17.43	15.22	13.90	0.17	0.17	0.03	0.03	6.35	5.90	18.55	16.92	30.94	27.86	23.52	21.27	0.17	0.17	0.04	0.04	7.96	7.33	30.21	27.22

Table H-166. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.08	0.07	-	-	-	-	-	-	-	-	0.06	0.06
170	0.40	0.39	0.10	0.10	-	-	-	-	-	-	0.26	0.25	0.41	0.40	0.10	0.10	-	-	-	-	-	-	0.26	0.26
160	1.41	1.35	0.47	0.45	-	-	-	-	0.02	0.02	0.99	0.95	1.49	1.43	0.48	0.47	-	-	-	-	0.02	0.02	1.05	1.00
150	3.41	3.20	1.63	1.55	-	-	-	-	0.14	0.13	2.74	2.59	3.78	3.55	1.73	1.64	-	-	-	-	0.12	0.12	2.93	2.77
140	6.35	5.90	3.82	3.57	-	-	-	-	0.67	0.65	5.59	5.22	7.53	6.92	4.26	3.98	-	-	-	-	0.69	0.67	6.66	6.18
130	10.33	9.40	7.02	6.50	-	-	-	-	1.97	1.86	9.59	8.80	13.80	12.58	8.96	8.20	-	-	-	-	2.10	1.99	13.04	11.88
120	15.68	14.32	11.97	10.91	0.07	0.07	-	-	4.40	4.13	15.03	13.74	23.23	21.01	16.70	15.19	0.07	0.07	-	-	5.01	4.69	22.35	20.14

Table H-167. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02
170	0.18	0.18	0.06	0.06	-	-	-	-	-	-	0.12	0.11	0.20	0.19	0.06	0.06	-	-	-	-	-	-	0.12	0.12
160	0.89	0.86	0.26	0.26	-	-	-	-	-	-	0.64	0.62	0.94	0.90	0.27	0.26	-	-	-	-	-	-	0.66	0.64
150	2.49	2.36	1.02	0.97	-	-	-	-	0.08	0.08	1.92	1.82	2.66	2.52	1.08	1.03	-	-	-	-	0.08	0.08	2.04	1.92
140	5.08	4.75	2.74	2.60	-	-	-	-	0.40	0.38	4.37	4.10	5.78	5.39	2.94	2.78	-	-	-	-	0.41	0.40	4.95	4.64
130	8.68	7.96	5.57	5.21	-	-	-	-	1.36	1.30	7.91	7.27	10.94	9.89	6.68	6.21	-	-	-	-	1.43	1.37	9.92	9.09
120	13.59	12.43	9.63	8.84	0.03	0.03	-	-	3.27	3.04	12.91	11.82	18.67	16.98	13.34	12.16	0.03	0.03	-	-	3.64	3.41	17.99	16.35

Table H-168. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.09	0.08	-	-	-	-	-	-	-	-	0.06	0.06	0.09	0.08	-	-	-	-	-	-	-	-	0.06	0.06
160	0.44	0.42	0.11	0.11	-	-	-	-	-	-	0.31	0.30	0.45	0.44	0.11	0.11	-	-	-	-	-	-	0.31	0.31
150	1.57	1.50	0.54	0.52	-	-	-	-	0.04	0.04	1.17	1.11	1.66	1.59	0.58	0.56	-	-	-	-	0.04	0.04	1.25	1.18
140	3.71	3.48	1.78	1.69	-	-	-	-	0.17	0.17	2.93	2.77	4.10	3.84	1.88	1.79	-	-	-	-	0.16	0.16	3.23	3.04
130	6.69	6.20	4.09	3.83	-	-	-	-	0.78	0.74	5.94	5.53	8.05	7.39	4.58	4.30	-	-	-	-	0.82	0.78	7.13	6.60
120	10.95	9.93	7.47	6.88	-	-	-	-	2.18	2.05	9.96	9.16	14.52	13.23	9.52	8.72	-	-	-	-	2.35	2.22	13.77	12.55

Table H-169. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05	0.06	0.06	-	-	-	-	-	-	-	-	0.04	0.04
180	0.28	0.28	0.07	0.07	-	-	-	-	-	-	0.18	0.17	0.29	0.28	0.08	0.07	-	-	-	-	-	-	0.18	0.17
170	1.09	1.05	0.34	0.33	-	-	-	-	-	-	0.78	0.75	1.16	1.11	0.35	0.34	-	-	-	-	-	-	0.82	0.79
160	2.78	2.63	1.29	1.24	-	-	-	-	0.10	0.10	2.27	2.13	2.94	2.79	1.36	1.31	-	-	-	-	0.10	0.10	2.43	2.30
150	5.46	5.10	3.11	2.91	-	-	-	-	0.48	0.46	4.77	4.47	6.28	5.83	3.47	3.24	-	-	-	-	0.50	0.48	5.45	5.09
140	9.20	8.41	6.11	5.67	-	-	-	-	1.61	1.54	8.51	7.79	12.02	10.86	7.42	6.81	-	-	-	-	1.71	1.64	11.11	9.97
130	14.34	13.06	10.43	9.42	0.06	0.06	-	-	3.76	3.52	13.73	12.50	19.95	18.10	14.58	13.19	0.06	0.06	-	-	4.16	3.90	19.40	17.56
120	19.93	18.18	16.19	14.71	0.26	0.26	0.07	0.07	6.91	6.37	19.47	17.73	32.95	29.64	25.48	23.06	0.29	0.28	0.09	0.08	8.80	8.03	32.25	28.97

Table H-170. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.10	0.10	-	-	-	-	-	-	-	-	0.07	0.07	0.10	0.10	-	-	-	-	-	-	-	-	0.07	0.07
170	0.49	0.48	0.12	0.11	-	-	-	-	-	-	0.34	0.32	0.52	0.50	0.12	0.12	-	-	-	-	-	-	0.34	0.33
160	1.66	1.58	0.62	0.60	-	-	-	-	0.05	0.05	1.26	1.22	1.76	1.68	0.67	0.64	-	-	-	-	0.05	0.05	1.33	1.28
150	3.82	3.58	1.90	1.80	-	-	-	-	0.19	0.19	3.06	2.87	4.19	3.92	1.98	1.89	-	-	-	-	0.19	0.18	3.41	3.19
140	6.78	6.27	4.23	3.97	-	-	-	-	0.83	0.79	6.08	5.64	8.21	7.51	4.72	4.43	-	-	-	-	0.88	0.84	7.33	6.73
130	11.19	10.10	7.69	7.05	-	-	-	-	2.35	2.20	10.27	9.31	14.89	13.50	9.78	8.92	-	-	-	-	2.52	2.38	14.20	12.84
120	16.52	15.03	12.84	11.69	0.10	0.10	0.03	0.03	4.84	4.54	15.93	14.49	25.19	22.80	18.21	16.44	0.10	0.10	0.03	0.03	5.57	5.20	24.49	22.08

Table H-171. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	-	-	-	-	-	-	-	-	0.05	0.05	0.06	0.06	-	-	-	-	-	-	-	-	0.04	0.04
170	0.28	0.28	0.07	0.07	-	-	-	-	-	-	0.18	0.17	0.29	0.28	0.08	0.07	-	-	-	-	-	-	0.18	0.17
160	1.09	1.05	0.34	0.33	-	-	-	-	-	-	0.78	0.75	1.16	1.11	0.35	0.34	-	-	-	-	-	-	0.82	0.79
150	2.78	2.63	1.29	1.24	-	-	-	-	0.10	0.10	2.27	2.13	2.94	2.79	1.36	1.31	-	-	-	-	0.10	0.10	2.43	2.30
140	5.46	5.10	3.11	2.91	-	-	-	-	0.48	0.46	4.77	4.47	6.28	5.83	3.47	3.24	-	-	-	-	0.50	0.48	5.45	5.09
130	9.20	8.41	6.11	5.67	-	-	-	-	1.61	1.54	8.51	7.79	12.02	10.86	7.42	6.81	-	-	-	-	1.71	1.64	11.11	9.97
120	14.34	13.05	10.43	9.42	0.06	0.06	-	-	3.76	3.52	13.73	12.50	19.95	18.10	14.58	13.18	0.06	0.06	-	-	4.16	3.90	19.40	17.56

Table H-172. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
170	0.11	0.11	0.03	0.03	-	-	-	-	-	-	0.08	0.08	0.11	0.11	0.03	0.03	-	-	-	-	-	-	0.09	0.08
160	0.57	0.55	0.16	0.16	-	-	-	-	-	-	0.41	0.40	0.59	0.57	0.15	0.15	-	-	-	-	-	-	0.44	0.42
150	1.83	1.74	0.74	0.71	-	-	-	-	0.06	0.06	1.40	1.35	1.92	1.83	0.75	0.73	-	-	-	-	0.06	0.06	1.50	1.43
140	4.09	3.82	2.06	1.95	-	-	-	-	0.21	0.21	3.35	3.14	4.48	4.20	2.23	2.12	-	-	-	-	0.23	0.22	3.73	3.49
130	7.15	6.58	4.51	4.22	-	-	-	-	0.94	0.90	6.43	5.96	8.74	7.98	5.09	4.76	-	-	-	-	0.99	0.94	7.91	7.24
120	11.78	10.67	8.14	7.45	-	-	-	-	2.54	2.39	10.93	9.85	15.69	14.21	10.52	9.46	-	-	-	-	2.72	2.56	14.98	13.57

Table H-173. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
180	0.12	0.12	0.03	0.03	-	-	-	-	-	-	0.09	0.08	0.12	0.12	0.03	0.03	-	-	-	-	-	-	0.09	0.09
170	0.65	0.63	0.16	0.15	-	-	-	-	-	-	0.41	0.40	0.67	0.65	0.14	0.13	-	-	-	-	-	-	0.43	0.42
160	2.06	1.95	0.75	0.72	-	-	-	-	0.06	0.06	1.52	1.46	2.19	2.09	0.80	0.76	-	-	-	-	0.06	0.06	1.60	1.53
150	4.58	4.30	2.21	2.10	-	-	-	-	0.22	0.21	3.66	3.44	5.02	4.69	2.38	2.26	-	-	-	-	0.21	0.20	3.98	3.75
140	8.00	7.38	4.78	4.47	-	-	-	-	0.96	0.92	6.84	6.35	9.52	8.74	5.36	4.98	-	-	-	-	1.00	0.96	8.42	7.72
130	12.95	11.84	8.60	7.89	-	-	-	-	2.66	2.53	11.86	10.78	17.51	15.63	11.27	10.19	-	-	-	-	2.83	2.68	16.52	14.74
120	18.81	16.98	14.35	13.00	0.11	0.10	-	-	5.43	5.05	18.06	16.25	29.72	26.54	21.27	18.75	0.11	0.11	-	-	6.26	5.77	28.83	25.76

Table H-174. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	-	-	-	-	-	-	-	-	0.03	0.03	0.06	0.06	-	-	-	-	-	-	-	-	0.03	0.03
170	0.28	0.27	0.07	0.07	-	-	-	-	-	-	0.16	0.15	0.28	0.27	0.07	0.07	-	-	-	-	-	-	0.14	0.14
160	1.10	1.05	0.31	0.30	-	-	-	-	-	-	0.75	0.72	1.15	1.11	0.32	0.31	-	-	-	-	-	-	0.79	0.76
150	2.90	2.75	1.24	1.19	-	-	-	-	0.09	0.09	2.22	2.10	3.08	2.90	1.30	1.25	-	-	-	-	0.10	0.09	2.38	2.25
140	5.81	5.40	3.04	2.87	-	-	-	-	0.43	0.42	4.79	4.50	6.56	6.06	3.32	3.13	-	-	-	-	0.45	0.43	5.40	5.02
130	9.62	8.86	6.09	5.65	-	-	-	-	1.54	1.48	8.62	7.92	12.46	11.30	7.24	6.63	-	-	-	-	1.62	1.56	11.12	10.06
120	15.19	13.76	10.55	9.56	0.03	0.03	-	-	3.67	3.45	14.21	12.90	21.66	19.11	14.89	13.37	0.03	0.03	-	-	3.99	3.76	20.42	18.18

Table H-175. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
170	0.12	0.12	0.03	0.03	-	-	-	-	-	-	0.09	0.08	0.12	0.12	0.03	0.03	-	-	-	-	-	-	0.09	0.09
160	0.65	0.63	0.16	0.15	-	-	-	-	-	-	0.41	0.40	0.67	0.65	0.14	0.13	-	-	-	-	-	-	0.43	0.42
150	2.06	1.95	0.75	0.72	-	-	-	-	0.06	0.06	1.52	1.46	2.19	2.09	0.80	0.76	-	-	-	-	0.06	0.06	1.60	1.53
140	4.58	4.30	2.21	2.10	-	-	-	-	0.22	0.21	3.66	3.44	5.02	4.69	2.38	2.26	-	-	-	-	0.21	0.20	3.98	3.75
130	8.00	7.38	4.78	4.47	-	-	-	-	0.96	0.92	6.84	6.35	9.52	8.74	5.36	4.98	-	-	-	-	1.00	0.96	8.42	7.72
120	12.95	11.84	8.60	7.89	-	-	-	-	2.66	2.53	11.86	10.78	17.51	15.63	11.27	10.19	-	-	-	-	2.83	2.68	16.52	14.74

Table H-176. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.07	0.06	-	-	-	-	-	-	-	-	0.05	0.05	0.07	0.06	-	-	-	-	-	-	-	-	0.04	0.04
160	0.31	0.30	0.08	0.08	-	-	-	-	-	-	0.18	0.18	0.32	0.31	0.08	0.08	-	-	-	-	-	-	0.18	0.17
150	1.27	1.21	0.35	0.34	-	-	-	-	-	-	0.87	0.84	1.32	1.26	0.37	0.35	-	-	-	-	-	-	0.91	0.87
140	3.15	2.96	1.36	1.31	-	-	-	-	0.11	0.10	2.44	2.32	3.42	3.22	1.44	1.38	-	-	-	-	0.11	0.11	2.58	2.46
130	6.14	5.70	3.34	3.14	-	-	-	-	0.51	0.49	5.12	4.78	6.97	6.44	3.66	3.44	-	-	-	-	0.54	0.52	5.83	5.39
120	9.99	9.20	6.45	5.98	-	-	-	-	1.70	1.62	9.07	8.32	13.21	11.97	7.82	7.17	-	-	-	-	1.79	1.72	12.02	10.88

Table H-177. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.04	0.04	-	-	-	-	-	-	-	-	-	-	0.04	0.04	-	-	-	-	-	-	-	-	-	-
180	0.15	0.15	0.06	0.06	-	-	-	-	-	-	0.11	0.11	0.14	0.14	0.06	0.06	-	-	-	-	-	-	0.12	0.11
170	0.75	0.72	0.22	0.21	-	-	-	-	-	-	0.52	0.50	0.78	0.75	0.21	0.21	-	-	-	-	-	-	0.55	0.53
160	2.32	2.20	0.93	0.90	-	-	-	-	0.08	0.07	1.80	1.73	2.48	2.36	0.97	0.94	-	-	-	-	0.08	0.07	1.90	1.81
150	5.03	4.70	2.64	2.51	-	-	-	-	0.32	0.31	4.27	4.01	5.67	5.26	2.80	2.66	-	-	-	-	0.33	0.32	4.71	4.40
140	8.86	8.15	5.50	5.12	-	-	-	-	1.23	1.18	7.88	7.25	10.97	9.93	6.32	5.82	-	-	-	-	1.30	1.25	9.66	8.86
130	14.24	12.93	9.58	8.81	-	-	-	-	3.10	2.91	13.24	12.04	19.18	17.17	12.98	11.74	-	-	-	-	3.40	3.21	18.24	16.27
120	20.08	18.15	15.63	14.11	0.12	0.12	-	-	6.22	5.76	19.27	17.41	31.89	28.53	23.60	20.92	0.13	0.12	-	-	7.35	6.72	30.86	27.59

Table H-178. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06
170	0.33	0.32	0.09	0.09	-	-	-	-	-	-	0.21	0.21	0.33	0.32	0.09	0.09	-	-	-	-	-	-	0.21	0.20
160	1.25	1.20	0.39	0.38	-	-	-	-	-	-	0.92	0.88	1.32	1.26	0.41	0.40	-	-	-	-	-	-	0.96	0.92
150	3.23	3.03	1.49	1.43	-	-	-	-	0.12	0.11	2.64	2.50	3.55	3.34	1.58	1.51	-	-	-	-	0.12	0.12	2.79	2.65
140	6.41	5.93	3.68	3.46	-	-	-	-	0.56	0.54	5.54	5.15	7.47	6.85	4.03	3.79	-	-	-	-	0.59	0.57	6.39	5.88
130	10.79	9.78	6.93	6.41	-	-	-	-	1.85	1.77	9.64	8.87	14.07	12.70	8.46	7.76	-	-	-	-	1.95	1.86	12.91	11.67
120	16.60	14.96	12.01	10.93	0.07	0.06	-	-	4.30	4.03	15.58	14.09	24.05	21.43	16.64	14.83	0.07	0.06	-	-	4.72	4.41	22.84	20.19

Table H-179. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.04	0.04	-	-	-	-	-	-	-	-	-	-	0.04	0.04	-	-	-	-	-	-	-	-	-	-
170	0.15	0.15	0.06	0.06	-	-	-	-	-	-	0.11	0.11	0.14	0.14	0.06	0.06	-	-	-	-	-	-	0.12	0.11
160	0.75	0.72	0.22	0.21	-	-	-	-	-	-	0.52	0.50	0.78	0.75	0.21	0.21	-	-	-	-	-	-	0.55	0.53
150	2.32	2.20	0.93	0.90	-	-	-	-	0.08	0.07	1.80	1.73	2.48	2.36	0.97	0.94	-	-	-	-	0.08	0.07	1.90	1.81
140	5.03	4.70	2.64	2.51	-	-	-	-	0.32	0.31	4.27	4.01	5.67	5.26	2.80	2.66	-	-	-	-	0.33	0.32	4.71	4.40
130	8.86	8.15	5.50	5.12	-	-	-	-	1.23	1.18	7.88	7.25	10.97	9.93	6.32	5.82	-	-	-	-	1.30	1.25	9.66	8.86
120	14.24	12.93	9.58	8.81	-	-	-	-	3.10	2.91	13.24	12.04	19.18	17.17	12.98	11.74	-	-	-	-	3.40	3.21	18.24	16.27

Table H-180. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.08	0.08	-	-	-	-	-	-	-	-	0.07	0.06	0.08	0.08	-	-	-	-	-	-	-	-	0.07	0.06
160	0.37	0.36	0.10	0.10	-	-	-	-	-	-	0.23	0.23	0.37	0.36	0.11	0.10	-	-	-	-	-	-	0.23	0.23
150	1.41	1.34	0.47	0.46	-	-	-	-	0.02	0.02	1.02	0.98	1.47	1.41	0.49	0.47	-	-	-	-	0.02	0.02	1.10	1.05
140	3.55	3.33	1.65	1.58	-	-	-	-	0.12	0.12	2.83	2.69	3.88	3.65	1.76	1.67	-	-	-	-	0.13	0.12	3.01	2.85
130	6.76	6.26	3.97	3.74	-	-	-	-	0.64	0.61	5.90	5.46	7.99	7.34	4.34	4.07	-	-	-	-	0.68	0.66	6.84	6.31
120	11.41	10.39	7.35	6.77	-	-	-	-	1.99	1.91	10.08	9.24	14.88	13.39	9.06	8.31	-	-	-	-	2.19	2.07	13.72	12.37

Table H-181. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	-	-	-	-	-	-	-	-	0.02	0.02	0.06	0.06	-	-	-	-	-	-	-	-	0.02	0.02
180	0.21	0.20	0.07	0.07	-	-	-	-	-	-	0.15	0.15	0.21	0.20	0.07	0.07	-	-	-	-	-	-	0.13	0.13
170	0.96	0.92	0.31	0.30	-	-	-	-	-	-	0.71	0.68	1.00	0.95	0.31	0.30	-	-	-	-	-	-	0.74	0.71
160	2.72	2.58	1.20	1.15	-	-	-	-	0.09	0.09	2.20	2.08	2.88	2.73	1.27	1.22	-	-	-	-	0.10	0.09	2.34	2.22
150	5.66	5.26	3.06	2.88	-	-	-	-	0.40	0.39	4.85	4.54	6.48	5.97	3.34	3.15	-	-	-	-	0.43	0.42	5.46	5.06
140	9.64	8.87	6.18	5.72	-	-	-	-	1.54	1.47	8.74	8.04	12.56	11.36	7.30	6.66	-	-	-	-	1.62	1.55	11.23	10.12
130	15.36	13.88	10.63	9.65	0.03	0.03	-	-	3.71	3.49	14.37	13.01	21.52	18.95	14.79	13.26	0.03	0.03	-	-	4.04	3.81	20.10	17.98
120	22.06	19.63	16.93	15.21	0.20	0.19	0.03	0.03	6.93	6.40	20.76	18.54	35.46	31.79	26.54	23.72	0.19	0.19	0.03	0.03	8.50	7.78	34.51	30.87

Table H-182. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.07	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.07
170	0.40	0.38	0.11	0.11	-	-	-	-	-	-	0.31	0.30	0.42	0.40	0.12	0.11	-	-	-	-	-	-	0.31	0.30
160	1.53	1.47	0.54	0.52	-	-	-	-	0.02	0.02	1.18	1.13	1.62	1.55	0.57	0.55	-	-	-	-	0.02	0.02	1.24	1.19
150	3.80	3.58	1.82	1.75	-	-	-	-	0.17	0.17	3.04	2.87	4.14	3.90	1.93	1.83	-	-	-	-	0.15	0.15	3.34	3.14
140	7.10	6.55	4.26	3.99	-	-	-	-	0.74	0.72	6.22	5.76	8.47	7.78	4.67	4.36	-	-	-	-	0.77	0.74	7.35	6.72
130	11.99	10.90	7.78	7.15	-	-	-	-	2.26	2.14	10.70	9.71	15.74	14.09	9.62	8.82	-	-	-	-	2.42	2.29	14.59	13.10
120	17.79	16.00	13.21	11.98	0.08	0.08	-	-	4.88	4.55	16.84	15.15	26.70	23.88	18.70	16.66	0.09	0.08	-	-	5.46	5.06	25.70	22.96

Table H-183. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	-	-	-	-	-	-	-	-	0.02	0.02	0.06	0.06	-	-	-	-	-	-	-	-	0.02	0.02
170	0.21	0.20	0.07	0.07	-	-	-	-	-	-	0.15	0.15	0.21	0.20	0.07	0.07	-	-	-	-	-	-	0.13	0.13
160	0.96	0.92	0.31	0.30	-	-	-	-	-	-	0.71	0.68	1.00	0.95	0.31	0.30	-	-	-	-	-	-	0.74	0.71
150	2.72	2.58	1.20	1.15	-	-	-	-	0.09	0.09	2.20	2.08	2.88	2.73	1.27	1.22	-	-	-	-	0.10	0.09	2.34	2.22
140	5.66	5.26	3.06	2.88	-	-	-	-	0.40	0.39	4.85	4.54	6.48	5.97	3.34	3.15	-	-	-	-	0.43	0.42	5.46	5.06
130	9.64	8.87	6.18	5.72	-	-	-	-	1.54	1.47	8.74	8.04	12.56	11.36	7.30	6.66	-	-	-	-	1.62	1.55	11.23	10.12
120	15.36	13.88	10.63	9.64	0.03	0.03	-	-	3.71	3.49	14.37	13.01	21.52	18.95	14.79	13.26	0.03	0.03	-	-	4.04	3.81	20.10	17.98

Table H-184. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.11	0.10	0.02	0.02	-	-	-	-	-	-	0.08	0.07	0.11	0.11	0.02	0.02	-	-	-	-	-	-	0.08	0.08
160	0.46	0.45	0.12	0.12	-	-	-	-	-	-	0.34	0.33	0.48	0.47	0.12	0.12	-	-	-	-	-	-	0.34	0.34
150	1.70	1.62	0.63	0.60	-	-	-	-	0.05	0.05	1.32	1.27	1.79	1.72	0.67	0.64	-	-	-	-	0.04	0.04	1.39	1.33
140	4.10	3.85	1.97	1.89	-	-	-	-	0.20	0.19	3.36	3.16	4.48	4.20	2.12	2.02	-	-	-	-	0.19	0.19	3.68	3.46
130	7.52	6.93	4.54	4.25	-	-	-	-	0.85	0.81	6.59	6.10	9.01	8.28	5.03	4.68	-	-	-	-	0.89	0.86	7.92	7.25
120	12.57	11.44	8.22	7.57	-	-	-	-	2.47	2.35	11.40	10.34	16.64	14.84	10.32	9.37	-	-	-	-	2.63	2.50	15.48	13.86

Table H-185. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.08	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.08	0.07	-	-	-	-	-	-	-	-	0.06	0.06
180	0.35	0.34	0.10	0.10	-	-	-	-	-	-	0.23	0.23	0.35	0.34	0.11	0.10	-	-	-	-	-	-	0.23	0.22
170	1.43	1.37	0.50	0.48	-	-	-	-	0.02	0.02	1.04	0.99	1.50	1.44	0.52	0.50	-	-	-	-	0.02	0.02	1.12	1.08
160	3.58	3.37	1.70	1.63	-	-	-	-	0.13	0.12	2.84	2.70	3.90	3.67	1.79	1.72	-	-	-	-	0.13	0.13	3.00	2.85
150	6.70	6.21	3.99	3.75	-	-	-	-	0.68	0.64	5.78	5.38	7.79	7.17	4.35	4.08	-	-	-	-	0.75	0.72	6.62	6.11
140	11.19	10.18	7.28	6.72	0.02	0.02	-	-	2.08	1.98	9.90	9.11	14.44	13.09	8.88	8.12	0.02	0.02	-	-	2.26	2.15	13.30	12.10
130	16.98	15.37	12.59	11.49	0.09	0.09	0.04	0.04	4.62	4.33	16.09	14.60	25.22	22.56	17.48	15.71	0.10	0.10	0.04	0.04	5.15	4.78	23.98	21.50
120	24.92	22.36	18.99	17.21	0.46	0.44	0.15	0.14	8.29	7.64	23.98	21.55	43.02	38.00	31.61	28.25	0.54	0.52	0.16	0.15	10.70	9.64	41.16	36.59

Table H-186. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
180	0.12	0.12	0.04	0.04	-	-	-	-	-	-	0.10	0.09	0.13	0.12	0.03	0.03	-	-	-	-	-	-	0.10	0.09
170	0.65	0.62	0.19	0.19	-	-	-	-	-	-	0.49	0.47	0.69	0.66	0.17	0.17	-	-	-	-	-	-	0.50	0.48
160	2.12	2.02	0.85	0.82	-	-	-	-	0.07	0.06	1.65	1.58	2.26	2.16	0.89	0.85	-	-	-	-	0.07	0.06	1.75	1.67
150	4.74	4.44	2.48	2.36	-	-	-	-	0.28	0.26	3.96	3.72	5.23	4.87	2.64	2.51	-	-	-	-	0.29	0.27	4.31	4.04
140	8.31	7.67	5.18	4.81	-	-	-	-	1.15	1.10	7.24	6.70	9.85	9.05	5.78	5.35	-	-	-	-	1.23	1.18	8.83	8.08
130	13.43	12.28	9.09	8.36	0.03	0.03	0.02	0.02	2.92	2.78	12.46	11.38	17.99	16.16	11.91	10.77	0.03	0.03	0.02	0.02	3.20	3.00	16.97	15.24
120	19.37	17.58	15.00	13.65	0.16	0.16	0.06	0.06	5.91	5.47	18.68	16.93	30.69	27.38	22.17	19.84	0.17	0.16	0.06	0.06	6.79	6.26	29.63	26.44

Table H-187. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.08	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.08	0.07	-	-	-	-	-	-	-	-	0.06	0.06
170	0.35	0.34	0.10	0.10	-	-	-	-	-	-	0.23	0.23	0.35	0.34	0.11	0.10	-	-	-	-	-	-	0.23	0.22
160	1.43	1.37	0.50	0.48	-	-	-	-	0.02	0.02	1.04	0.99	1.50	1.44	0.52	0.50	-	-	-	-	0.02	0.02	1.12	1.08
150	3.58	3.37	1.70	1.63	-	-	-	-	0.13	0.12	2.84	2.70	3.90	3.67	1.79	1.72	-	-	-	-	0.13	0.13	3.00	2.85
140	6.70	6.21	3.99	3.75	-	-	-	-	0.68	0.64	5.78	5.38	7.79	7.17	4.36	4.08	-	-	-	-	0.75	0.72	6.62	6.11
130	11.19	10.18	7.28	6.72	0.02	0.02	-	-	2.08	1.98	9.90	9.11	14.44	13.09	8.88	8.12	0.02	0.02	-	-	2.26	2.15	13.30	12.10
120	16.98	15.37	12.59	11.49	0.09	0.09	0.04	0.04	4.62	4.33	16.09	14.60	25.22	22.56	17.48	15.71	0.10	0.10	0.04	0.04	5.15	4.78	23.98	21.50

Table H-188. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
170	0.13	0.13	0.06	0.06	-	-	-	-	-	-	0.11	0.11	0.14	0.13	0.05	0.05	-	-	-	-	-	-	0.11	0.11
160	0.79	0.76	0.22	0.21	-	-	-	-	-	-	0.54	0.52	0.82	0.78	0.21	0.20	-	-	-	-	-	-	0.56	0.54
150	2.37	2.25	0.93	0.89	-	-	-	-	0.07	0.07	1.82	1.74	2.51	2.39	0.99	0.94	-	-	-	-	0.08	0.07	1.92	1.83
140	5.05	4.71	2.67	2.54	-	-	-	-	0.33	0.32	4.24	3.98	5.61	5.21	2.84	2.70	-	-	-	-	0.33	0.32	4.64	4.33
130	8.73	8.05	5.49	5.10	-	-	-	-	1.29	1.24	7.69	7.10	10.59	9.59	6.19	5.72	-	-	-	-	1.35	1.30	9.40	8.60
120	13.97	12.76	9.53	8.76	0.04	0.04	0.02	0.02	3.17	2.98	13.02	11.91	18.85	16.97	12.75	11.57	0.04	0.04	0.02	0.02	3.52	3.30	17.92	16.10

Table H-189. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
180	0.12	0.12	0.02	0.02	-	-	-	-	-	-	0.09	0.09	0.13	0.12	0.02	0.02	-	-	-	-	-	-	0.09	0.09
170	0.65	0.62	0.13	0.13	-	-	-	-	-	-	0.41	0.40	0.68	0.65	0.14	0.14	-	-	-	-	-	-	0.42	0.40
160	2.11	1.99	0.72	0.69	-	-	-	-	0.06	0.06	1.56	1.48	2.24	2.12	0.75	0.72	-	-	-	-	0.06	0.06	1.63	1.56
150	4.72	4.43	2.29	2.16	-	-	-	-	0.23	0.22	3.81	3.58	5.16	4.82	2.45	2.33	-	-	-	-	0.23	0.22	4.11	3.87
140	8.39	7.77	4.98	4.67	-	-	-	-	0.99	0.95	7.19	6.69	9.81	9.08	5.50	5.16	-	-	-	-	1.04	0.99	8.64	8.03
130	13.72	12.47	9.01	8.36	-	-	-	-	2.75	2.61	12.66	11.52	18.14	16.15	11.58	10.57	-	-	-	-	2.91	2.76	16.86	15.15
120	20.11	17.82	15.16	13.72	0.11	0.11	-	-	5.69	5.31	19.29	17.12	30.44	27.03	21.85	19.03	0.11	0.11	-	-	6.40	5.99	29.34	26.07

Table H-190. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	-	-	-	-	-	-	-	-	0.02	0.02	0.06	0.06	-	-	-	-	-	-	-	-	0.02	0.02
170	0.23	0.22	0.08	0.07	-	-	-	-	-	-	0.13	0.13	0.26	0.24	0.07	0.07	-	-	-	-	-	-	0.14	0.13
160	1.11	1.05	0.31	0.30	-	-	-	-	-	-	0.72	0.68	1.16	1.11	0.32	0.31	-	-	-	-	-	-	0.74	0.72
150	2.96	2.80	1.26	1.20	-	-	-	-	0.09	0.09	2.28	2.16	3.18	2.98	1.33	1.27	-	-	-	-	0.10	0.10	2.44	2.31
140	6.02	5.61	3.19	2.99	-	-	-	-	0.42	0.41	5.00	4.68	6.74	6.29	3.49	3.27	-	-	-	-	0.43	0.42	5.56	5.20
130	10.07	9.27	6.37	5.94	-	-	-	-	1.60	1.53	9.04	8.38	12.95	11.79	7.39	6.88	-	-	-	-	1.68	1.60	11.55	10.53
120	16.12	14.51	11.34	10.33	0.02	0.02	-	-	3.84	3.61	15.05	13.64	22.77	19.79	15.02	13.67	0.02	0.02	-	-	4.16	3.92	21.30	18.60

Table H-191. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
170	0.12	0.12	0.02	0.02	-	-	-	-	-	-	0.09	0.09	0.13	0.12	0.02	0.02	-	-	-	-	-	-	0.09	0.09
160	0.65	0.62	0.13	0.13	-	-	-	-	-	-	0.41	0.40	0.68	0.65	0.14	0.14	-	-	-	-	-	-	0.42	0.40
150	2.11	1.99	0.72	0.69	-	-	-	-	0.06	0.06	1.56	1.48	2.24	2.12	0.75	0.72	-	-	-	-	0.06	0.06	1.63	1.56
140	4.72	4.43	2.29	2.16	-	-	-	-	0.23	0.22	3.81	3.58	5.16	4.82	2.45	2.33	-	-	-	-	0.23	0.22	4.11	3.87
130	8.39	7.77	4.98	4.67	-	-	-	-	0.99	0.95	7.19	6.69	9.81	9.08	5.50	5.16	-	-	-	-	1.04	0.99	8.64	8.03
120	13.72	12.47	9.01	8.36	-	-	-	-	2.75	2.61	12.66	11.52	18.14	16.15	11.58	10.57	-	-	-	-	2.91	2.76	16.86	15.15

Table H-192. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.07	0.06	-	-	-	-	-	-	-	-	0.04	0.04	0.07	0.06	-	-	-	-	-	-	-	-	0.04	0.04
160	0.32	0.30	0.08	0.08	-	-	-	-	-	-	0.19	0.18	0.32	0.31	0.09	0.08	-	-	-	-	-	-	0.17	0.17
150	1.27	1.21	0.37	0.35	-	-	-	-	-	-	0.89	0.84	1.33	1.27	0.38	0.36	-	-	-	-	-	-	0.92	0.88
140	3.26	3.05	1.41	1.34	-	-	-	-	0.11	0.11	2.51	2.38	3.52	3.30	1.47	1.40	-	-	-	-	0.11	0.11	2.66	2.52
130	6.36	5.94	3.51	3.28	-	-	-	-	0.49	0.47	5.34	4.99	7.20	6.70	3.80	3.57	-	-	-	-	0.52	0.50	5.98	5.59
120	10.78	9.77	6.74	6.29	-	-	-	-	1.75	1.67	9.49	8.79	13.70	12.44	7.99	7.43	-	-	-	-	1.84	1.76	12.43	11.32

Table H-193. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.04	0.04	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
180	0.14	0.14	0.06	0.06	-	-	-	-	-	-	0.11	0.11	0.14	0.14	0.06	0.06	-	-	-	-	-	-	0.12	0.12
170	0.77	0.74	0.23	0.22	-	-	-	-	-	-	0.54	0.52	0.80	0.76	0.22	0.22	-	-	-	-	-	-	0.58	0.56
160	2.47	2.34	1.00	0.96	-	-	-	-	0.08	0.08	1.90	1.81	2.62	2.49	1.06	1.01	-	-	-	-	0.08	0.08	1.98	1.89
150	5.32	4.97	2.77	2.63	-	-	-	-	0.33	0.32	4.46	4.19	5.92	5.54	2.92	2.77	-	-	-	-	0.34	0.32	4.88	4.58
140	9.31	8.61	5.74	5.36	-	-	-	-	1.30	1.24	8.24	7.65	11.60	10.54	6.46	6.05	-	-	-	-	1.37	1.31	9.91	9.18
130	14.94	13.57	9.97	9.23	-	-	-	-	3.31	3.10	13.90	12.63	19.93	17.74	13.35	12.16	-	-	-	-	3.58	3.37	18.86	16.81
120	22.21	19.21	16.52	14.85	0.13	0.13	0.02	0.02	6.47	6.04	20.79	18.22	33.14	29.68	24.55	21.65	0.13	0.13	-	-	7.53	7.00	32.02	28.59

Table H-194. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.08	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.08	0.07	-	-	-	-	-	-	-	-	0.05	0.05
170	0.35	0.33	0.09	0.09	-	-	-	-	-	-	0.23	0.22	0.35	0.34	0.10	0.09	-	-	-	-	-	-	0.22	0.21
160	1.34	1.27	0.42	0.40	-	-	-	-	-	-	0.99	0.95	1.41	1.34	0.44	0.42	-	-	-	-	-	-	1.03	0.98
150	3.48	3.26	1.59	1.51	-	-	-	-	0.12	0.12	2.76	2.62	3.77	3.54	1.67	1.59	-	-	-	-	0.12	0.12	2.91	2.76
140	6.72	6.27	3.87	3.64	-	-	-	-	0.58	0.56	5.78	5.40	7.81	7.25	4.18	3.94	-	-	-	-	0.63	0.60	6.54	6.13
130	11.58	10.51	7.26	6.74	-	-	-	-	1.95	1.85	10.05	9.27	14.55	13.22	8.71	8.08	-	-	-	-	2.04	1.94	13.32	12.12
120	17.60	15.69	12.73	11.58	0.07	0.07	-	-	4.47	4.20	16.45	14.79	25.25	22.26	17.02	15.32	0.07	0.06	-	-	4.88	4.58	23.97	21.05

Table H-195. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.04	0.04	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
170	0.14	0.14	0.06	0.06	-	-	-	-	-	-	0.11	0.11	0.14	0.14	0.06	0.06	-	-	-	-	-	-	0.12	0.12
160	0.77	0.74	0.23	0.22	-	-	-	-	-	-	0.54	0.52	0.80	0.76	0.22	0.22	-	-	-	-	-	-	0.58	0.56
150	2.47	2.34	1.00	0.96	-	-	-	-	0.08	0.08	1.90	1.81	2.62	2.49	1.06	1.01	-	-	-	-	0.08	0.08	1.98	1.89
140	5.32	4.97	2.77	2.63	-	-	-	-	0.33	0.32	4.46	4.19	5.92	5.54	2.92	2.77	-	-	-	-	0.34	0.32	4.88	4.58
130	9.31	8.61	5.74	5.36	-	-	-	-	1.30	1.24	8.24	7.65	11.60	10.54	6.46	6.05	-	-	-	-	1.37	1.31	9.91	9.18
120	14.94	13.57	9.97	9.23	-	-	-	-	3.31	3.10	13.90	12.63	19.93	17.74	13.35	12.16	-	-	-	-	3.58	3.37	18.86	16.81

Table H-196. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.09	0.08	-	-	-	-	-	-	-	-	0.07	0.06	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.06
160	0.39	0.37	0.11	0.11	-	-	-	-	-	-	0.24	0.24	0.40	0.38	0.11	0.11	-	-	-	-	-	-	0.24	0.23
150	1.50	1.42	0.48	0.46	-	-	-	-	-	-	1.12	1.06	1.58	1.50	0.49	0.47	-	-	-	-	-	-	1.18	1.12
140	3.78	3.55	1.76	1.67	-	-	-	-	0.13	0.13	2.95	2.80	4.09	3.85	1.84	1.75	-	-	-	-	0.13	0.13	3.21	3.01
130	7.12	6.61	4.15	3.91	-	-	-	-	0.67	0.65	6.14	5.73	8.34	7.75	4.50	4.23	-	-	-	-	0.72	0.69	7.02	6.56
120	12.22	11.08	7.71	7.16	-	-	-	-	2.15	2.04	10.80	9.81	15.33	13.92	9.32	8.62	-	-	-	-	2.28	2.17	14.11	12.83

Table H-197. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	-	-	-	-	-	-	-	-	-	-	0.05	0.05	-	-	-	-	-	-	-	-	-	-
180	0.21	0.20	0.07	0.07	-	-	-	-	-	-	0.13	0.13	0.20	0.20	0.07	0.06	-	-	-	-	-	-	0.13	0.13
170	1.00	0.95	0.26	0.25	-	-	-	-	-	-	0.69	0.66	1.03	0.98	0.29	0.27	-	-	-	-	-	-	0.73	0.69
160	2.78	2.63	1.20	1.14	-	-	-	-	0.09	0.09	2.21	2.10	2.92	2.78	1.26	1.20	-	-	-	-	0.09	0.09	2.35	2.23
150	5.82	5.43	3.09	2.90	-	-	-	-	0.40	0.39	4.94	4.62	6.54	6.12	3.38	3.18	-	-	-	-	0.42	0.40	5.46	5.12
140	9.93	9.17	6.29	5.87	-	-	-	-	1.54	1.47	8.97	8.31	12.80	11.64	7.24	6.75	-	-	-	-	1.62	1.54	11.36	10.35
130	15.99	14.40	11.20	10.18	0.02	0.02	-	-	3.76	3.53	14.91	13.52	22.41	19.38	14.74	13.40	0.02	0.02	-	-	4.07	3.84	20.85	18.24
120	23.87	20.82	17.88	15.91	0.16	0.15	0.02	0.02	7.07	6.58	22.75	19.69	35.80	32.36	26.74	23.68	0.15	0.14	0.02	0.02	8.45	7.85	34.68	31.13

Table H-198. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.06	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.06
170	0.40	0.38	0.11	0.11	-	-	-	-	-	-	0.25	0.24	0.41	0.39	0.11	0.11	-	-	-	-	-	-	0.28	0.27
160	1.57	1.49	0.52	0.50	-	-	-	-	-	-	1.19	1.13	1.65	1.57	0.56	0.54	-	-	-	-	-	-	1.24	1.18
150	3.92	3.68	1.84	1.75	-	-	-	-	0.13	0.13	3.09	2.90	4.23	3.98	1.92	1.83	-	-	-	-	0.14	0.13	3.37	3.17
140	7.33	6.80	4.30	4.05	-	-	-	-	0.71	0.68	6.34	5.91	8.61	7.99	4.67	4.39	-	-	-	-	0.74	0.71	7.32	6.83
130	12.53	11.38	7.99	7.41	-	-	-	-	2.26	2.14	11.24	10.20	15.95	14.38	9.64	8.94	-	-	-	-	2.40	2.29	14.65	13.32
120	18.71	16.60	13.76	12.49	0.08	0.08	-	-	4.93	4.62	17.75	15.79	27.37	24.21	18.87	16.77	0.08	0.08	-	-	5.43	5.09	26.24	23.18

Table H-199. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.05	0.05	-	-	-	-	-	-	-	-	-	-	0.05	0.05	-	-	-	-	-	-	-	-	-	-
170	0.21	0.20	0.07	0.07	-	-	-	-	-	-	0.13	0.13	0.20	0.20	0.07	0.06	-	-	-	-	-	-	0.13	0.13
160	1.00	0.95	0.26	0.25	-	-	-	-	-	-	0.69	0.66	1.03	0.98	0.29	0.27	-	-	-	-	-	-	0.73	0.69
150	2.78	2.63	1.20	1.14	-	-	-	-	0.09	0.09	2.21	2.10	2.92	2.78	1.26	1.20	-	-	-	-	0.09	0.09	2.35	2.23
140	5.82	5.43	3.09	2.90	-	-	-	-	0.40	0.39	4.94	4.62	6.54	6.12	3.38	3.18	-	-	-	-	0.42	0.40	5.46	5.12
130	9.93	9.17	6.29	5.87	-	-	-	-	1.54	1.47	8.97	8.31	12.80	11.64	7.24	6.75	-	-	-	-	1.62	1.54	11.36	10.35
120	15.99	14.40	11.20	10.18	0.02	0.02	-	-	3.76	3.53	14.91	13.52	22.41	19.38	14.74	13.40	0.02	0.02	-	-	4.07	3.84	20.85	18.24

Table H-200. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.10	0.10	-	-	-	-	-	-	-	-	0.08	0.07	0.11	0.10	-	-	-	-	-	-	-	-	0.08	0.07
160	0.46	0.44	0.12	0.12	-	-	-	-	-	-	0.33	0.32	0.47	0.45	0.12	0.12	-	-	-	-	-	-	0.34	0.32
150	1.74	1.66	0.62	0.59	-	-	-	-	0.02	0.02	1.32	1.26	1.83	1.74	0.66	0.63	-	-	-	-	0.02	0.02	1.39	1.33
140	4.20	3.96	1.99	1.90	-	-	-	-	0.18	0.18	3.43	3.21	4.56	4.29	2.12	2.01	-	-	-	-	0.15	0.14	3.71	3.49
130	7.78	7.21	4.60	4.32	-	-	-	-	0.80	0.76	6.71	6.26	9.15	8.49	5.03	4.72	-	-	-	-	0.90	0.83	7.92	7.37
120	13.08	11.88	8.46	7.84	-	-	-	-	2.49	2.36	11.94	10.83	16.94	15.14	10.35	9.50	-	-	-	-	2.64	2.51	15.55	14.09

Table H-201. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.07	0.07	-	-	-	-	-	-	-	-	0.05	0.05
180	0.34	0.33	0.09	0.09	-	-	-	-	-	-	0.23	0.22	0.34	0.33	0.09	0.09	-	-	-	-	-	-	0.22	0.22
170	1.33	1.26	0.40	0.39	-	-	-	-	-	-	0.98	0.94	1.40	1.33	0.41	0.39	-	-	-	-	-	-	1.01	0.96
160	3.42	3.21	1.57	1.50	-	-	-	-	0.12	0.11	2.74	2.60	3.69	3.48	1.66	1.58	-	-	-	-	0.12	0.12	2.89	2.74
150	6.62	6.19	3.87	3.64	-	-	-	-	0.59	0.57	5.74	5.38	7.58	7.06	4.19	3.94	-	-	-	-	0.63	0.60	6.43	6.03
140	11.45	10.42	7.28	6.78	-	-	-	-	1.94	1.85	10.05	9.29	14.51	13.21	8.65	8.05	-	-	-	-	2.03	1.93	13.41	12.22
130	17.68	15.79	12.87	11.73	0.07	0.06	-	-	4.50	4.23	16.71	15.02	25.77	22.68	17.41	15.57	0.07	0.06	-	-	4.88	4.59	24.62	21.57
120	25.97	23.06	19.67	17.50	0.26	0.25	0.05	0.05	8.26	7.68	25.20	22.22	42.72	37.45	30.44	26.97	0.31	0.29	0.05	0.05	9.91	9.19	41.42	36.20

Table H-202. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.12	0.11	0.02	0.02	-	-	-	-	-	-	0.09	0.09	0.12	0.12	0.02	0.02	-	-	-	-	-	-	0.09	0.09
170	0.60	0.57	0.13	0.13	-	-	-	-	-	-	0.40	0.39	0.62	0.60	0.14	0.14	-	-	-	-	-	-	0.40	0.39
160	1.97	1.88	0.74	0.72	-	-	-	-	0.06	0.06	1.55	1.48	2.09	1.98	0.75	0.72	-	-	-	-	0.06	0.06	1.63	1.56
150	4.60	4.33	2.36	2.24	-	-	-	-	0.23	0.23	3.85	3.62	5.00	4.70	2.50	2.38	-	-	-	-	0.23	0.22	4.15	3.91
140	8.32	7.72	5.08	4.77	-	-	-	-	1.00	0.96	7.28	6.78	9.76	9.05	5.58	5.24	-	-	-	-	1.06	1.00	8.67	8.07
130	13.80	12.55	9.15	8.49	-	-	-	-	2.81	2.66	12.84	11.70	18.41	16.34	11.71	10.72	-	-	-	-	2.95	2.81	17.23	15.40
120	20.48	18.05	15.35	13.92	0.11	0.11	-	-	5.80	5.43	19.52	17.38	30.92	27.39	22.25	19.28	0.11	0.11	-	-	6.46	6.06	29.78	26.38

Table H-203. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.07	0.07	-	-	-	-	-	-	-	-	0.05	0.05
170	0.34	0.33	0.09	0.09	-	-	-	-	-	-	0.23	0.22	0.34	0.33	0.09	0.09	-	-	-	-	-	-	0.22	0.22
160	1.33	1.26	0.40	0.39	-	-	-	-	-	-	0.98	0.94	1.40	1.33	0.41	0.39	-	-	-	-	-	-	1.01	0.96
150	3.42	3.21	1.57	1.50	-	-	-	-	0.12	0.11	2.74	2.60	3.69	3.48	1.66	1.58	-	-	-	-	0.12	0.12	2.89	2.74
140	6.62	6.19	3.87	3.64	-	-	-	-	0.59	0.57	5.74	5.38	7.58	7.06	4.19	3.94	-	-	-	-	0.63	0.60	6.43	6.03
130	11.45	10.42	7.28	6.78	-	-	-	-	1.94	1.85	10.05	9.29	14.51	13.21	8.65	8.05	-	-	-	-	2.03	1.93	13.41	12.22
120	17.68	15.79	12.87	11.73	0.07	0.06	-	-	4.50	4.23	16.71	15.02	25.77	22.68	17.41	15.57	0.07	0.06	-	-	4.88	4.59	24.62	21.57

Table H-204. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
170	0.13	0.12	0.04	0.04	-	-	-	-	-	-	0.10	0.10	0.13	0.13	0.02	0.02	-	-	-	-	-	-	0.11	0.10
160	0.66	0.64	0.20	0.20	-	-	-	-	-	-	0.45	0.44	0.69	0.66	0.19	0.19	-	-	-	-	-	-	0.50	0.46
150	2.22	2.10	0.92	0.88	-	-	-	-	0.07	0.06	1.74	1.65	2.34	2.22	0.94	0.90	-	-	-	-	0.07	0.06	1.82	1.73
140	4.92	4.61	2.56	2.43	-	-	-	-	0.26	0.25	4.15	3.91	5.38	5.04	2.70	2.57	-	-	-	-	0.25	0.24	4.46	4.21
130	8.75	8.12	5.42	5.07	-	-	-	-	1.12	1.06	7.76	7.21	10.49	9.59	5.98	5.62	-	-	-	-	1.20	1.15	9.27	8.63
120	14.37	13.06	9.60	8.90	-	-	-	-	2.99	2.84	13.43	12.23	19.35	17.16	12.63	11.53	-	-	-	-	3.27	3.07	18.29	16.26

Table H-205. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.09	0.08	-	-	-	-	-	-	-	-	0.07	0.06	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.06
180	0.40	0.38	0.11	0.11	-	-	-	-	-	-	0.29	0.27	0.40	0.38	0.11	0.11	-	-	-	-	-	-	0.31	0.30
170	1.57	1.49	0.56	0.54	-	-	-	-	0.02	0.02	1.17	1.11	1.65	1.57	0.58	0.56	-	-	-	-	0.02	0.02	1.25	1.19
160	3.87	3.65	1.85	1.77	-	-	-	-	0.13	0.13	3.06	2.88	4.15	3.92	1.94	1.85	-	-	-	-	0.14	0.13	3.33	3.12
150	7.14	6.66	4.30	4.05	-	-	-	-	0.74	0.71	6.24	5.83	8.30	7.73	4.62	4.35	-	-	-	-	0.76	0.73	7.08	6.60
140	12.27	11.17	7.91	7.35	-	-	-	-	2.31	2.20	11.02	10.05	15.70	14.23	9.52	8.83	-	-	-	-	2.43	2.32	14.55	13.27
130	18.49	16.52	13.65	12.42	0.08	0.08	0.02	0.02	4.94	4.64	17.59	15.78	27.64	24.47	19.01	16.94	0.09	0.08	0.02	0.02	5.38	5.05	26.57	23.52
120	26.88	24.00	20.74	18.26	0.37	0.36	0.09	0.09	8.87	8.24	26.09	23.26	46.24	40.95	33.26	29.76	0.40	0.38	0.10	0.10	11.30	10.37	45.34	39.85

Table H-206. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
180	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.11	0.11	0.14	0.13	0.05	0.05	-	-	-	-	-	-	0.11	0.11
170	0.74	0.71	0.22	0.21	-	-	-	-	-	-	0.54	0.52	0.77	0.74	0.22	0.21	-	-	-	-	-	-	0.57	0.55
160	2.37	2.24	0.94	0.90	-	-	-	-	0.07	0.07	1.83	1.74	2.49	2.36	0.98	0.93	-	-	-	-	0.07	0.07	1.91	1.83
150	5.04	4.74	2.67	2.53	-	-	-	-	0.33	0.32	4.27	4.02	5.52	5.18	2.81	2.67	-	-	-	-	0.34	0.33	4.58	4.32
140	8.90	8.26	5.54	5.19	-	-	-	-	1.23	1.18	7.90	7.35	10.78	9.84	6.12	5.75	-	-	-	-	1.32	1.26	9.49	8.81
130	14.51	13.20	9.73	9.02	-	-	-	-	3.17	2.97	13.60	12.38	19.70	17.51	12.98	11.86	-	-	-	-	3.42	3.22	18.72	16.67
120	21.73	18.94	16.20	14.68	0.13	0.12	0.03	0.03	6.30	5.89	20.49	18.12	33.34	29.78	24.55	21.58	0.13	0.13	0.03	0.03	7.13	6.65	32.22	28.70

Table H-207. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.09	0.08	-	-	-	-	-	-	-	-	0.07	0.06	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.06
170	0.40	0.38	0.11	0.11	-	-	-	-	-	-	0.29	0.27	0.40	0.38	0.11	0.11	-	-	-	-	-	-	0.31	0.30
160	1.57	1.49	0.56	0.54	-	-	-	-	0.02	0.02	1.17	1.11	1.65	1.57	0.58	0.56	-	-	-	-	0.02	0.02	1.25	1.19
150	3.87	3.65	1.85	1.77	-	-	-	-	0.13	0.13	3.06	2.88	4.15	3.92	1.94	1.85	-	-	-	-	0.14	0.13	3.33	3.12
140	7.14	6.66	4.30	4.05	-	-	-	-	0.74	0.71	6.24	5.83	8.30	7.73	4.62	4.35	-	-	-	-	0.76	0.73	7.08	6.60
130	12.27	11.17	7.91	7.35	-	-	-	-	2.31	2.20	11.02	10.05	15.70	14.23	9.52	8.83	-	-	-	-	2.43	2.32	14.55	13.27
120	18.49	16.52	13.65	12.42	0.08	0.08	0.02	0.02	4.94	4.64	17.59	15.78	27.64	24.47	19.01	16.94	0.09	0.08	0.02	0.02	5.38	5.05	26.57	23.52

Table H-208. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
170	0.14	0.14	0.06	0.06	-	-	-	-	-	-	0.12	0.12	0.15	0.15	0.06	0.06	-	-	-	-	-	-	0.12	0.12
160	0.89	0.85	0.24	0.23	-	-	-	-	-	-	0.60	0.58	0.91	0.87	0.24	0.23	-	-	-	-	-	-	0.63	0.61
150	2.56	2.43	1.03	0.98	-	-	-	-	0.08	0.08	1.97	1.88	2.70	2.56	1.10	1.06	-	-	-	-	0.08	0.08	2.08	1.97
140	5.38	5.04	2.88	2.73	-	-	-	-	0.37	0.35	4.56	4.29	5.92	5.54	3.03	2.87	-	-	-	-	0.37	0.36	4.94	4.64
130	9.32	8.64	5.90	5.51	-	-	-	-	1.41	1.35	8.37	7.77	11.64	10.63	6.58	6.16	-	-	-	-	1.48	1.41	10.09	9.33
120	15.08	13.72	10.30	9.44	0.02	0.02	-	-	3.49	3.28	14.20	12.91	21.00	18.35	13.84	12.63	0.02	0.02	-	-	3.75	3.53	19.70	17.52

Table H-209. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.10	0.09	-	-	-	-	-	-	-	-	0.08	0.07	0.10	0.10	-	-	-	-	-	-	-	-	0.08	0.07
180	0.50	0.48	0.13	0.12	-	-	-	-	-	-	0.35	0.34	0.52	0.50	0.13	0.13	-	-	-	-	-	-	0.35	0.34
170	1.80	1.72	0.61	0.59	-	-	-	-	0.02	0.02	1.39	1.32	1.89	1.80	0.69	0.65	-	-	-	-	0.02	0.02	1.46	1.39
160	4.23	3.99	2.06	1.96	-	-	-	-	0.20	0.20	3.44	3.24	4.55	4.29	2.19	2.09	-	-	-	-	0.17	0.16	3.72	3.51
150	7.65	7.12	4.60	4.33	-	-	-	-	0.87	0.84	6.60	6.18	8.86	8.23	5.00	4.69	-	-	-	-	0.90	0.87	7.64	7.09
140	12.88	11.74	8.38	7.79	-	-	-	-	2.55	2.42	11.77	10.72	16.31	14.78	9.98	9.23	-	-	-	-	2.71	2.57	15.10	13.77
130	19.19	17.14	14.33	13.04	0.09	0.09	0.03	0.03	5.26	4.94	18.37	16.45	28.34	25.24	19.59	17.55	0.10	0.10	0.03	0.03	5.80	5.44	27.28	24.30
120	27.83	24.89	22.14	19.32	0.48	0.46	0.12	0.12	9.36	8.70	27.11	24.22	48.12	43.07	35.02	31.60	0.52	0.50	0.12	0.12	12.16	11.15	47.24	41.88

Table H-210. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
180	0.15	0.15	0.06	0.06	-	-	-	-	-	-	0.12	0.12	0.16	0.16	0.06	0.06	-	-	-	-	-	-	0.13	0.13
170	0.88	0.84	0.25	0.24	-	-	-	-	-	-	0.60	0.57	0.91	0.87	0.24	0.24	-	-	-	-	-	-	0.63	0.61
160	2.62	2.49	1.11	1.07	-	-	-	-	0.09	0.08	2.02	1.92	2.76	2.63	1.19	1.14	-	-	-	-	0.09	0.08	2.15	2.05
150	5.44	5.10	2.92	2.77	-	-	-	-	0.37	0.36	4.58	4.32	5.98	5.61	3.10	2.93	-	-	-	-	0.38	0.36	4.96	4.68
140	9.36	8.69	5.90	5.52	-	-	-	-	1.44	1.38	8.37	7.78	11.53	10.52	6.58	6.14	-	-	-	-	1.53	1.46	9.95	9.21
130	15.10	13.75	10.35	9.49	0.02	0.02	-	-	3.55	3.33	14.23	12.94	20.28	18.01	13.58	12.39	0.02	0.02	-	-	3.81	3.59	19.21	17.18
120	22.82	19.95	17.10	15.40	0.19	0.18	0.06	0.06	6.66	6.24	21.73	18.97	34.33	31.01	25.43	22.58	0.18	0.18	0.05	0.05	7.73	7.16	33.24	29.91

Table H-211. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.10	0.09	-	-	-	-	-	-	-	-	0.08	0.07	0.10	0.10	-	-	-	-	-	-	-	-	0.08	0.07
170	0.50	0.48	0.13	0.12	-	-	-	-	-	-	0.35	0.34	0.52	0.50	0.13	0.13	-	-	-	-	-	-	0.35	0.34
160	1.80	1.72	0.61	0.59	-	-	-	-	0.02	0.02	1.39	1.32	1.89	1.80	0.69	0.65	-	-	-	-	0.02	0.02	1.46	1.39
150	4.23	3.99	2.06	1.96	-	-	-	-	0.20	0.20	3.44	3.24	4.55	4.29	2.19	2.09	-	-	-	-	0.17	0.16	3.72	3.51
140	7.65	7.12	4.60	4.33	-	-	-	-	0.87	0.84	6.60	6.18	8.86	8.23	5.00	4.69	-	-	-	-	0.90	0.87	7.64	7.09
130	12.88	11.74	8.38	7.79	-	-	-	-	2.55	2.42	11.77	10.72	16.31	14.78	9.98	9.23	-	-	-	-	2.71	2.57	15.10	13.77
120	19.19	17.14	14.33	13.04	0.09	0.09	0.03	0.03	5.26	4.94	18.37	16.45	28.34	25.24	19.59	17.55	0.10	0.10	0.03	0.03	5.80	5.44	27.28	24.30

Table H-212. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.05	0.05	-	-	-	-	-	-	-	-	-	-	0.05	0.05	-	-	-	-	-	-	-	-	-	-
170	0.20	0.19	0.07	0.07	-	-	-	-	-	-	0.13	0.13	0.18	0.18	0.07	0.06	-	-	-	-	-	-	0.14	0.14
160	0.98	0.94	0.30	0.29	-	-	-	-	-	-	0.76	0.74	1.03	0.99	0.31	0.29	-	-	-	-	-	-	0.79	0.76
150	2.83	2.69	1.27	1.22	-	-	-	-	0.09	0.09	2.29	2.17	2.97	2.83	1.32	1.26	-	-	-	-	0.09	0.09	2.41	2.30
140	5.78	5.41	3.16	2.96	-	-	-	-	0.44	0.43	4.90	4.60	6.40	5.99	3.43	3.23	-	-	-	-	0.46	0.45	5.34	5.02
130	9.79	9.06	6.26	5.85	-	-	-	-	1.59	1.52	8.84	8.21	12.33	11.25	7.06	6.56	-	-	-	-	1.68	1.60	10.83	9.91
120	15.74	14.30	11.10	10.13	0.03	0.03	-	-	3.83	3.60	14.82	13.49	21.78	19.00	14.42	13.16	0.03	0.03	-	-	4.12	3.88	20.26	18.02

Table H-213. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	-	-	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-	-	-
180	0.11	0.11	0.01	0.01	-	-	-	-	-	-	0.09	0.08	0.12	0.11	0.01	0.01	-	-	-	-	-	-	0.09	0.08
170	0.60	0.58	0.13	0.12	-	-	-	-	-	-	0.39	0.37	0.63	0.60	0.13	0.13	-	-	-	-	-	-	0.39	0.37
160	1.99	1.89	0.70	0.67	-	-	-	-	0.06	0.06	1.49	1.42	2.11	2.00	0.73	0.70	-	-	-	-	0.06	0.06	1.57	1.49
150	4.57	4.29	2.23	2.09	-	-	-	-	0.22	0.21	3.71	3.48	4.97	4.67	2.37	2.25	-	-	-	-	0.21	0.20	3.98	3.76
140	8.07	7.49	4.84	4.53	-	-	-	-	0.95	0.91	6.89	6.44	9.45	8.77	5.31	4.98	-	-	-	-	0.98	0.94	8.21	7.65
130	13.23	12.02	8.57	7.96	-	-	-	-	2.68	2.54	11.96	10.89	17.16	15.38	10.71	9.81	-	-	-	-	2.83	2.68	15.94	14.31
120	19.00	17.13	14.35	12.97	0.10	0.10	-	-	5.48	5.12	18.06	16.26	28.82	25.66	19.86	17.92	0.11	0.10	-	-	6.11	5.73	27.72	24.69

Table H-214. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	-	-	-	-	-	-	-	-	0.01	0.01	0.06	0.06	-	-	-	-	-	-	-	-	0.01	0.01
170	0.21	0.21	0.07	0.07	-	-	-	-	-	-	0.13	0.12	0.21	0.21	0.07	0.07	-	-	-	-	-	-	0.13	0.13
160	1.02	0.97	0.31	0.30	-	-	-	-	-	-	0.70	0.66	1.08	1.03	0.31	0.30	-	-	-	-	-	-	0.73	0.70
150	2.86	2.71	1.19	1.14	-	-	-	-	0.09	0.09	2.21	2.09	3.01	2.85	1.27	1.20	-	-	-	-	0.10	0.09	2.37	2.24
140	5.81	5.43	3.06	2.88	-	-	-	-	0.39	0.38	4.87	4.56	6.49	6.07	3.34	3.14	-	-	-	-	0.41	0.39	5.35	5.02
130	9.71	8.99	6.11	5.73	-	-	-	-	1.53	1.46	8.65	8.03	12.38	11.25	6.96	6.54	-	-	-	-	1.61	1.53	10.74	9.82
120	15.49	13.95	10.48	9.60	0.02	0.02	-	-	3.71	3.49	14.35	12.97	20.81	18.55	14.27	12.89	0.02	0.02	-	-	4.01	3.78	19.52	17.61

Table H-215. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.01	0.01	-	-	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-	-	-
170	0.11	0.11	0.01	0.01	-	-	-	-	-	-	0.09	0.08	0.12	0.11	0.01	0.01	-	-	-	-	-	-	0.09	0.08
160	0.60	0.58	0.13	0.12	-	-	-	-	-	-	0.39	0.37	0.63	0.60	0.13	0.13	-	-	-	-	-	-	0.39	0.37
150	1.99	1.89	0.70	0.67	-	-	-	-	0.06	0.06	1.49	1.42	2.11	2.00	0.73	0.70	-	-	-	-	0.06	0.06	1.57	1.49
140	4.57	4.29	2.23	2.09	-	-	-	-	0.22	0.21	3.71	3.48	4.97	4.67	2.37	2.25	-	-	-	-	0.21	0.20	3.98	3.76
130	8.07	7.49	4.84	4.53	-	-	-	-	0.95	0.91	6.89	6.44	9.45	8.77	5.31	4.98	-	-	-	-	0.98	0.94	8.21	7.65
120	13.23	12.02	8.57	7.96	-	-	-	-	2.68	2.54	11.96	10.89	17.16	15.38	10.71	9.81	-	-	-	-	2.83	2.68	15.94	14.31

Table H-216. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.07	0.07	-	-	-	-	-	-	-	-	0.04	0.04	0.07	0.07	-	-	-	-	-	-	-	-	0.04	0.04
160	0.30	0.29	0.08	0.08	-	-	-	-	-	-	0.18	0.18	0.30	0.29	0.08	0.08	-	-	-	-	-	-	0.17	0.17
150	1.18	1.12	0.35	0.33	-	-	-	-	-	-	0.81	0.78	1.24	1.18	0.35	0.34	-	-	-	-	-	-	0.85	0.81
140	3.10	2.91	1.35	1.28	-	-	-	-	0.11	0.10	2.44	2.31	3.36	3.15	1.42	1.35	-	-	-	-	0.11	0.11	2.59	2.45
130	6.15	5.75	3.37	3.17	-	-	-	-	0.48	0.46	5.18	4.85	6.91	6.45	3.67	3.45	-	-	-	-	0.49	0.47	5.75	5.39
120	10.17	9.35	6.47	6.05	-	-	-	-	1.69	1.61	9.07	8.44	13.11	11.90	7.53	7.04	-	-	-	-	1.79	1.70	11.66	10.63

Table H-217. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.04	0.04	-	-	-	-	-	-	-	-	0.01	0.01	0.03	0.03	-	-	-	-	-	-	-	-	0.01	0.01
180	0.13	0.13	0.06	0.06	-	-	-	-	-	-	0.11	0.11	0.14	0.14	0.06	0.06	-	-	-	-	-	-	0.11	0.11
170	0.82	0.78	0.23	0.22	-	-	-	-	-	-	0.56	0.54	0.85	0.82	0.22	0.22	-	-	-	-	-	-	0.59	0.57
160	2.45	2.32	0.97	0.92	-	-	-	-	0.08	0.08	1.87	1.78	2.59	2.46	0.99	0.95	-	-	-	-	0.08	0.08	1.96	1.87
150	5.22	4.89	2.72	2.58	-	-	-	-	0.33	0.32	4.37	4.12	5.80	5.43	2.88	2.74	-	-	-	-	0.34	0.33	4.80	4.51
140	9.09	8.43	5.65	5.28	-	-	-	-	1.27	1.21	8.05	7.49	11.25	10.24	6.35	5.96	-	-	-	-	1.35	1.29	9.71	9.03
130	14.80	13.34	9.81	9.11	0.01	0.01	-	-	3.24	3.04	13.71	12.43	19.49	17.57	13.17	11.97	0.01	0.01	-	-	3.54	3.34	18.53	16.66
120	21.37	18.94	16.35	14.68	0.13	0.12	0.02	0.02	6.37	5.97	20.02	18.05	32.86	29.29	24.03	21.37	0.13	0.13	0.02	0.02	7.36	6.88	31.73	28.27

Table H-218. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.08	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.08	0.07	-	-	-	-	-	-	-	-	0.05	0.05
170	0.34	0.33	0.10	0.09	-	-	-	-	-	-	0.22	0.21	0.35	0.33	0.10	0.09	-	-	-	-	-	-	0.22	0.21
160	1.33	1.27	0.41	0.39	-	-	-	-	0.01	0.01	0.95	0.91	1.40	1.33	0.42	0.40	-	-	-	-	0.01	0.01	0.98	0.94
150	3.40	3.21	1.56	1.48	-	-	-	-	0.12	0.11	2.71	2.57	3.71	3.50	1.65	1.56	-	-	-	-	0.12	0.12	2.86	2.72
140	6.57	6.15	3.81	3.58	-	-	-	-	0.59	0.56	5.65	5.30	7.57	7.06	4.13	3.90	-	-	-	-	0.62	0.59	6.40	6.00
130	11.25	10.22	7.08	6.62	-	-	-	-	1.92	1.83	9.82	9.12	14.40	12.99	8.48	7.93	-	-	-	-	2.02	1.92	13.11	11.92
120	17.22	15.46	12.51	11.39	0.07	0.07	-	-	4.41	4.15	16.24	14.60	24.77	22.07	16.91	15.14	0.07	0.07	-	-	4.84	4.54	23.45	20.82

Table H-219. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.04	0.04	-	-	-	-	-	-	-	-	0.01	0.01	0.03	0.03	-	-	-	-	-	-	-	-	0.01	0.01
170	0.13	0.13	0.06	0.06	-	-	-	-	-	-	0.11	0.11	0.14	0.14	0.06	0.06	-	-	-	-	-	-	0.11	0.11
160	0.82	0.78	0.23	0.22	-	-	-	-	-	-	0.56	0.54	0.85	0.82	0.22	0.22	-	-	-	-	-	-	0.59	0.57
150	2.45	2.32	0.97	0.92	-	-	-	-	0.08	0.08	1.87	1.78	2.59	2.46	1.00	0.95	-	-	-	-	0.08	0.08	1.96	1.87
140	5.22	4.89	2.72	2.58	-	-	-	-	0.33	0.32	4.38	4.12	5.80	5.43	2.88	2.74	-	-	-	-	0.34	0.33	4.80	4.51
130	9.09	8.43	5.65	5.28	-	-	-	-	1.27	1.21	8.05	7.49	11.25	10.24	6.36	5.96	-	-	-	-	1.35	1.29	9.71	9.03
120	14.80	13.34	9.81	9.11	0.01	0.01	-	-	3.24	3.04	13.71	12.43	19.49	17.57	13.17	11.97	0.01	0.01	-	-	3.54	3.34	18.53	16.66

Table H-220. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	0.08	0.08	-	-	-	-	-	-	-	-	0.07	0.07	0.09	0.08	-	-	-	-	-	-	-	-	0.07	0.07
160	0.38	0.36	0.11	0.10	-	-	-	-	-	-	0.24	0.23	0.39	0.37	0.11	0.11	-	-	-	-	-	-	0.24	0.23
150	1.48	1.41	0.48	0.46	-	-	-	-	0.01	0.01	1.05	0.99	1.57	1.49	0.51	0.48	-	-	-	-	0.01	0.01	1.12	1.07
140	3.72	3.51	1.72	1.63	-	-	-	-	0.13	0.12	2.90	2.76	4.04	3.81	1.81	1.73	-	-	-	-	0.13	0.13	3.13	2.95
130	6.93	6.48	4.09	3.86	-	-	-	-	0.65	0.62	6.00	5.63	8.11	7.56	4.45	4.19	-	-	-	-	0.68	0.65	6.85	6.43
120	11.88	10.81	7.53	7.03	-	-	-	-	2.10	1.98	10.44	9.56	15.25	13.69	9.08	8.48	-	-	-	-	2.26	2.15	13.96	12.63

Table H-221. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	-	-	-	-	-	-	-	-	0.01	0.01	0.05	0.05	-	-	-	-	-	-	-	-	0.01	0.01
180	0.21	0.20	0.07	0.07	-	-	-	-	-	-	0.13	0.13	0.21	0.20	0.07	0.07	-	-	-	-	-	-	0.13	0.13
170	0.97	0.93	0.30	0.29	-	-	-	-	-	-	0.73	0.69	1.02	0.98	0.31	0.30	-	-	-	-	-	-	0.76	0.72
160	2.78	2.64	1.22	1.16	-	-	-	-	0.10	0.09	2.18	2.06	2.93	2.78	1.28	1.22	-	-	-	-	0.10	0.09	2.35	2.22
150	5.73	5.36	3.06	2.88	-	-	-	-	0.42	0.40	4.87	4.57	6.43	6.02	3.36	3.16	-	-	-	-	0.44	0.42	5.37	5.06
140	9.77	9.05	6.21	5.81	-	-	-	-	1.54	1.46	8.85	8.22	12.63	11.52	7.15	6.70	-	-	-	-	1.62	1.55	11.19	10.26
130	15.83	14.28	10.95	10.03	0.02	0.02	-	-	3.74	3.51	14.84	13.43	21.98	19.33	14.81	13.38	0.02	0.02	-	-	4.05	3.82	20.29	18.19
120	23.29	20.66	17.50	15.78	0.19	0.18	0.01	0.01	6.97	6.52	21.98	19.51	35.77	31.97	26.62	23.69	0.17	0.17	0.01	0.01	8.39	7.82	34.63	30.86

Table H-222. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.09	0.08	0.01	0.01	-	-	-	-	-	-	0.07	0.07	0.09	0.09	0.01	0.01	-	-	-	-	-	-	0.07	0.07
170	0.44	0.43	0.11	0.11	-	-	-	-	-	-	0.30	0.29	0.46	0.44	0.11	0.11	-	-	-	-	-	-	0.30	0.29
160	1.60	1.52	0.53	0.51	-	-	-	-	0.01	0.01	1.20	1.14	1.69	1.61	0.56	0.54	-	-	-	-	0.01	0.01	1.26	1.20
150	3.90	3.67	1.82	1.73	-	-	-	-	0.13	0.13	3.04	2.87	4.20	3.97	1.92	1.83	-	-	-	-	0.14	0.13	3.34	3.14
140	7.19	6.68	4.27	4.02	-	-	-	-	0.75	0.72	6.25	5.83	8.49	7.86	4.64	4.37	-	-	-	-	0.79	0.74	7.21	6.75
130	12.28	11.21	7.87	7.32	-	-	-	-	2.25	2.12	10.98	10.06	15.92	14.32	9.57	8.91	-	-	-	-	2.42	2.29	14.70	13.28
120	18.31	16.52	13.58	12.37	0.08	0.08	-	-	4.89	4.60	17.41	15.70	27.18	24.18	18.60	16.77	0.08	0.08	-	-	5.39	5.06	25.99	23.13

Table H-223. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.05	0.05	-	-	-	-	-	-	-	-	0.01	0.01	0.05	0.05	-	-	-	-	-	-	-	-	0.01	0.01
170	0.21	0.20	0.07	0.07	-	-	-	-	-	-	0.13	0.12	0.21	0.20	0.07	0.07	-	-	-	-	-	-	0.13	0.13
160	0.97	0.93	0.30	0.29	-	-	-	-	-	-	0.73	0.69	1.02	0.98	0.31	0.30	-	-	-	-	-	-	0.76	0.72
150	2.78	2.64	1.22	1.16	-	-	-	-	0.10	0.09	2.18	2.06	2.93	2.78	1.28	1.22	-	-	-	-	0.10	0.09	2.35	2.22
140	5.73	5.36	3.06	2.88	-	-	-	-	0.42	0.40	4.87	4.57	6.43	6.02	3.36	3.16	-	-	-	-	0.44	0.42	5.37	5.06
130	9.77	9.05	6.21	5.81	-	-	-	-	1.54	1.46	8.85	8.22	12.63	11.52	7.15	6.70	-	-	-	-	1.62	1.55	11.19	10.26
120	15.83	14.28	10.95	10.03	0.02	0.02	-	-	3.74	3.51	14.84	13.43	21.98	19.33	14.81	13.38	0.02	0.02	-	-	4.05	3.82	20.29	18.19

Table H-224. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.01	0.01	-	-	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-	-	-
170	0.10	0.10	0.01	0.01	-	-	-	-	-	-	0.08	0.08	0.11	0.10	0.01	0.01	-	-	-	-	-	-	0.08	0.08
160	0.49	0.48	0.12	0.12	-	-	-	-	-	-	0.34	0.32	0.51	0.49	0.13	0.12	-	-	-	-	-	-	0.34	0.33
150	1.76	1.66	0.61	0.59	-	-	-	-	0.04	0.04	1.33	1.26	1.85	1.75	0.66	0.62	-	-	-	-	0.03	0.03	1.40	1.33
140	4.17	3.94	2.00	1.90	-	-	-	-	0.20	0.19	3.38	3.17	4.52	4.27	2.15	2.03	-	-	-	-	0.18	0.18	3.66	3.45
130	7.63	7.08	4.57	4.29	-	-	-	-	0.84	0.80	6.61	6.18	9.03	8.37	4.98	4.70	-	-	-	-	0.88	0.84	7.83	7.29
120	12.86	11.74	8.35	7.75	-	-	-	-	2.49	2.35	11.69	10.70	16.81	15.09	10.23	9.45	-	-	-	-	2.63	2.50	15.62	14.05

Table H-225. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.07	-	-	-	-	-	-	-	-	0.03	0.03	0.07	0.07	-	-	-	-	-	-	-	-	0.03	0.03
180	0.27	0.26	0.09	0.08	-	-	-	-	-	-	0.19	0.19	0.27	0.27	0.09	0.08	-	-	-	-	-	-	0.18	0.17
170	1.19	1.14	0.39	0.38	-	-	-	-	0.01	0.01	0.90	0.85	1.26	1.21	0.41	0.39	-	-	-	-	0.01	0.01	0.93	0.89
160	3.12	2.92	1.45	1.38	-	-	-	-	0.11	0.11	2.54	2.40	3.39	3.19	1.53	1.45	-	-	-	-	0.11	0.11	2.68	2.54
150	6.16	5.75	3.55	3.34	-	-	-	-	0.51	0.49	5.28	4.94	6.93	6.48	3.83	3.62	-	-	-	-	0.55	0.53	5.87	5.50
140	10.31	9.45	6.65	6.22	0.01	0.01	-	-	1.82	1.73	9.27	8.62	13.41	12.12	7.77	7.25	0.01	0.01	-	-	1.91	1.82	12.08	10.96
130	16.42	14.76	11.70	10.67	0.08	0.08	0.02	0.02	4.16	3.92	15.43	13.91	23.44	20.67	15.93	14.19	0.08	0.08	0.02	0.02	4.56	4.28	22.02	19.30
120	24.09	21.50	18.18	16.40	0.34	0.33	0.11	0.09	7.54	7.03	22.98	20.45	39.07	34.82	29.00	25.67	0.34	0.32	0.11	0.10	9.20	8.58	37.71	33.40

Table H-226. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	-	-	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-	-	-
180	0.11	0.11	0.01	0.01	-	-	-	-	-	-	0.08	0.08	0.11	0.11	0.01	0.01	-	-	-	-	-	-	0.08	0.08
170	0.51	0.48	0.13	0.12	-	-	-	-	-	-	0.39	0.37	0.54	0.52	0.13	0.13	-	-	-	-	-	-	0.40	0.38
160	1.85	1.76	0.67	0.64	-	-	-	-	0.05	0.05	1.41	1.34	1.94	1.85	0.70	0.67	-	-	-	-	0.04	0.04	1.49	1.42
150	4.29	4.04	2.11	1.99	-	-	-	-	0.22	0.21	3.49	3.29	4.66	4.38	2.27	2.15	-	-	-	-	0.20	0.20	3.78	3.57
140	7.66	7.13	4.68	4.39	-	-	-	-	0.93	0.89	6.64	6.21	9.03	8.38	5.14	4.81	-	-	-	-	0.96	0.92	7.78	7.27
130	12.86	11.71	8.38	7.79	0.01	0.01	0.01	0.01	2.62	2.48	11.66	10.64	16.82	15.01	10.24	9.41	0.01	0.01	0.01	0.01	2.77	2.63	15.63	13.95
120	18.84	17.01	14.22	12.90	0.12	0.11	0.05	0.05	5.37	5.02	18.01	16.23	28.80	25.55	19.85	17.78	0.12	0.11	0.05	0.05	6.00	5.61	27.64	24.54

Table H-227. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	-	-	-	-	-	-	-	-	0.03	0.03	0.07	0.07	-	-	-	-	-	-	-	-	0.03	0.03
170	0.27	0.26	0.09	0.08	-	-	-	-	-	-	0.20	0.19	0.27	0.27	0.09	0.08	-	-	-	-	-	-	0.18	0.17
160	1.19	1.14	0.39	0.38	-	-	-	-	0.01	0.01	0.90	0.85	1.26	1.21	0.41	0.39	-	-	-	-	0.01	0.01	0.93	0.89
150	3.12	2.92	1.45	1.38	-	-	-	-	0.11	0.11	2.54	2.40	3.39	3.19	1.53	1.45	-	-	-	-	0.11	0.11	2.68	2.54
140	6.16	5.75	3.55	3.34	-	-	-	-	0.51	0.49	5.28	4.94	6.93	6.48	3.83	3.62	-	-	-	-	0.55	0.53	5.87	5.50
130	10.31	9.45	6.65	6.22	0.01	0.01	-	-	1.82	1.73	9.27	8.62	13.41	12.12	7.77	7.25	0.01	0.01	-	-	1.91	1.82	12.08	10.96
120	16.42	14.77	11.70	10.67	0.08	0.08	0.02	0.02	4.16	3.92	15.43	13.91	23.44	20.67	15.93	14.19	0.08	0.08	0.02	0.02	4.56	4.28	22.02	19.30

Table H-228. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.01	0.01	-	-	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-	-	-
170	0.12	0.11	0.01	0.01	-	-	-	-	-	-	0.10	0.09	0.12	0.12	0.01	0.01	-	-	-	-	-	-	0.10	0.09
160	0.62	0.59	0.16	0.15	-	-	-	-	-	-	0.43	0.41	0.66	0.63	0.14	0.14	-	-	-	-	-	-	0.44	0.42
150	1.99	1.90	0.75	0.72	-	-	-	-	0.06	0.06	1.56	1.48	2.15	2.03	0.80	0.76	-	-	-	-	0.06	0.06	1.64	1.56
140	4.57	4.30	2.35	2.23	-	-	-	-	0.24	0.23	3.81	3.58	5.00	4.69	2.50	2.38	-	-	-	-	0.24	0.23	4.11	3.88
130	8.09	7.53	4.98	4.67	-	-	-	-	1.00	0.96	7.01	6.55	9.55	8.86	5.51	5.14	-	-	-	-	1.11	1.05	8.36	7.81
120	13.41	12.20	8.84	8.21	0.02	0.02	0.01	0.01	2.81	2.66	12.32	11.23	17.71	15.81	11.25	10.22	0.02	0.02	0.01	0.01	2.96	2.82	16.58	14.77

H.2.2. Monopile Foundation (Difficult-to-Drive)

Table H-229. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06
180	0.40	0.39	0.10	0.10	-	-	-	-	-	-	0.27	0.26	0.41	0.40	0.10	0.10	-	-	-	-	-	-	0.28	0.27
170	1.42	1.33	0.49	0.47	-	-	-	-	0.03	0.03	1.02	0.97	1.50	1.41	0.53	0.50	-	-	-	-	0.02	0.02	1.11	1.07
160	3.30	3.02	1.69	1.58	-	-	-	-	0.14	0.14	2.78	2.58	3.70	3.39	1.79	1.68	-	-	-	-	0.14	0.13	3.01	2.79
150	5.92	5.48	3.86	3.56	-	-	-	-	0.70	0.67	5.43	5.03	6.94	6.37	4.35	4.03	-	-	-	-	0.73	0.70	6.43	5.92
140	9.32	8.54	6.77	6.24	-	-	-	-	2.06	1.92	8.88	8.15	12.40	11.34	8.48	7.76	-	-	-	-	2.28	2.11	11.84	10.80
130	14.14	12.90	10.86	9.87	0.09	0.09	0.04	0.04	4.46	4.14	13.72	12.52	20.44	18.34	15.39	13.98	0.09	0.09	0.04	0.04	5.15	4.77	19.79	17.88
120	19.57	17.74	16.21	14.72	0.44	0.43	0.16	0.16	7.69	7.06	19.23	17.41	33.96	30.60	27.38	24.37	0.60	0.58	0.20	0.20	9.88	9.04	32.87	29.86

Table H-230. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
180	0.13	0.12	0.05	0.05	-	-	-	-	-	-	0.09	0.08	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.10	0.10
170	0.69	0.66	0.19	0.19	-	-	-	-	-	-	0.48	0.46	0.72	0.69	0.19	0.19	-	-	-	-	-	-	0.49	0.47
160	2.02	1.89	0.89	0.84	-	-	-	-	0.06	0.06	1.66	1.55	2.21	2.04	0.93	0.88	-	-	-	-	0.06	0.06	1.76	1.64
150	4.31	4.01	2.45	2.24	-	-	-	-	0.31	0.30	3.81	3.51	4.82	4.48	2.64	2.45	-	-	-	-	0.32	0.30	4.29	3.97
140	7.16	6.57	4.90	4.56	-	-	-	-	1.12	1.07	6.68	6.15	8.76	8.01	5.74	5.30	-	-	-	-	1.24	1.17	8.24	7.56
130	11.16	10.17	8.26	7.59	0.04	0.04	-	-	2.88	2.68	10.56	9.61	15.22	13.84	10.76	9.79	0.03	0.03	-	-	3.25	2.95	14.68	13.36
120	16.24	14.76	13.00	11.91	0.17	0.17	0.06	0.06	5.60	5.19	15.78	14.37	26.00	23.07	19.13	17.25	0.20	0.20	0.08	0.08	6.76	6.20	25.38	22.48

Table H-231. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06
170	0.40	0.39	0.10	0.10	-	-	-	-	-	-	0.27	0.26	0.41	0.40	0.10	0.10	-	-	-	-	-	-	0.28	0.27
160	1.42	1.33	0.49	0.47	-	-	-	-	0.03	0.03	1.02	0.97	1.50	1.41	0.53	0.50	-	-	-	-	0.02	0.02	1.11	1.07
150	3.30	3.02	1.69	1.58	-	-	-	-	0.14	0.14	2.78	2.58	3.70	3.39	1.79	1.68	-	-	-	-	0.14	0.13	3.01	2.80
140	5.92	5.48	3.86	3.56	-	-	-	-	0.70	0.67	5.43	5.03	6.94	6.37	4.35	4.03	-	-	-	-	0.73	0.70	6.43	5.92
130	9.32	8.54	6.77	6.24	-	-	-	-	2.06	1.92	8.88	8.15	12.40	11.34	8.48	7.76	-	-	-	-	2.28	2.11	11.84	10.80
120	14.14	12.90	10.86	9.87	0.09	0.09	0.04	0.04	4.46	4.14	13.72	12.52	20.44	18.34	15.39	13.98	0.09	0.09	0.04	0.04	5.15	4.77	19.78	17.88

Table H-232. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.04	0.04	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
170	0.15	0.15	0.05	0.05	-	-	-	-	-	-	0.11	0.10	0.16	0.15	0.05	0.05	-	-	-	-	-	-	0.11	0.11
160	0.78	0.74	0.23	0.22	-	-	-	-	-	-	0.57	0.55	0.83	0.80	0.24	0.23	-	-	-	-	-	-	0.61	0.59
150	2.27	2.08	0.96	0.91	-	-	-	-	0.06	0.06	1.82	1.70	2.45	2.26	1.01	0.96	-	-	-	-	0.07	0.07	1.93	1.80
140	4.55	4.24	2.63	2.44	-	-	-	-	0.37	0.36	4.07	3.77	5.14	4.77	2.85	2.65	-	-	-	-	0.38	0.36	4.58	4.26
130	7.51	6.89	5.19	4.82	-	-	-	-	1.30	1.22	7.00	6.44	9.24	8.44	6.14	5.66	-	-	-	-	1.38	1.31	8.76	8.00
120	11.72	10.70	8.66	7.94	0.05	0.05	-	-	3.11	2.85	11.16	10.16	16.05	14.54	11.55	10.55	0.05	0.04	-	-	3.57	3.26	15.47	14.06

Table H-233. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02
190	0.23	0.22	0.06	0.06	-	-	-	-	-	-	0.14	0.13	0.23	0.22	0.06	0.06	-	-	-	-	-	-	0.14	0.13
180	0.91	0.87	0.28	0.27	-	-	-	-	-	-	0.65	0.62	0.95	0.91	0.29	0.28	-	-	-	-	-	-	0.69	0.66
170	2.47	2.30	1.04	0.99	-	-	-	-	0.07	0.07	1.93	1.80	2.63	2.45	1.13	1.08	-	-	-	-	0.07	0.07	2.02	1.90
160	4.76	4.44	2.75	2.56	-	-	-	-	0.39	0.38	4.22	3.94	5.34	4.95	2.93	2.74	-	-	-	-	0.40	0.38	4.74	4.42
150	7.88	7.17	5.38	5.01	-	-	-	-	1.39	1.31	7.34	6.70	9.64	8.74	6.36	5.88	-	-	-	-	1.48	1.39	9.20	8.32
140	12.20	11.15	9.04	8.22	0.05	0.05	0.02	0.02	3.29	3.01	11.72	10.66	16.74	15.17	12.16	11.04	0.08	0.08	0.02	0.02	3.68	3.40	16.12	14.65
130	17.40	15.75	13.90	12.72	0.39	0.37	0.13	0.13	6.14	5.70	16.91	15.36	28.12	25.00	20.98	18.69	0.29	0.28	0.15	0.14	7.66	6.95	27.45	24.35
120	24.77	22.13	19.52	17.71	1.18	1.12	0.56	0.53	1-	9.14	24.18	21.58	47.82	41.24	39.00	33.36	1.46	1.39	0.68	0.65	15.04	13.72	46.46	39.82

Table H-234. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.07	-	-	-	-	-	-	-	-	0.05	0.05	0.07	0.07	-	-	-	-	-	-	-	-	0.06	0.06
180	0.41	0.39	0.09	0.08	-	-	-	-	-	-	0.27	0.27	0.41	0.40	0.10	0.10	-	-	-	-	-	-	0.29	0.28
170	1.44	1.35	0.50	0.48	-	-	-	-	0.02	0.02	1.00	0.96	1.52	1.43	0.55	0.53	-	-	-	-	0.02	0.02	1.10	1.05
160	3.29	3.01	1.65	1.54	-	-	-	-	0.14	0.14	2.73	2.53	3.61	3.32	1.74	1.62	-	-	-	-	0.14	0.14	2.90	2.71
150	5.86	5.43	3.77	3.48	-	-	-	-	0.67	0.65	5.34	4.96	6.79	6.24	4.16	3.88	-	-	-	-	0.73	0.69	6.25	5.77
140	9.34	8.49	6.68	6.17	-	-	-	-	1.99	1.87	8.92	8.10	12.28	11.19	8.40	7.59	-	-	-	-	2.17	2.01	11.72	10.63
130	14.09	12.88	10.84	9.77	0.12	0.11	0.05	0.05	4.35	4.06	13.66	12.51	20.20	18.18	15.06	13.76	0.13	0.13	0.08	0.08	4.94	4.62	19.56	17.71
120	19.57	17.74	16.09	14.63	0.52	0.50	0.26	0.25	7.66	6.98	19.21	17.39	33.10	29.99	26.95	23.86	0.65	0.63	0.25	0.24	9.92	8.99	32.34	29.16

Table H-235. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02	0.05	0.05	-	-	-	-	-	-	-	-	0.02	0.02
180	0.23	0.22	0.06	0.06	-	-	-	-	-	-	0.14	0.13	0.23	0.22	0.06	0.06	-	-	-	-	-	-	0.14	0.13
170	0.91	0.87	0.28	0.27	-	-	-	-	-	-	0.65	0.62	0.95	0.91	0.29	0.28	-	-	-	-	-	-	0.69	0.66
160	2.47	2.30	1.04	0.99	-	-	-	-	0.07	0.07	1.93	1.80	2.63	2.45	1.13	1.08	-	-	-	-	0.07	0.07	2.02	1.90
150	4.76	4.44	2.75	2.56	-	-	-	-	0.39	0.38	4.22	3.94	5.34	4.95	2.93	2.74	-	-	-	-	0.40	0.38	4.74	4.42
140	7.88	7.16	5.38	5.01	-	-	-	-	1.39	1.31	7.34	6.70	9.64	8.74	6.36	5.88	-	-	-	-	1.48	1.39	9.20	8.32
130	12.20	11.15	9.04	8.22	0.05	0.05	0.02	0.02	3.29	3.01	11.72	10.66	16.74	15.17	12.16	11.04	0.08	0.08	0.02	0.02	3.68	3.40	16.12	14.65
120	17.39	15.75	13.90	12.72	0.39	0.37	0.13	0.13	6.14	5.70	16.91	15.36	28.12	25.00	20.98	18.69	0.29	0.28	0.15	0.14	7.66	6.95	27.45	24.35

Table H-236. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.08	0.08	-	-	-	-	-	-	-	-	0.06	0.06	0.09	0.08	-	-	-	-	-	-	-	-	0.06	0.06
170	0.46	0.44	0.11	0.11	-	-	-	-	-	-	0.33	0.31	0.50	0.48	0.11	0.11	-	-	-	-	-	-	0.35	0.34
160	1.60	1.49	0.58	0.57	-	-	-	-	0.03	0.03	1.19	1.13	1.69	1.58	0.62	0.60	-	-	-	-	0.03	0.03	1.27	1.20
150	3.55	3.27	1.79	1.69	-	-	-	-	0.17	0.16	2.90	2.71	3.89	3.60	1.91	1.78	-	-	-	-	0.17	0.16	3.16	2.91
140	6.16	5.69	4.03	3.73	-	-	-	-	0.82	0.77	5.64	5.23	7.22	6.60	4.46	4.17	-	-	-	-	0.85	0.81	6.68	6.14
130	9.68	8.81	7.02	6.46	-	-	-	-	2.24	2.04	9.30	8.45	12.90	11.82	8.92	8.06	0.02	0.02	-	-	2.40	2.21	12.40	11.32
120	14.58	13.33	11.40	10.34	0.14	0.13	0.08	0.08	4.62	4.31	14.14	12.94	21.72	19.18	15.95	14.52	0.15	0.15	0.08	0.08	5.32	4.95	20.78	18.53

Table H-237. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.08	0.08	0.01	0.01	-	-	-	-	-	-	0.07	0.06	0.09	0.09	0.01	0.01	-	-	-	-	-	-	0.06	0.06
180	0.43	0.40	0.11	0.11	-	-	-	-	-	-	0.31	0.30	0.46	0.44	0.11	0.11	-	-	-	-	-	-	0.31	0.31
170	1.58	1.51	0.56	0.53	-	-	-	-	0.01	0.01	1.22	1.16	1.66	1.58	0.57	0.55	-	-	-	-	0.01	0.01	1.28	1.22
160	3.79	3.60	1.84	1.76	-	-	-	-	0.15	0.14	2.99	2.86	4.10	3.90	1.94	1.86	-	-	-	-	0.14	0.14	3.27	3.11
150	7.00	6.55	4.25	4.04	-	-	-	-	0.82	0.78	6.22	5.83	8.35	7.74	4.66	4.41	-	-	-	-	0.84	0.81	7.36	6.81
140	12.00	10.95	7.98	7.44	0.01	0.01	-	-	2.31	2.20	11.02	10.04	15.78	14.33	9.87	9.14	0.01	0.01	-	-	2.48	2.37	14.89	13.54
130	17.94	16.29	13.72	12.51	0.10	0.09	0.01	0.01	4.96	4.68	17.24	15.70	27.67	24.70	19.34	17.43	0.10	0.10	0.01	0.01	5.56	5.22	26.75	23.87
120	26.29	23.60	20.47	18.34	0.47	0.45	0.11	0.11	9.07	8.42	25.66	23.03	45.26	40.84	34.50	30.59	0.48	0.45	0.12	0.12	12.06	11.03	44.07	39.60

Table H-238. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	-	-	-	-	-	-	-	-	0.01	0.01	0.02	0.02	-	-	-	-	-	-	-	-	0.01	0.01
180	0.13	0.13	0.05	0.05	-	-	-	-	-	-	0.11	0.10	0.14	0.14	0.05	0.05	-	-	-	-	-	-	0.11	0.11
170	0.79	0.76	0.21	0.21	-	-	-	-	-	-	0.54	0.52	0.82	0.79	0.21	0.21	-	-	-	-	-	-	0.56	0.54
160	2.29	2.19	0.92	0.88	-	-	-	-	0.07	0.07	1.81	1.72	2.45	2.34	0.97	0.93	-	-	-	-	0.07	0.07	1.89	1.81
150	4.94	4.67	2.65	2.53	-	-	-	-	0.34	0.33	4.21	3.99	5.50	5.18	2.81	2.69	-	-	-	-	0.35	0.33	4.59	4.36
140	8.76	8.12	5.53	5.21	-	-	-	-	1.30	1.24	7.90	7.36	10.84	9.87	6.38	5.94	-	-	-	-	1.37	1.30	9.72	9.01
130	14.28	13.00	9.83	9.12	0.02	0.02	-	-	3.15	3.00	13.52	12.35	19.59	17.66	13.44	12.28	0.02	0.02	-	-	3.50	3.32	18.77	16.97
120	20.88	18.61	16.23	14.77	0.18	0.18	0.05	0.05	6.38	5.97	19.91	18.02	33.74	29.85	25.14	22.36	0.20	0.19	0.05	0.04	7.60	7.04	32.74	28.96

Table H-239. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.08	0.08	0.01	0.01	-	-	-	-	-	-	0.07	0.06	0.09	0.09	0.01	0.01	-	-	-	-	-	-	0.06	0.06
170	0.43	0.40	0.11	0.11	-	-	-	-	-	-	0.31	0.30	0.46	0.44	0.11	0.11	-	-	-	-	-	-	0.31	0.31
160	1.58	1.51	0.56	0.53	-	-	-	-	0.01	0.01	1.22	1.16	1.66	1.58	0.57	0.55	-	-	-	-	0.01	0.01	1.28	1.22
150	3.79	3.60	1.84	1.76	-	-	-	-	0.15	0.14	2.99	2.86	4.10	3.90	1.95	1.86	-	-	-	-	0.14	0.14	3.27	3.11
140	7.00	6.55	4.25	4.04	-	-	-	-	0.82	0.78	6.22	5.83	8.35	7.74	4.66	4.41	-	-	-	-	0.84	0.81	7.36	6.81
130	12.00	10.95	7.98	7.44	0.01	0.01	-	-	2.31	2.20	11.02	10.04	15.78	14.33	9.87	9.14	0.01	0.01	-	-	2.48	2.37	14.89	13.54
120	17.94	16.29	13.72	12.51	0.09	0.09	0.01	0.01	4.95	4.68	17.24	15.70	27.67	24.70	19.34	17.43	0.10	0.09	0.01	0.01	5.56	5.22	26.75	23.87

Table H-240. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.04	0.04	-	-	-	-	-	-	-	-	0.01	0.01	0.04	0.04	-	-	-	-	-	-	-	-	0.01	0.01
170	0.16	0.16	0.06	0.06	-	-	-	-	-	-	0.12	0.11	0.16	0.15	0.05	0.05	-	-	-	-	-	-	0.12	0.12
160	0.87	0.83	0.24	0.23	-	-	-	-	-	-	0.61	0.58	0.90	0.86	0.28	0.25	-	-	-	-	-	-	0.64	0.61
150	2.51	2.41	1.08	1.00	-	-	-	-	0.09	0.08	1.97	1.88	2.65	2.55	1.15	1.10	-	-	-	-	0.09	0.09	2.10	1.99
140	5.25	4.96	2.84	2.71	-	-	-	-	0.37	0.36	4.50	4.26	5.92	5.55	3.01	2.87	-	-	-	-	0.38	0.37	4.97	4.70
130	9.19	8.51	5.90	5.54	-	-	-	-	1.40	1.34	8.37	7.79	11.71	10.67	6.88	6.39	-	-	-	-	1.52	1.45	10.49	9.60
120	14.86	13.51	10.46	9.56	0.02	0.02	-	-	3.47	3.30	14.13	12.87	20.90	18.54	14.33	13.06	0.04	0.04	-	-	3.81	3.61	19.75	17.80

Table H-241. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.04	0.04	-	-	-	-	-	-	-	-	0.01	0.01	0.04	0.04	-	-	-	-	-	-	-	-	0.01	0.01
190	0.21	0.20	0.06	0.06	-	-	-	-	-	-	0.14	0.13	0.22	0.21	0.06	0.06	-	-	-	-	-	-	0.14	0.14
180	1.03	0.99	0.33	0.32	-	-	-	-	-	-	0.77	0.74	1.08	1.04	0.33	0.32	-	-	-	-	-	-	0.80	0.77
170	2.75	2.63	1.26	1.20	-	-	-	-	0.09	0.09	2.16	2.05	2.89	2.77	1.33	1.27	-	-	-	-	0.09	0.09	2.31	2.21
160	5.49	5.17	2.99	2.85	-	-	-	-	0.46	0.45	4.64	4.39	6.08	5.67	3.27	3.09	-	-	-	-	0.48	0.47	5.03	4.74
150	9.30	8.60	5.96	5.61	-	-	-	-	1.60	1.52	8.41	7.80	11.41	10.38	6.76	6.26	-	-	-	-	1.71	1.62	10.02	9.26
140	14.90	13.53	10.49	9.56	0.05	0.05	0.02	0.02	3.69	3.50	14.15	12.86	20.07	18.12	14.00	12.72	0.05	0.05	0.02	0.02	3.99	3.79	19.23	17.43
130	21.94	19.45	16.95	15.37	0.34	0.32	0.10	0.10	6.81	6.37	20.95	18.72	35.78	31.46	26.61	23.72	0.29	0.27	0.10	0.10	8.12	7.49	34.72	30.52
120	30.92	27.29	25.54	22.79	1.20	1.12	0.54	0.50	12.18	11.08	30.30	26.74	73.08	59.67	49.40	44.49	1.24	1.14	0.56	0.51	16.93	15.43	70.42	57.54

Table H-242. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.08	0.08	0.01	0.01	-	-	-	-	-	-	0.05	0.05	0.08	0.08	0.01	0.01	-	-	-	-	-	-	0.05	0.05
180	0.47	0.45	0.11	0.11	-	-	-	-	-	-	0.32	0.31	0.48	0.47	0.11	0.11	-	-	-	-	-	-	0.32	0.31
170	1.65	1.57	0.55	0.52	-	-	-	-	0.01	0.01	1.24	1.18	1.73	1.65	0.58	0.55	-	-	-	-	0.01	0.01	1.30	1.24
160	3.81	3.60	1.84	1.75	-	-	-	-	0.14	0.14	2.96	2.82	4.08	3.87	1.93	1.85	-	-	-	-	0.15	0.15	3.19	3.03
150	6.81	6.38	4.13	3.92	-	-	-	-	0.80	0.77	5.92	5.57	7.81	7.23	4.44	4.21	-	-	-	-	0.83	0.80	6.72	6.21
140	11.47	10.43	7.56	7.03	0.01	0.01	-	-	2.27	2.16	10.31	9.43	14.54	13.21	9.04	8.35	0.01	0.01	-	-	2.45	2.33	13.58	12.36
130	17.32	15.72	13.14	11.98	0.10	0.09	0.04	0.04	4.76	4.52	16.66	15.11	25.96	23.20	17.91	16.29	0.11	0.10	0.04	0.04	5.26	4.94	24.96	22.32
120	25.64	22.93	19.60	17.78	0.52	0.48	0.21	0.20	8.64	8.00	24.95	22.29	44.49	39.74	33.90	29.79	0.57	0.54	0.23	0.23	10.97	9.97	43.26	38.40

Table H-243. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.04	0.04	-	-	-	-	-	-	-	-	0.01	0.01	0.04	0.04	-	-	-	-	-	-	-	-	0.01	0.01
180	0.21	0.20	0.06	0.06	-	-	-	-	-	-	0.14	0.13	0.22	0.21	0.06	0.06	-	-	-	-	-	-	0.14	0.14
170	1.03	0.99	0.33	0.32	-	-	-	-	-	-	0.77	0.74	1.08	1.04	0.33	0.32	-	-	-	-	-	-	0.80	0.77
160	2.75	2.63	1.26	1.20	-	-	-	-	0.09	0.09	2.16	2.05	2.89	2.77	1.33	1.27	-	-	-	-	0.09	0.09	2.31	2.21
150	5.49	5.17	2.99	2.85	-	-	-	-	0.46	0.45	4.64	4.39	6.08	5.67	3.27	3.09	-	-	-	-	0.48	0.47	5.03	4.74
140	9.30	8.60	5.96	5.61	-	-	-	-	1.60	1.52	8.41	7.80	11.41	10.38	6.76	6.26	-	-	-	-	1.71	1.62	10.02	9.26
130	14.90	13.53	10.49	9.56	0.05	0.05	0.02	0.02	3.69	3.50	14.15	12.86	20.07	18.12	14.00	12.72	0.05	0.05	0.02	0.02	3.99	3.79	19.23	17.43
120	21.94	19.45	16.95	15.37	0.34	0.32	0.10	0.10	6.81	6.37	20.95	18.72	35.78	31.46	26.61	23.72	0.29	0.27	0.10	0.10	8.12	7.49	34.72	30.52

Table H-244. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.10	0.09	0.01	0.01	-	-	-	-	-	-	0.07	0.07	0.11	0.10	0.01	0.01	-	-	-	-	-	-	0.07	0.07
170	0.52	0.49	0.12	0.12	-	-	-	-	-	-	0.35	0.34	0.54	0.52	0.13	0.13	-	-	-	-	-	-	0.36	0.35
160	1.79	1.71	0.67	0.64	-	-	-	-	0.02	0.02	1.35	1.29	1.87	1.79	0.72	0.69	-	-	-	-	0.02	0.02	1.42	1.36
150	4.07	3.86	2.00	1.91	-	-	-	-	0.20	0.19	3.23	3.05	4.36	4.13	2.16	2.06	-	-	-	-	0.19	0.18	3.50	3.31
140	7.20	6.71	4.39	4.17	-	-	-	-	0.87	0.83	6.28	5.89	8.31	7.70	4.76	4.49	-	-	-	-	0.91	0.88	7.20	6.64
130	12.08	11.00	8.02	7.45	0.01	0.01	-	-	2.49	2.38	11.04	10.02	15.40	13.96	9.63	8.89	0.01	0.01	-	-	2.67	2.54	14.45	13.12
120	17.94	16.30	13.76	12.51	0.11	0.11	0.05	0.05	5.07	4.80	17.31	15.70	27.45	24.41	18.97	17.23	0.12	0.12	0.04	0.04	5.63	5.27	26.42	23.56

Table H-245. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.07	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.06
180	0.43	0.41	0.12	0.12	-	-	-	-	-	-	0.27	0.26	0.44	0.42	0.12	0.12	-	-	-	-	-	-	0.28	0.27
170	1.67	1.59	0.60	0.57	-	-	-	-	0.02	0.02	1.25	1.20	1.76	1.68	0.63	0.61	-	-	-	-	0.02	0.02	1.33	1.27
160	4.03	3.83	1.94	1.86	-	-	-	-	0.15	0.14	3.20	3.04	4.32	4.11	2.08	1.98	-	-	-	-	0.16	0.15	3.48	3.30
150	7.44	6.90	4.45	4.22	-	-	-	-	0.89	0.86	6.38	5.97	8.54	7.93	4.83	4.58	-	-	-	-	0.93	0.89	7.22	6.73
140	12.57	11.53	8.22	7.58	0.02	0.02	-	-	2.50	2.39	11.44	10.43	16.11	14.45	9.76	9.01	0.02	0.02	-	-	2.67	2.55	14.95	13.41
130	18.85	17.02	14.13	12.89	0.11	0.11	0.06	0.06	5.20	4.91	17.97	16.30	28.60	25.46	19.60	17.67	0.12	0.11	0.06	0.06	5.79	5.47	27.38	24.40
120	27.69	24.89	21.78	19.32	0.55	0.53	0.21	0.21	9.42	8.69	26.89	24.20	50.12	45.21	38.34	34.08	0.85	0.81	0.30	0.29	12.70	11.53	48.58	43.77

Table H-246. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	-	-	-	-	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-
180	0.14	0.14	0.04	0.04	-	-	-	-	-	-	0.12	0.11	0.15	0.14	0.03	0.03	-	-	-	-	-	-	0.12	0.11
170	0.82	0.78	0.24	0.23	-	-	-	-	-	-	0.57	0.55	0.86	0.83	0.22	0.22	-	-	-	-	-	-	0.60	0.58
160	2.48	2.37	1.02	0.97	-	-	-	-	0.08	0.08	1.90	1.82	2.62	2.50	1.07	1.03	-	-	-	-	0.08	0.07	1.99	1.91
150	5.22	4.92	2.79	2.67	-	-	-	-	0.37	0.36	4.38	4.16	5.70	5.37	2.96	2.83	-	-	-	-	0.38	0.37	4.73	4.48
140	9.18	8.50	5.70	5.37	-	-	-	-	1.40	1.34	8.18	7.54	11.13	10.09	6.32	5.95	-	-	-	-	1.47	1.41	9.62	8.90
130	14.94	13.57	10.10	9.28	0.06	0.06	-	-	3.44	3.27	13.95	12.73	19.81	17.85	13.49	12.17	0.05	0.05	0.02	0.02	3.79	3.60	18.84	16.95
120	22.43	19.86	16.80	15.28	0.24	0.23	0.10	0.10	6.60	6.18	21.24	18.86	35.50	31.52	26.14	23.29	0.29	0.28	0.10	0.10	7.72	7.21	34.20	30.31

Table H-247. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.07	0.09	0.09	-	-	-	-	-	-	-	-	0.07	0.06
170	0.43	0.41	0.12	0.12	-	-	-	-	-	-	0.27	0.26	0.44	0.42	0.12	0.12	-	-	-	-	-	-	0.28	0.27
160	1.67	1.59	0.60	0.57	-	-	-	-	0.02	0.02	1.25	1.20	1.76	1.68	0.63	0.61	-	-	-	-	0.02	0.02	1.33	1.27
150	4.03	3.83	1.94	1.86	-	-	-	-	0.15	0.14	3.20	3.04	4.32	4.11	2.08	1.98	-	-	-	-	0.16	0.15	3.48	3.30
140	7.44	6.90	4.45	4.22	-	-	-	-	0.89	0.86	6.38	5.97	8.54	7.93	4.83	4.58	-	-	-	-	0.93	0.89	7.22	6.73
130	12.57	11.53	8.22	7.58	0.02	0.02	-	-	2.50	2.39	11.44	10.43	16.11	14.45	9.76	9.01	0.02	0.02	-	-	2.67	2.55	14.95	13.41
120	18.85	17.02	14.13	12.89	0.11	0.11	0.06	0.06	5.20	4.91	17.97	16.30	28.60	25.46	19.60	17.67	0.12	0.11	0.06	0.06	5.79	5.47	27.38	24.40

Table H-248. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
170	0.16	0.15	0.07	0.06	-	-	-	-	-	-	0.12	0.12	0.16	0.16	0.06	0.06	-	-	-	-	-	-	0.13	0.13
160	0.93	0.90	0.26	0.25	-	-	-	-	-	-	0.64	0.62	0.96	0.92	0.26	0.25	-	-	-	-	-	-	0.66	0.64
150	2.68	2.56	1.14	1.09	-	-	-	-	0.09	0.09	2.06	1.97	2.82	2.69	1.22	1.17	-	-	-	-	0.09	0.09	2.23	2.12
140	5.54	5.22	2.99	2.86	-	-	-	-	0.42	0.40	4.66	4.43	6.10	5.74	3.27	3.10	-	-	-	-	0.42	0.41	5.06	4.79
130	9.60	8.88	6.06	5.69	-	-	-	-	1.53	1.47	8.66	7.98	11.98	10.86	6.76	6.34	-	-	-	-	1.63	1.57	10.35	9.44
120	15.53	14.11	10.84	9.87	0.06	0.06	0.02	0.02	3.75	3.55	14.60	13.29	21.28	18.87	14.46	12.98	0.06	0.06	0.02	0.02	4.10	3.89	19.80	17.85

Table H-249. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
190	0.21	0.20	0.05	0.05	-	-	-	-	-	-	0.13	0.13	0.22	0.21	0.05	0.05	-	-	-	-	-	-	0.14	0.13
180	1.00	0.96	0.27	0.27	-	-	-	-	-	-	0.79	0.76	1.07	1.03	0.27	0.25	-	-	-	-	-	-	0.81	0.78
170	2.95	2.81	1.27	1.22	-	-	-	-	0.08	0.08	2.31	2.21	3.18	3.01	1.33	1.27	-	-	-	-	0.08	0.07	2.45	2.34
160	5.94	5.57	3.20	3.03	-	-	-	-	0.43	0.41	4.95	4.66	6.58	6.13	3.51	3.32	-	-	-	-	0.44	0.42	5.42	5.08
150	9.85	9.05	6.20	5.82	-	-	-	-	1.60	1.53	8.70	8.04	12.18	10.91	6.95	6.47	-	-	-	-	1.70	1.62	10.30	9.29
140	15.57	13.99	10.68	9.66	0.04	0.04	0.02	0.02	3.88	3.68	14.43	13.00	19.89	17.80	13.66	12.21	0.05	0.05	0.02	0.02	4.22	3.98	18.71	16.71
130	22.85	20.18	16.99	15.37	0.26	0.26	0.09	0.09	7.00	6.54	21.52	18.98	34.00	30.16	25.03	22.24	0.29	0.28	0.10	0.09	8.20	7.57	32.64	28.90
120	31.41	28.07	25.84	23.07	1.21	1.16	0.50	0.48	12.29	11.18	30.56	27.29	64.95	57.49	48.60	43.32	1.24	1.18	0.70	0.65	16.56	14.81	61.51	55.24

Table H-250. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.08	0.07	-	-	-	-	-	-	-	-	0.05	0.05	0.08	0.07	-	-	-	-	-	-	-	-	0.04	0.04
180	0.47	0.45	0.11	0.10	-	-	-	-	-	-	0.27	0.26	0.48	0.47	0.11	0.10	-	-	-	-	-	-	0.26	0.25
170	1.73	1.65	0.55	0.53	-	-	-	-	-	-	1.26	1.20	1.81	1.73	0.57	0.55	-	-	-	-	-	-	1.32	1.26
160	4.13	3.92	1.90	1.82	-	-	-	-	0.14	0.14	3.18	3.02	4.46	4.21	2.00	1.91	-	-	-	-	0.15	0.15	3.50	3.31
150	7.37	6.84	4.36	4.13	-	-	-	-	0.82	0.78	6.22	5.83	8.43	7.78	4.74	4.46	-	-	-	-	0.84	0.81	6.99	6.49
140	12.28	11.09	7.77	7.22	-	-	-	-	2.38	2.27	10.71	9.66	15.05	13.39	9.07	8.32	-	-	-	-	2.54	2.42	13.58	12.13
130	17.92	16.17	13.25	12.01	0.09	0.09	0.04	0.04	4.99	4.71	16.87	15.23	25.26	22.41	17.26	15.37	0.10	0.10	0.04	0.04	5.53	5.17	23.76	21.00
120	26.27	23.52	19.83	17.82	0.53	0.50	0.17	0.17	8.78	8.13	25.38	22.63	43.32	38.49	31.85	28.20	0.62	0.57	0.25	0.24	10.74	9.64	41.86	37.08

Table H-251. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	-	-	-	-	-	-	-	-	-	-	0.03	0.03	-	-	-	-	-	-	-	-	-	-
180	0.21	0.20	0.05	0.05	-	-	-	-	-	-	0.13	0.13	0.22	0.21	0.05	0.05	-	-	-	-	-	-	0.14	0.13
170	1.00	0.96	0.27	0.27	-	-	-	-	-	-	0.79	0.76	1.07	1.03	0.27	0.25	-	-	-	-	-	-	0.81	0.78
160	2.95	2.81	1.27	1.22	-	-	-	-	0.08	0.08	2.31	2.21	3.18	3.01	1.33	1.27	-	-	-	-	0.08	0.07	2.45	2.34
150	5.94	5.57	3.20	3.03	-	-	-	-	0.43	0.41	4.95	4.66	6.58	6.13	3.51	3.32	-	-	-	-	0.44	0.42	5.42	5.08
140	9.85	9.05	6.20	5.82	-	-	-	-	1.60	1.53	8.70	8.04	12.18	10.91	6.95	6.47	-	-	-	-	1.70	1.62	10.30	9.29
130	15.57	13.99	10.68	9.66	0.04	0.04	0.02	0.02	3.88	3.68	14.43	13.00	19.89	17.80	13.66	12.21	0.05	0.05	0.02	0.02	4.22	3.98	18.71	16.71
120	22.85	20.18	16.99	15.37	0.26	0.26	0.09	0.09	7.00	6.54	21.52	18.98	34.00	30.16	25.03	22.24	0.29	0.28	0.10	0.09	8.20	7.57	32.64	28.90

Table H-252. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.09	0.09	-	-	-	-	-	-	-	-	0.06	0.06	0.09	0.09	-	-	-	-	-	-	-	-	0.06	0.06
170	0.53	0.51	0.12	0.12	-	-	-	-	-	-	0.31	0.30	0.55	0.53	0.12	0.12	-	-	-	-	-	-	0.32	0.30
160	1.89	1.82	0.60	0.58	-	-	-	-	0.02	0.02	1.39	1.33	1.99	1.90	0.63	0.60	-	-	-	-	0.02	0.02	1.46	1.39
150	4.41	4.17	2.06	1.97	-	-	-	-	0.16	0.15	3.51	3.34	4.78	4.50	2.23	2.12	-	-	-	-	0.17	0.17	3.82	3.61
140	7.79	7.22	4.64	4.39	-	-	-	-	0.89	0.85	6.58	6.15	8.94	8.21	5.07	4.75	-	-	-	-	0.91	0.87	7.50	6.92
130	12.82	11.60	8.22	7.63	0.02	0.02	-	-	2.58	2.47	11.40	10.29	15.81	14.05	9.62	8.80	0.02	0.02	-	-	2.74	2.62	14.40	12.81
120	18.57	16.72	13.86	12.54	0.11	0.11	0.04	0.04	5.31	4.99	17.52	15.83	26.52	23.58	18.22	16.27	0.12	0.11	0.05	0.05	5.90	5.51	25.12	22.28

H.2.1. Jacket Foundation

Table H-253. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.10	0.09	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.10	0.10	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08
160	0.54	0.53	0.18	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.40	0.56	0.54	0.18	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.44
150	1.75	1.67	0.85	0.81	0.00	0.00	0.00	0.00	0.07	0.07	1.48	1.41	1.84	1.75	0.88	0.84	0.00	0.00	0.00	0.00	0.07	0.07	1.56	1.48
140	3.93	3.68	2.31	2.18	0.00	0.00	0.00	0.00	0.32	0.31	3.46	3.25	4.37	4.07	2.47	2.35	0.00	0.00	0.00	0.00	0.33	0.32	3.88	3.64
130	6.80	6.21	4.75	4.41	0.01	0.01	0.00	0.00	1.20	1.14	6.37	5.85	8.33	7.47	5.42	5.00	0.01	0.01	0.00	0.00	1.26	1.21	7.87	7.04
120	10.63	9.53	8.16	7.39	0.10	0.10	0.05	0.05	2.84	2.69	10.09	9.17	14.44	12.94	10.36	9.27	0.10	0.09	0.04	0.04	3.07	2.89	14.03	12.60

Table H-254. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.05	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
160	0.19	0.18	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.15	0.19	0.19	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.15
150	0.93	0.89	0.35	0.34	0.00	0.00	0.00	0.00	0.01	0.01	0.75	0.72	0.96	0.92	0.36	0.35	0.00	0.00	0.00	0.00	0.01	0.01	0.77	0.74
140	2.49	2.37	1.34	1.27	0.00	0.00	0.00	0.00	0.11	0.10	2.12	2.01	2.66	2.53	1.39	1.33	0.00	0.00	0.00	0.00	0.11	0.11	2.28	2.17
130	4.99	4.63	3.07	2.89	0.00	0.00	0.00	0.00	0.57	0.55	4.57	4.25	5.70	5.23	3.46	3.23	0.00	0.00	0.00	0.00	0.59	0.57	5.21	4.82
120	8.30	7.51	5.94	5.46	0.03	0.03	0.01	0.01	1.76	1.68	7.87	7.13	10.19	9.16	7.16	6.46	0.03	0.03	0.01	0.01	1.86	1.77	9.79	8.84

Table H-255. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
160	0.10	0.09	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.10	0.10	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08
150	0.54	0.53	0.18	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.40	0.56	0.54	0.18	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.44
140	1.75	1.67	0.85	0.81	0.00	0.00	0.00	0.00	0.07	0.07	1.48	1.41	1.84	1.75	0.88	0.84	0.00	0.00	0.00	0.00	0.07	0.07	1.56	1.48
130	3.93	3.68	2.31	2.18	0.00	0.00	0.00	0.00	0.32	0.31	3.46	3.25	4.37	4.07	2.47	2.35	0.00	0.00	0.00	0.00	0.33	0.32	3.88	3.64
120	6.80	6.21	4.75	4.41	0.01	0.01	0.00	0.00	1.20	1.14	6.37	5.85	8.33	7.47	5.42	5.00	0.01	0.01	0.00	0.00	1.26	1.21	7.87	7.04

Table H-256. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
160	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04
150	0.26	0.25	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.18	0.25	0.25	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.17
140	1.02	0.97	0.44	0.41	0.00	0.00	0.00	0.00	0.02	0.02	0.85	0.81	1.08	1.03	0.46	0.44	0.00	0.00	0.00	0.00	0.02	0.02	0.89	0.84
130	2.68	2.54	1.47	1.40	0.00	0.00	0.00	0.00	0.13	0.12	2.34	2.22	2.86	2.72	1.54	1.47	0.00	0.00	0.00	0.00	0.12	0.11	2.52	2.39
120	5.27	4.88	3.38	3.16	0.00	0.00	0.00	0.00	0.68	0.65	4.84	4.50	6.08	5.55	3.77	3.53	0.00	0.00	0.00	0.00	0.70	0.68	5.58	5.14

Table H-257. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
170	0.13	0.13	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.10	0.14	0.13	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.10
160	0.68	0.65	0.22	0.21	0.00	0.00	0.00	0.00	0.01	0.01	0.49	0.48	0.67	0.64	0.21	0.21	0.00	0.00	0.00	0.00	0.01	0.01	0.49	0.48
150	2.30	2.19	0.99	0.95	0.00	0.00	0.00	0.00	0.06	0.06	1.93	1.85	2.44	2.32	1.03	0.98	0.00	0.00	0.00	0.00	0.06	0.06	2.02	1.93
140	5.15	4.79	3.13	2.94	0.00	0.00	0.00	0.00	0.34	0.33	4.84	4.51	6.01	5.53	3.63	3.40	0.00	0.00	0.00	0.00	0.33	0.32	5.67	5.26
130	9.00	8.17	6.68	6.13	0.02	0.02	0.00	0.00	1.46	1.40	8.78	7.96	12.31	11.03	8.82	7.94	0.02	0.02	0.00	0.00	1.53	1.46	12.03	10.77
120	14.13	12.77	11.45	10.30	0.13	0.12	0.09	0.09	4.10	3.85	13.94	12.60	24.22	21.51	18.28	16.28	0.13	0.12	0.09	0.09	4.81	4.51	23.82	21.12

Table H-258. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.04	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.04	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
160	0.26	0.25	0.10	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.18	0.26	0.25	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.17
150	1.19	1.14	0.41	0.39	0.00	0.00	0.00	0.00	0.03	0.03	0.92	0.88	1.19	1.14	0.40	0.38	0.00	0.00	0.00	0.00	0.03	0.03	0.92	0.88
140	3.27	3.08	1.69	1.61	0.00	0.00	0.00	0.00	0.13	0.12	2.89	2.75	3.65	3.43	1.77	1.69	0.00	0.00	0.00	0.00	0.13	0.12	3.22	3.02
130	6.54	6.00	4.50	4.21	0.00	0.00	0.00	0.00	0.65	0.62	6.25	5.76	8.17	7.34	5.29	4.94	0.00	0.00	0.00	0.00	0.65	0.63	7.85	7.07
120	10.82	9.70	8.48	7.69	0.06	0.06	0.02	0.02	2.31	2.19	10.51	9.47	15.86	14.19	11.90	10.65	0.06	0.06	0.02	0.02	2.54	2.40	15.59	13.95

Table H-259. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
160	0.13	0.13	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.10	0.14	0.13	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.10
150	0.68	0.65	0.22	0.21	0.00	0.00	0.00	0.00	0.01	0.01	0.49	0.48	0.67	0.64	0.21	0.21	0.00	0.00	0.00	0.00	0.01	0.01	0.49	0.48
140	2.30	2.19	0.99	0.95	0.00	0.00	0.00	0.00	0.06	0.06	1.93	1.85	2.44	2.32	1.03	0.98	0.00	0.00	0.00	0.00	0.06	0.06	2.02	1.93
130	5.15	4.79	3.13	2.94	0.00	0.00	0.00	0.00	0.34	0.33	4.84	4.51	6.01	5.53	3.63	3.40	0.00	0.00	0.00	0.00	0.33	0.32	5.67	5.26
120	9.00	8.17	6.68	6.13	0.02	0.02	0.00	0.00	1.46	1.40	8.78	7.96	12.31	11.03	8.82	7.94	0.02	0.02	0.00	0.00	1.53	1.46	12.03	10.77

Table H-260. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
160	0.05	0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.05	0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
150	0.29	0.28	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.23	0.29	0.28	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.22
140	1.33	1.28	0.48	0.47	0.00	0.00	0.00	0.00	0.03	0.03	1.07	1.00	1.35	1.29	0.48	0.47	0.00	0.00	0.00	0.00	0.03	0.03	1.06	1.02
130	3.61	3.39	1.89	1.80	0.00	0.00	0.00	0.00	0.15	0.14	3.19	3.00	4.02	3.77	1.98	1.89	0.00	0.00	0.00	0.00	0.15	0.14	3.63	3.41
120	6.90	6.31	4.83	4.51	0.00	0.00	0.00	0.00	0.76	0.72	6.63	6.08	8.74	7.87	5.77	5.36	0.00	0.00	0.00	0.00	0.76	0.73	8.47	7.62

Table H-261. Jacket foundation (2.5 m diameter, IHC S-4000, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.05	0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.05	0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
170	0.27	0.27	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.22	0.28	0.27	0.11	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.21
160	1.20	1.16	0.44	0.42	0.00	0.00	0.00	0.00	0.03	0.03	0.93	0.90	1.19	1.13	0.45	0.43	0.00	0.00	0.00	0.00	0.03	0.03	0.92	0.88
150	3.30	3.10	1.82	1.74	0.00	0.00	0.00	0.00	0.15	0.15	2.93	2.80	3.53	3.31	1.79	1.70	0.00	0.00	0.00	0.00	0.16	0.15	3.10	2.91
140	6.70	6.13	4.77	4.45	0.01	0.01	0.00	0.00	0.75	0.72	6.46	5.94	8.30	7.44	5.45	5.07	0.01	0.01	0.00	0.00	0.73	0.70	8.02	7.21
130	11.39	10.22	9.02	8.20	0.12	0.12	0.06	0.04	2.55	2.43	11.16	10.01	16.82	15.08	12.80	11.53	0.11	0.11	0.04	0.04	2.62	2.48	16.51	14.80
120	17.30	15.52	14.69	13.26	0.50	0.48	0.31	0.25	5.99	5.55	17.13	15.38	34.64	31.08	28.32	25.08	0.47	0.45	0.24	0.23	7.55	6.80	33.81	30.34

Table H-262. Jacket foundation (2.5 m diameter, IHC S-4000, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
170	0.12	0.12	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.13	0.12	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10
160	0.48	0.46	0.17	0.17	0.00	0.00	0.00	0.00	0.01	0.01	0.39	0.38	0.47	0.45	0.18	0.17	0.00	0.00	0.00	0.00	0.01	0.01	0.39	0.38
150	1.87	1.78	0.84	0.80	0.00	0.00	0.00	0.00	0.05	0.05	1.59	1.52	1.87	1.79	0.83	0.80	0.00	0.00	0.00	0.00	0.05	0.05	1.58	1.51
140	4.59	4.28	2.76	2.63	0.00	0.00	0.00	0.00	0.29	0.28	4.32	4.03	5.08	4.71	2.86	2.71	0.00	0.00	0.00	0.00	0.29	0.28	4.77	4.44
130	8.45	7.66	6.29	5.80	0.03	0.03	0.01	0.01	1.28	1.23	8.25	7.47	10.97	9.79	7.93	7.13	0.03	0.03	0.01	0.01	1.27	1.21	10.69	9.54
120	13.64	12.34	11.09	9.97	0.18	0.17	0.12	0.12	3.78	3.57	13.45	12.19	22.87	20.22	17.36	15.53	0.20	0.20	0.11	0.11	4.17	3.91	22.38	19.74

Table H-263. Jacket foundation (2.5 m diameter, IHC S-4000, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.05	0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.05	0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
160	0.27	0.27	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.22	0.28	0.27	0.11	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.21
150	1.20	1.16	0.44	0.42	0.00	0.00	0.00	0.00	0.03	0.03	0.93	0.90	1.19	1.13	0.45	0.43	0.00	0.00	0.00	0.00	0.03	0.03	0.92	0.88
140	3.30	3.10	1.82	1.74	0.00	0.00	0.00	0.00	0.15	0.15	2.93	2.80	3.53	3.31	1.79	1.70	0.00	0.00	0.00	0.00	0.16	0.15	3.10	2.91
130	6.70	6.13	4.77	4.45	0.01	0.01	0.00	0.00	0.75	0.72	6.46	5.94	8.30	7.44	5.45	5.07	0.01	0.01	0.00	0.00	0.73	0.70	8.02	7.21
120	11.39	10.22	9.02	8.20	0.12	0.12	0.06	0.04	2.55	2.43	11.16	10.01	16.82	15.08	12.80	11.53	0.11	0.11	0.04	0.04	2.62	2.48	16.51	14.80

Table H-264. Jacket foundation (2.5 m diameter, IHC S-4000, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
160	0.14	0.13	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.10	0.14	0.13	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.11
150	0.58	0.56	0.20	0.19	0.00	0.00	0.00	0.00	0.01	0.01	0.44	0.43	0.57	0.55	0.21	0.20	0.00	0.00	0.00	0.00	0.01	0.01	0.45	0.43
140	2.03	1.94	0.93	0.89	0.00	0.00	0.00	0.00	0.05	0.05	1.81	1.73	2.03	1.93	0.93	0.89	0.00	0.00	0.00	0.00	0.07	0.07	1.79	1.68
130	4.91	4.57	2.98	2.84	0.00	0.00	0.00	0.00	0.35	0.34	4.64	4.33	5.51	5.10	3.22	3.00	0.00	0.00	0.00	0.00	0.35	0.34	5.21	4.84
120	8.88	8.05	6.70	6.15	0.03	0.03	0.01	0.01	1.46	1.40	8.69	7.88	11.91	10.66	8.64	7.76	0.03	0.03	0.01	0.01	1.43	1.37	11.63	10.40

Table H-265. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
180	0.11	0.10	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.11	0.10	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08
170	0.37	0.36	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.28	0.36	0.35	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.28
160	1.46	1.39	0.61	0.57	0.00	0.00	0.00	0.00	0.03	0.03	1.23	1.18	1.43	1.37	0.60	0.58	0.00	0.00	0.00	0.00	0.03	0.03	1.21	1.16
150	3.78	3.56	2.20	2.09	0.00	0.00	0.00	0.00	0.20	0.20	3.44	3.22	4.00	3.74	2.11	2.00	0.00	0.00	0.00	0.00	0.22	0.22	3.61	3.38
140	7.31	6.64	5.36	4.98	0.02	0.02	0.01	0.01	0.99	0.91	7.03	6.44	9.06	8.15	6.17	5.68	0.02	0.02	0.01	0.01	0.96	0.92	8.83	7.92
130	12.31	11.12	9.73	8.90	0.14	0.13	0.09	0.09	3.00	2.86	12.10	10.92	18.80	16.80	14.40	12.99	0.14	0.14	0.09	0.09	3.09	2.90	18.39	16.44
120	18.46	16.53	15.89	14.33	0.61	0.59	0.41	0.40	6.85	6.29	18.26	16.35	41.94	36.51	32.62	29.17	0.60	0.58	0.38	0.37	8.82	7.92	39.84	34.85

Table H-266. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
170	0.18	0.17	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.12	0.18	0.18	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.13
160	0.68	0.66	0.25	0.24	0.00	0.00	0.00	0.00	0.01	0.01	0.52	0.49	0.67	0.64	0.25	0.24	0.00	0.00	0.00	0.00	0.01	0.01	0.51	0.49
150	2.22	2.10	1.11	1.06	0.00	0.00	0.00	0.00	0.10	0.09	1.89	1.80	2.19	2.09	1.05	0.98	0.00	0.00	0.00	0.00	0.10	0.09	1.89	1.80
140	5.05	4.69	3.23	3.04	0.00	0.00	0.00	0.00	0.40	0.39	4.77	4.45	5.60	5.17	3.34	3.14	0.01	0.01	0.00	0.00	0.42	0.41	5.29	4.90
130	9.08	8.24	6.97	6.40	0.07	0.07	0.02	0.02	1.61	1.54	8.89	8.07	12.21	10.96	8.93	8.02	0.07	0.07	0.02	0.02	1.59	1.52	11.90	10.67
120	14.57	13.15	12.25	11.09	0.25	0.24	0.14	0.13	4.47	4.19	14.39	12.98	26.01	23.12	19.76	17.65	0.23	0.22	0.14	0.13	4.88	4.54	25.32	22.51

Table H-267. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
170	0.11	0.10	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.11	0.10	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08
160	0.37	0.36	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.28	0.36	0.35	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.28
150	1.46	1.39	0.61	0.57	0.00	0.00	0.00	0.00	0.03	0.03	1.23	1.18	1.43	1.37	0.60	0.58	0.00	0.00	0.00	0.00	0.03	0.03	1.21	1.16
140	3.78	3.56	2.20	2.09	0.00	0.00	0.00	0.00	0.20	0.20	3.44	3.22	4.00	3.74	2.11	2.00	0.00	0.00	0.00	0.00	0.22	0.22	3.61	3.38
130	7.31	6.64	5.36	4.98	0.02	0.02	0.01	0.01	0.99	0.91	7.03	6.44	9.06	8.15	6.17	5.68	0.02	0.02	0.01	0.01	0.96	0.92	8.83	7.92
120	12.31	11.12	9.73	8.90	0.14	0.13	0.09	0.09	3.00	2.86	12.10	10.92	18.80	16.80	14.40	12.99	0.14	0.14	0.09	0.09	3.09	2.90	18.39	16.44

Table H-268. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.03	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.03	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
160	0.20	0.19	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.14	0.20	0.20	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.14
150	0.76	0.73	0.29	0.28	0.00	0.00	0.00	0.00	0.02	0.02	0.63	0.58	0.74	0.71	0.29	0.28	0.00	0.00	0.00	0.00	0.02	0.02	0.59	0.56
140	2.42	2.31	1.23	1.18	0.00	0.00	0.00	0.00	0.11	0.10	2.12	2.01	2.45	2.32	1.22	1.17	0.00	0.00	0.00	0.00	0.11	0.11	2.02	1.93
130	5.39	5.00	3.58	3.37	0.01	0.01	0.00	0.00	0.45	0.43	5.12	4.76	6.08	5.58	3.79	3.54	0.01	0.01	0.00	0.00	0.46	0.44	5.76	5.32
120	9.47	8.63	7.47	6.80	0.08	0.08	0.02	0.02	1.83	1.75	9.30	8.46	13.10	11.80	9.57	8.65	0.09	0.08	0.02	0.02	1.81	1.71	12.82	11.54

Table H-269. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.09	0.09	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.07	0.09	0.09	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08
160	0.49	0.47	0.17	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.42	0.50	0.48	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.41
150	1.84	1.77	0.81	0.78	0.00	0.00	0.00	0.00	0.07	0.06	1.53	1.47	1.93	1.85	0.83	0.80	0.00	0.00	0.00	0.00	0.07	0.06	1.61	1.54
140	4.40	4.17	2.50	2.39	0.00	0.00	0.00	0.00	0.28	0.26	3.90	3.69	4.92	4.67	2.66	2.55	0.00	0.00	0.00	0.00	0.29	0.28	4.31	4.09
130	8.03	7.48	5.32	5.02	0.00	0.00	0.00	0.00	1.20	1.15	7.32	6.84	9.93	9.23	6.15	5.79	0.00	0.00	0.00	0.00	1.27	1.22	9.28	8.63
120	13.33	12.26	9.41	8.74	0.10	0.09	0.04	0.04	3.18	2.98	12.69	11.67	19.00	17.24	13.24	12.15	0.10	0.09	0.04	0.04	3.51	3.31	18.34	16.60

Table H-270. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
160	0.16	0.16	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.16	0.15	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.13
150	0.93	0.90	0.33	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.70	0.96	0.93	0.33	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.71
140	2.71	2.59	1.37	1.31	0.00	0.00	0.00	0.00	0.11	0.10	2.30	2.20	2.89	2.75	1.42	1.36	0.00	0.00	0.00	0.00	0.11	0.10	2.46	2.36
130	5.67	5.34	3.53	3.33	0.00	0.00	0.00	0.00	0.52	0.50	5.10	4.83	6.60	6.20	3.89	3.68	0.00	0.00	0.00	0.00	0.56	0.54	5.89	5.55
120	9.76	9.06	6.74	6.32	0.02	0.02	0.00	0.00	1.86	1.78	9.18	8.53	13.33	12.24	8.37	7.81	0.02	0.02	0.00	0.00	1.95	1.87	12.55	11.53

Table H-271. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
160	0.09	0.09	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.07	0.09	0.09	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08
150	0.49	0.47	0.17	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.42	0.50	0.48	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.41
140	1.84	1.77	0.81	0.78	0.00	0.00	0.00	0.00	0.07	0.06	1.53	1.47	1.93	1.85	0.83	0.80	0.00	0.00	0.00	0.00	0.07	0.06	1.61	1.54
130	4.40	4.17	2.50	2.39	0.00	0.00	0.00	0.00	0.28	0.26	3.90	3.69	4.92	4.67	2.66	2.55	0.00	0.00	0.00	0.00	0.29	0.28	4.31	4.09
120	8.03	7.48	5.32	5.02	0.00	0.00	0.00	0.00	1.20	1.15	7.32	6.84	9.93	9.23	6.15	5.79	0.00	0.00	0.00	0.00	1.27	1.22	9.28	8.63

Table H-272. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
160	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04
150	0.20	0.20	0.08	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.16	0.20	0.20	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.14
140	1.07	1.02	0.43	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.78	1.11	1.06	0.42	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.79
130	2.92	2.78	1.52	1.46	0.00	0.00	0.00	0.00	0.12	0.11	2.54	2.42	3.18	3.02	1.59	1.53	0.00	0.00	0.00	0.00	0.12	0.11	2.71	2.58
120	6.02	5.66	3.82	3.62	0.00	0.00	0.00	0.00	0.60	0.58	5.43	5.13	7.08	6.63	4.20	3.99	0.00	0.00	0.00	0.00	0.65	0.63	6.36	5.98

Table H-273. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
170	0.14	0.14	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.15	0.15	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10
160	0.80	0.76	0.24	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.56	0.81	0.78	0.23	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.55
150	2.76	2.64	1.15	1.11	0.00	0.00	0.00	0.00	0.07	0.06	2.28	2.18	2.96	2.82	1.20	1.15	0.00	0.00	0.00	0.00	0.07	0.06	2.49	2.37
140	6.24	5.87	3.62	3.45	0.00	0.00	0.00	0.00	0.38	0.37	5.71	5.38	7.63	7.12	4.22	4.01	0.00	0.00	0.00	0.00	0.39	0.38	6.97	6.54
130	11.34	10.42	7.80	7.29	0.04	0.04	0.00	0.00	1.61	1.55	10.70	9.82	16.36	14.89	10.68	9.83	0.02	0.02	0.00	0.00	1.73	1.66	15.83	14.43
120	17.82	16.22	13.93	12.78	0.15	0.14	0.10	0.10	4.51	4.29	17.42	15.86	32.27	28.64	23.88	21.39	0.12	0.12	0.10	0.09	5.47	5.18	31.73	28.17

Table H-274. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04
160	0.30	0.29	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.29	0.28	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.19
150	1.42	1.36	0.44	0.42	0.00	0.00	0.00	0.00	0.03	0.03	1.05	1.01	1.46	1.40	0.45	0.44	0.00	0.00	0.00	0.00	0.03	0.03	1.08	1.03
140	4.04	3.85	1.88	1.80	0.00	0.00	0.00	0.00	0.14	0.13	3.46	3.29	4.55	4.32	2.02	1.92	0.00	0.00	0.00	0.00	0.13	0.13	3.97	3.77
130	8.05	7.51	5.09	4.83	0.00	0.00	0.00	0.00	0.72	0.69	7.48	6.99	10.38	9.54	6.24	5.89	0.00	0.00	0.00	0.00	0.77	0.74	9.77	9.08
120	13.86	12.72	9.83	9.14	0.07	0.07	0.02	0.02	2.55	2.43	13.41	12.31	21.42	19.20	14.96	13.71	0.06	0.06	0.02	0.02	2.83	2.69	20.70	18.66

Table H-275. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
160	0.14	0.14	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.15	0.15	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10
150	0.80	0.76	0.24	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.56	0.81	0.78	0.23	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.55
140	2.76	2.64	1.15	1.11	0.00	0.00	0.00	0.00	0.07	0.06	2.28	2.18	2.96	2.82	1.20	1.15	0.00	0.00	0.00	0.00	0.07	0.06	2.49	2.37
130	6.24	5.87	3.62	3.45	0.00	0.00	0.00	0.00	0.38	0.37	5.71	5.38	7.63	7.12	4.22	4.01	0.00	0.00	0.00	0.00	0.39	0.38	6.97	6.54
120	11.34	10.42	7.80	7.29	0.04	0.04	0.00	0.00	1.61	1.55	10.70	9.82	16.36	14.89	10.68	9.83	0.02	0.02	0.00	0.00	1.73	1.66	15.83	14.43

Table H-276. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
160	0.06	0.06	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.06	0.06	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05
150	0.38	0.36	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.24	0.38	0.37	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.23
140	1.59	1.53	0.55	0.53	0.00	0.00	0.00	0.00	0.04	0.04	1.22	1.17	1.65	1.59	0.52	0.50	0.00	0.00	0.00	0.00	0.04	0.04	1.27	1.22
130	4.37	4.16	2.11	2.02	0.00	0.00	0.00	0.00	0.16	0.16	3.82	3.64	4.98	4.72	2.34	2.24	0.00	0.00	0.00	0.00	0.16	0.16	4.38	4.17
120	8.54	7.95	5.50	5.20	0.00	0.00	0.00	0.00	0.85	0.82	8.01	7.47	11.39	10.46	6.81	6.42	0.00	0.00	0.00	0.00	0.85	0.82	10.69	9.81

Table H-277. Jacket foundation (2.5 m diameter, IHC S-4000, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
170	0.17	0.16	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.17	0.16	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.13
160	0.82	0.79	0.25	0.24	0.00	0.00	0.00	0.00	0.02	0.02	0.57	0.55	0.74	0.71	0.26	0.25	0.00	0.00	0.00	0.00	0.02	0.02	0.57	0.55
150	2.75	2.63	1.25	1.18	0.00	0.00	0.00	0.00	0.07	0.07	2.35	2.25	2.76	2.64	1.20	1.16	0.00	0.00	0.00	0.00	0.07	0.07	2.35	2.25
140	6.43	6.05	4.00	3.83	0.00	0.00	0.00	0.00	0.44	0.42	6.04	5.70	7.49	7.03	4.22	4.01	0.00	0.00	0.00	0.00	0.44	0.42	6.97	6.56
130	12.12	11.16	8.70	8.15	0.04	0.04	0.03	0.03	1.79	1.72	11.74	10.81	17.34	15.80	11.71	10.86	0.04	0.04	0.03	0.03	1.77	1.70	16.91	15.43
120	19.15	17.42	15.58	14.29	0.27	0.26	0.15	0.15	5.16	4.91	18.88	17.20	36.74	32.44	27.82	24.80	0.26	0.26	0.13	0.13	5.80	5.50	36.15	31.93

Table H-278. Jacket foundation (2.5 m diameter, IHC S-4000, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.06	0.06	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.06	0.06	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04
160	0.35	0.34	0.10	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.22	0.34	0.33	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.23
150	1.39	1.34	0.48	0.46	0.00	0.00	0.00	0.00	0.03	0.03	1.01	0.97	1.39	1.33	0.48	0.46	0.00	0.00	0.00	0.00	0.03	0.03	1.03	0.98
140	4.08	3.89	2.05	1.97	0.00	0.00	0.00	0.00	0.16	0.16	3.59	3.44	4.31	4.09	1.96	1.88	0.00	0.00	0.00	0.00	0.17	0.16	3.79	3.61
130	8.40	7.85	5.65	5.34	0.02	0.02	0.00	0.00	0.81	0.78	8.02	7.50	10.56	9.76	6.47	6.11	0.02	0.02	0.00	0.00	0.77	0.74	9.97	9.31
120	14.79	13.55	11.28	10.40	0.12	0.12	0.04	0.04	2.85	2.73	14.48	13.28	23.84	21.36	16.67	15.26	0.10	0.10	0.04	0.04	2.87	2.74	23.33	20.91

Table H-279. Jacket foundation (2.5 m diameter, IHC S-4000, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
160	0.17	0.16	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.17	0.16	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.13
150	0.82	0.79	0.25	0.24	0.00	0.00	0.00	0.00	0.02	0.02	0.57	0.55	0.74	0.71	0.26	0.25	0.00	0.00	0.00	0.00	0.02	0.02	0.57	0.55
140	2.75	2.63	1.25	1.18	0.00	0.00	0.00	0.00	0.07	0.07	2.35	2.25	2.76	2.64	1.20	1.16	0.00	0.00	0.00	0.00	0.07	0.07	2.35	2.25
130	6.43	6.05	4.00	3.83	0.00	0.00	0.00	0.00	0.44	0.42	6.04	5.70	7.49	7.03	4.22	4.01	0.00	0.00	0.00	0.00	0.44	0.42	6.97	6.56
120	12.12	11.16	8.70	8.15	0.04	0.04	0.03	0.03	1.79	1.72	11.74	10.81	17.34	15.80	11.71	10.86	0.04	0.04	0.03	0.03	1.77	1.70	16.91	15.43

Table H-280. Jacket foundation (2.5 m diameter, IHC S-4000, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
160	0.06	0.06	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.06	0.06	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05
150	0.38	0.37	0.11	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.29	0.38	0.37	0.11	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.26
140	1.59	1.52	0.55	0.54	0.00	0.00	0.00	0.00	0.04	0.04	1.29	1.23	1.51	1.45	0.56	0.54	0.00	0.00	0.00	0.00	0.04	0.04	1.22	1.17
130	4.42	4.21	2.32	2.22	0.00	0.00	0.00	0.00	0.19	0.19	4.01	3.83	4.74	4.51	2.31	2.21	0.00	0.00	0.00	0.00	0.20	0.19	4.23	4.02
120	8.91	8.33	6.10	5.75	0.03	0.03	0.00	0.00	0.91	0.88	8.55	8.00	11.66	10.78	7.15	6.71	0.03	0.03	0.00	0.00	0.91	0.88	11.11	10.29

Table H-281. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 0 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.06	0.06	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.08	0.08	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04
170	0.37	0.36	0.12	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.23	0.36	0.34	0.12	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.24
160	1.36	1.31	0.50	0.49	0.00	0.00	0.00	0.00	0.04	0.04	0.99	0.96	1.36	1.30	0.50	0.48	0.00	0.00	0.00	0.00	0.04	0.04	0.99	0.96
150	3.86	3.69	2.05	1.96	0.00	0.00	0.00	0.00	0.19	0.19	3.40	3.25	3.91	3.72	1.98	1.88	0.00	0.00	0.00	0.00	0.20	0.19	3.40	3.22
140	8.13	7.62	5.65	5.35	0.03	0.03	0.02	0.02	0.89	0.85	7.78	7.29	9.67	9.04	6.00	5.69	0.03	0.03	0.02	0.02	0.87	0.83	9.30	8.68
130	14.68	13.46	11.50	10.65	0.15	0.15	0.10	0.10	3.01	2.87	14.38	13.20	23.14	20.76	16.38	15.01	0.14	0.14	0.10	0.09	2.94	2.81	22.53	20.21
120	23.56	21.07	19.20	17.53	0.63	0.60	0.41	0.40	7.48	7.02	23.16	20.71	51.56	46.30	39.61	34.99	0.66	0.63	0.39	0.38	8.72	8.15	50.12	44.95

Table H-282. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 6 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
170	0.15	0.14	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.10	0.15	0.14	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.10
160	0.59	0.57	0.21	0.20	0.00	0.00	0.00	0.00	0.02	0.02	0.45	0.43	0.60	0.57	0.22	0.21	0.00	0.00	0.00	0.00	0.02	0.02	0.44	0.43
150	2.11	2.01	0.94	0.91	0.00	0.00	0.00	0.00	0.06	0.06	1.75	1.68	2.04	1.96	0.93	0.89	0.00	0.00	0.00	0.00	0.06	0.06	1.76	1.68
140	5.32	5.05	3.22	3.08	0.00	0.00	0.00	0.00	0.38	0.36	4.94	4.70	5.65	5.36	3.10	2.92	0.00	0.00	0.00	0.00	0.36	0.35	5.16	4.90
130	10.34	9.54	7.66	7.19	0.04	0.04	0.03	0.03	1.52	1.43	9.93	9.25	14.00	12.88	9.12	8.52	0.04	0.04	0.03	0.03	1.47	1.40	13.56	12.50
120	17.66	16.12	14.49	13.32	0.26	0.25	0.15	0.15	4.60	4.38	17.38	15.87	31.73	28.17	23.77	21.36	0.24	0.24	0.14	0.14	4.66	4.42	31.07	27.59

Table H-283. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 10 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.06	0.06	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.08	0.08	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04
160	0.37	0.36	0.12	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.23	0.36	0.34	0.12	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.24
150	1.36	1.31	0.50	0.49	0.00	0.00	0.00	0.00	0.04	0.04	0.99	0.96	1.36	1.30	0.50	0.48	0.00	0.00	0.00	0.00	0.04	0.04	0.99	0.96
140	3.86	3.69	2.05	1.96	0.00	0.00	0.00	0.00	0.19	0.19	3.40	3.25	3.91	3.72	1.98	1.88	0.00	0.00	0.00	0.00	0.20	0.19	3.40	3.22
130	8.13	7.62	5.65	5.35	0.03	0.03	0.02	0.02	0.89	0.85	7.78	7.29	9.67	9.04	6.00	5.69	0.03	0.03	0.02	0.02	0.87	0.83	9.30	8.68
120	14.68	13.46	11.50	10.65	0.15	0.15	0.10	0.10	3.01	2.87	14.38	13.20	23.14	20.76	16.38	15.01	0.14	0.14	0.10	0.09	2.94	2.81	22.53	20.21

Table H-284. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SEL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 15 dB.

Level (L_E)	Summer												Winter											
	Flat		LF		MF		HF		PW		TUW		Flat		LF		MF		HF		PW		TUW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
160	0.18	0.18	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.13	0.18	0.18	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.13
150	0.67	0.64	0.24	0.23	0.00	0.00	0.00	0.00	0.02	0.02	0.50	0.48	0.67	0.65	0.24	0.24	0.00	0.00	0.00	0.00	0.02	0.02	0.50	0.48
140	2.35	2.25	1.01	0.97	0.00	0.00	0.00	0.00	0.10	0.09	1.98	1.91	2.33	2.23	1.02	0.97	0.00	0.00	0.00	0.00	0.10	0.08	1.92	1.81
130	5.73	5.43	3.55	3.40	0.00	0.00	0.00	0.00	0.44	0.42	5.34	5.08	6.19	5.85	3.57	3.40	0.00	0.00	0.00	0.00	0.42	0.40	5.71	5.41
120	11.11	10.26	8.24	7.72	0.10	0.10	0.03	0.03	1.72	1.65	10.72	9.88	15.19	13.94	9.90	9.27	0.09	0.09	0.03	0.03	1.70	1.59	14.76	13.57

H.3. Impact Pile Driving Single-Strike SPL Acoustic Ranges

H.3.1. Monopile Foundation

H.3.1.1. 9.6 m Diameter Pile

Table H-285. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.07	0.07	0.07	-	-	-	-	0.03	0.03	0.07	0.07	0.07	0.07	-	-	-	-	0.03	0.03
180	0.34	0.33	0.34	0.33	0.06	0.06	0.04	0.04	0.15	0.15	0.36	0.34	0.35	0.34	0.06	0.06	0.04	0.04	0.15	0.15
175	0.69	0.67	0.68	0.65	0.11	0.11	0.07	0.07	0.33	0.32	0.74	0.71	0.73	0.70	0.11	0.11	0.08	0.07	0.34	0.33
170	1.28	1.21	1.26	1.19	0.29	0.28	0.17	0.16	0.65	0.62	1.36	1.29	1.34	1.27	0.30	0.28	0.16	0.16	0.68	0.65
160	2.95	2.77	2.93	2.75	1.02	0.96	0.68	0.66	1.91	1.79	3.35	3.09	3.32	3.06	1.10	1.04	0.74	0.70	2.05	1.92
150	5.60	5.17	5.59	5.15	2.65	2.48	1.96	1.84	4.20	3.93	6.53	6.01	6.51	5.98	2.88	2.69	2.15	1.99	4.88	4.52
140	8.86	8.11	8.84	8.09	5.26	4.85	4.23	3.95	7.27	6.66	11.40	10.36	11.36	10.32	6.31	5.79	4.91	4.56	9.08	8.32
130	13.44	12.27	13.42	12.24	8.72	7.99	7.38	6.75	11.54	10.48	18.36	16.53	18.31	16.49	11.82	10.71	9.44	8.64	15.70	14.22
120	18.55	16.77	18.53	16.74	13.64	12.40	11.96	10.84	16.57	15.02	29.04	25.99	28.96	25.92	19.67	17.77	17.06	15.40	26.06	23.13

Table H-286. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	0.03	0.03	-	-	-	-	-	-	0.03	0.03	0.03	0.03	-	-	-	-	-	-
180	0.12	0.12	0.12	0.12	-	-	-	-	0.06	0.06	0.13	0.12	0.12	0.12	-	-	-	-	0.06	0.06
175	0.31	0.30	0.31	0.30	0.06	0.06	-	-	0.11	0.11	0.33	0.31	0.32	0.31	0.06	0.06	-	-	0.11	0.11
170	0.62	0.59	0.61	0.58	0.10	0.09	0.06	0.06	0.30	0.29	0.65	0.62	0.64	0.61	0.10	0.10	0.07	0.07	0.31	0.30
160	1.86	1.74	1.84	1.72	0.48	0.46	0.31	0.30	1.02	0.96	1.97	1.86	1.96	1.84	0.51	0.48	0.33	0.32	1.10	1.04
150	4.01	3.74	3.98	3.72	1.58	1.48	1.11	1.03	2.70	2.52	4.52	4.20	4.49	4.18	1.70	1.59	1.19	1.13	2.94	2.75
140	6.76	6.23	6.75	6.21	3.58	3.32	2.75	2.57	5.36	4.95	8.20	7.50	8.18	7.48	4.09	3.81	2.99	2.79	6.36	5.86
130	10.40	9.46	10.36	9.43	6.51	5.99	5.39	4.97	8.74	8.02	13.96	12.68	13.92	12.64	8.13	7.45	6.51	5.97	11.58	10.50
120	15.34	13.96	15.32	13.93	10.40	9.42	8.92	8.17	13.52	12.31	22.30	19.71	22.21	19.63	14.68	13.27	12.32	11.18	18.95	17.07

Table H-287. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	0.07	0.07	-	-	-	-	0.03	0.03	0.07	0.07	0.07	0.07	-	-	-	-	0.03	0.03
175	0.15	0.15	0.15	0.15	-	-	-	-	0.07	0.07	0.16	0.16	0.15	0.15	-	-	-	-	0.07	0.07
170	0.34	0.33	0.34	0.33	0.06	0.06	0.04	0.04	0.15	0.15	0.36	0.34	0.35	0.34	0.06	0.06	0.04	0.04	0.15	0.15
160	1.28	1.20	1.26	1.19	0.29	0.28	0.17	0.16	0.65	0.62	1.36	1.29	1.34	1.27	0.30	0.28	0.16	0.16	0.68	0.65
150	2.95	2.77	2.93	2.75	1.02	0.96	0.68	0.66	1.91	1.79	3.35	3.09	3.32	3.06	1.10	1.04	0.74	0.70	2.05	1.92
140	5.60	5.17	5.59	5.15	2.65	2.48	1.96	1.84	4.20	3.93	6.53	6.01	6.51	5.98	2.88	2.69	2.15	1.99	4.88	4.52
130	8.86	8.11	8.84	8.09	5.26	4.85	4.23	3.95	7.27	6.66	11.40	10.36	11.36	10.32	6.31	5.79	4.91	4.56	9.08	8.32
120	13.44	12.27	13.42	12.24	8.72	7.99	7.38	6.75	11.54	10.48	18.36	16.53	18.31	16.49	11.82	10.71	9.44	8.64	15.70	14.22

Table H-288. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.04	0.04	0.04	0.04	-	-	-	-	-	-	0.04	0.04	0.04	0.04	-	-	-	-	-	-
175	0.07	0.07	0.07	0.07	-	-	-	-	0.03	0.03	0.07	0.07	0.07	0.07	-	-	-	-	0.03	0.03
170	0.15	0.15	0.15	0.15	-	-	-	-	0.07	0.07	0.16	0.16	0.15	0.15	-	-	-	-	0.07	0.07
160	0.69	0.67	0.68	0.65	0.11	0.11	0.07	0.07	0.33	0.32	0.74	0.71	0.73	0.70	0.11	0.11	0.08	0.07	0.34	0.33
150	1.99	1.87	1.97	1.86	0.57	0.55	0.36	0.34	1.17	1.10	2.20	2.04	2.17	2.01	0.60	0.58	0.37	0.36	1.27	1.20
140	4.26	3.97	4.23	3.95	1.73	1.62	1.25	1.18	2.88	2.70	4.82	4.48	4.80	4.45	1.86	1.74	1.34	1.26	3.25	2.99
130	7.09	6.50	7.06	6.48	3.85	3.59	2.92	2.73	5.67	5.22	8.66	7.91	8.62	7.88	4.40	4.10	3.32	3.04	6.77	6.21
120	10.98	9.97	10.96	9.94	6.83	6.28	5.69	5.25	9.12	8.36	14.62	13.25	14.58	13.21	8.63	7.90	6.93	6.35	12.28	11.16

Table H-289. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
190	0.11	0.11	0.11	0.10	-	-	-	-	0.06	0.06	0.11	0.11	0.11	0.11	-	-	-	-	0.06	0.06
180	0.56	0.53	0.55	0.53	0.09	0.08	0.06	0.06	0.27	0.26	0.58	0.56	0.57	0.55	0.09	0.09	0.06	0.06	0.28	0.27
175	1.02	0.97	1.00	0.96	0.20	0.20	0.11	0.10	0.56	0.54	1.09	1.05	1.08	1.03	0.21	0.20	0.11	0.11	0.58	0.56
170	1.79	1.68	1.78	1.66	0.48	0.45	0.29	0.27	1.00	0.96	1.90	1.79	1.88	1.78	0.50	0.48	0.29	0.28	1.08	1.03
160	3.96	3.67	3.94	3.65	1.57	1.47	1.08	1.03	2.70	2.51	4.42	4.12	4.40	4.10	1.68	1.57	1.16	1.11	2.91	2.71
150	6.68	6.16	6.66	6.14	3.51	3.23	2.73	2.52	5.23	4.84	8.06	7.34	8.04	7.32	3.96	3.65	2.93	2.72	6.14	5.67
140	10.08	9.22	10.06	9.19	6.23	5.76	5.14	4.77	8.54	7.80	13.44	12.27	13.40	12.24	7.78	7.11	6.18	5.69	10.98	9.96
130	14.88	13.56	14.86	13.53	9.86	9.02	8.56	7.84	13.02	11.89	21.29	18.87	21.20	18.82	14.00	12.74	11.68	10.63	18.29	16.47
120	19.83	17.97	19.81	17.95	15.02	13.65	13.40	12.20	18.02	16.30	34.12	30.50	33.98	30.40	24.72	21.87	20.21	18.22	30.40	27.17

Table H-290. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	0.05	0.05	-	-	-	-	-	-	0.06	0.05	0.05	0.05	-	-	-	-	-	-
180	0.24	0.22	0.20	0.19	0.05	0.05	-	-	0.09	0.09	0.24	0.23	0.24	0.22	0.05	0.04	-	-	0.09	0.09
175	0.49	0.47	0.48	0.47	0.08	0.08	0.06	0.06	0.20	0.20	0.51	0.48	0.50	0.48	0.08	0.08	0.06	0.06	0.22	0.21
170	0.93	0.89	0.91	0.88	0.18	0.17	0.10	0.09	0.48	0.47	0.97	0.92	0.96	0.92	0.18	0.17	0.10	0.10	0.50	0.48
160	2.56	2.37	2.54	2.36	0.82	0.78	0.52	0.50	1.60	1.50	2.76	2.57	2.74	2.56	0.84	0.81	0.55	0.53	1.70	1.60
150	4.97	4.61	4.95	4.60	2.26	2.07	1.64	1.54	3.64	3.37	5.70	5.27	5.68	5.24	2.44	2.26	1.76	1.65	4.11	3.82
140	8.08	7.37	8.06	7.35	4.49	4.19	3.63	3.34	6.41	5.92	9.74	8.91	9.72	8.88	5.23	4.85	4.08	3.77	7.86	7.17
130	12.22	11.16	12.18	11.13	7.62	6.99	6.36	5.87	9.90	9.08	16.05	14.57	16.01	14.53	9.74	8.90	8.04	7.34	13.66	12.43
120	16.84	15.28	16.81	15.26	12.10	11.00	10.12	9.19	14.90	13.55	26.45	23.45	26.39	23.38	17.31	15.62	14.66	13.29	22.74	20.09

Table H-291. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
180	0.11	0.11	0.11	0.10	-	-	-	-	0.06	0.06	0.11	0.11	0.11	0.11	-	-	-	-	0.06	0.06
175	0.28	0.27	0.28	0.27	0.05	0.05	-	-	0.10	0.10	0.29	0.28	0.28	0.27	0.05	0.05	-	-	0.11	0.10
170	0.56	0.53	0.55	0.53	0.09	0.08	0.06	0.06	0.27	0.26	0.58	0.56	0.57	0.55	0.09	0.09	0.06	0.06	0.28	0.27
160	1.79	1.68	1.78	1.66	0.48	0.45	0.29	0.27	1.00	0.96	1.90	1.79	1.88	1.78	0.50	0.48	0.29	0.28	1.08	1.03
150	3.96	3.67	3.94	3.65	1.57	1.47	1.08	1.03	2.70	2.51	4.42	4.12	4.40	4.10	1.68	1.57	1.16	1.11	2.91	2.71
140	6.68	6.16	6.66	6.14	3.51	3.23	2.73	2.52	5.23	4.84	8.06	7.34	8.04	7.32	3.96	3.65	2.93	2.72	6.14	5.67
130	10.08	9.22	10.06	9.19	6.23	5.76	5.14	4.77	8.54	7.80	13.44	12.27	13.40	12.24	7.78	7.11	6.18	5.69	10.98	9.96
120	14.88	13.56	14.86	13.53	9.86	9.02	8.56	7.84	13.02	11.89	21.29	18.87	21.20	18.81	14.00	12.74	11.68	10.63	18.29	16.47

Table H-292. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
175	0.11	0.11	0.11	0.10	-	-	-	-	0.06	0.06	0.11	0.11	0.11	0.11	-	-	-	-	0.06	0.06
170	0.28	0.27	0.28	0.27	0.05	0.05	-	-	0.10	0.10	0.29	0.28	0.28	0.27	0.05	0.05	-	-	0.11	0.10
160	1.02	0.97	1.00	0.96	0.20	0.20	0.11	0.10	0.56	0.54	1.09	1.05	1.08	1.03	0.21	0.20	0.11	0.11	0.58	0.56
150	2.73	2.55	2.72	2.53	0.91	0.87	0.59	0.57	1.76	1.65	2.95	2.76	2.94	2.74	0.95	0.91	0.61	0.59	1.88	1.76
140	5.24	4.86	5.22	4.84	2.45	2.26	1.80	1.69	3.90	3.62	6.04	5.58	6.02	5.56	2.64	2.45	1.92	1.80	4.39	4.10
130	8.42	7.69	8.40	7.67	4.76	4.43	3.88	3.59	6.73	6.20	10.24	9.32	10.20	9.28	5.60	5.18	4.35	4.05	8.34	7.60
120	12.66	11.58	12.64	11.55	8.00	7.34	6.69	6.16	10.44	9.49	16.84	15.23	16.80	15.19	10.34	9.40	8.56	7.80	14.34	13.01

Table H-293. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.05	0.05	0.05	0.05	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	-	-	-	-	-
190	0.20	0.19	0.18	0.17	0.04	0.04	-	-	0.08	0.08	0.22	0.20	0.21	0.19	0.03	0.03	-	-	0.08	0.08
180	0.90	0.86	0.89	0.85	0.16	0.15	0.08	0.08	0.47	0.45	0.95	0.90	0.94	0.90	0.15	0.15	0.09	0.08	0.48	0.46
175	1.60	1.50	1.59	1.49	0.40	0.38	0.22	0.21	0.91	0.86	1.70	1.60	1.69	1.59	0.43	0.41	0.22	0.21	0.94	0.90
170	2.56	2.36	2.54	2.34	0.78	0.75	0.48	0.46	1.58	1.48	2.75	2.56	2.74	2.54	0.80	0.77	0.49	0.48	1.67	1.57
160	4.98	4.63	4.96	4.61	2.19	2.01	1.60	1.50	3.68	3.36	5.72	5.29	5.69	5.27	2.39	2.21	1.71	1.60	4.16	3.84
150	8.10	7.40	8.08	7.39	4.55	4.21	3.66	3.34	6.45	5.97	9.80	8.98	9.78	8.96	5.36	4.97	4.22	3.89	8.00	7.31
140	12.24	11.20	12.24	11.20	7.86	7.25	6.70	6.17	10.06	9.20	16.56	15.00	16.57	15.01	10.54	9.60	8.88	8.09	14.24	12.94
130	16.96	15.39	17.00	15.41	12.88	11.70	11.44	10.33	15.23	13.87	28.09	24.96	28.32	25.19	20.44	18.30	18.64	16.76	25.69	22.73
120	23.90	21.30	23.96	21.38	18.65	16.72	17.51	15.59	21.30	19.05	47.06	40.36	47.44	40.77	41.62	35.68	39.72	34.44	45.24	38.63

Table H-294. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.07	0.07	0.07	-	-	-	-	0.04	0.04	0.07	0.07	0.07	0.07	-	-	-	-	0.03	0.03
180	0.40	0.37	0.37	0.34	0.06	0.06	0.04	0.04	0.16	0.16	0.44	0.42	0.43	0.41	0.06	0.06	0.04	0.04	0.16	0.16
175	0.79	0.75	0.78	0.75	0.13	0.13	0.07	0.07	0.41	0.39	0.82	0.78	0.81	0.77	0.13	0.12	0.07	0.07	0.44	0.42
170	1.44	1.36	1.43	1.35	0.32	0.31	0.17	0.16	0.79	0.76	1.53	1.44	1.52	1.43	0.34	0.32	0.18	0.17	0.82	0.78
160	3.46	3.16	3.44	3.14	1.25	1.18	0.82	0.79	2.29	2.11	3.90	3.58	3.87	3.56	1.32	1.24	0.84	0.81	2.49	2.30
150	6.10	5.65	6.08	5.63	2.96	2.74	2.30	2.11	4.68	4.35	7.20	6.60	7.18	6.58	3.39	3.07	2.53	2.33	5.46	5.06
140	9.44	8.64	9.42	8.63	5.72	5.31	4.72	4.37	7.88	7.22	12.42	11.36	12.40	11.34	7.11	6.53	5.68	5.26	9.89	9.06
130	14.02	12.80	14.02	12.81	9.50	8.70	8.26	7.61	12.36	11.26	19.92	18.00	19.97	18.05	13.88	12.64	11.94	10.94	17.75	15.99
120	19.06	17.26	19.12	17.30	14.93	13.54	13.73	12.47	17.48	15.79	33.40	30.05	34.06	30.47	27.70	24.58	26.21	23.25	31.16	27.92

Table H-295. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	0.05	0.05	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	-	-	-	-	-
180	0.20	0.19	0.18	0.17	0.04	0.04	-	-	0.08	0.08	0.22	0.20	0.21	0.19	0.03	0.03	-	-	0.08	0.08
175	0.47	0.45	0.46	0.45	0.07	0.07	0.05	0.05	0.20	0.19	0.48	0.46	0.48	0.46	0.07	0.07	0.05	0.05	0.21	0.20
170	0.90	0.86	0.89	0.85	0.16	0.15	0.08	0.08	0.47	0.45	0.95	0.90	0.94	0.90	0.15	0.15	0.09	0.08	0.48	0.46
160	2.56	2.36	2.54	2.34	0.78	0.75	0.48	0.46	1.58	1.48	2.75	2.56	2.74	2.54	0.80	0.77	0.50	0.48	1.67	1.57
150	4.98	4.63	4.96	4.61	2.19	2.01	1.60	1.50	3.68	3.36	5.72	5.29	5.69	5.27	2.39	2.21	1.71	1.60	4.16	3.84
140	8.10	7.40	8.08	7.39	4.55	4.21	3.66	3.34	6.45	5.97	9.80	8.98	9.78	8.96	5.36	4.97	4.22	3.89	8.00	7.31
130	12.24	11.20	12.24	11.20	7.86	7.25	6.70	6.17	10.06	9.20	16.56	15.00	16.57	15.01	10.54	9.60	8.88	8.09	14.24	12.94
120	16.96	15.39	17.00	15.41	12.88	11.70	11.44	10.33	15.23	13.87	28.09	24.96	28.32	25.19	20.44	18.30	18.64	16.76	25.69	22.73

Table H-296. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 15 dB.

Level (L_P)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.08	0.08	0.08	0.08	-	-	-	-	0.05	0.05	0.09	0.08	0.09	0.08	-	-	-	-	0.05	0.05
175	0.20	0.19	0.18	0.17	0.04	0.04	-	-	0.08	0.08	0.22	0.20	0.21	0.19	0.03	0.03	-	-	0.08	0.08
170	0.47	0.45	0.46	0.45	0.07	0.07	0.05	0.05	0.20	0.19	0.48	0.46	0.48	0.46	0.07	0.07	0.05	0.05	0.21	0.20
160	1.60	1.50	1.59	1.49	0.40	0.38	0.22	0.21	0.91	0.86	1.70	1.60	1.69	1.59	0.42	0.41	0.22	0.21	0.94	0.90
150	3.73	3.43	3.71	3.41	1.37	1.30	0.94	0.90	2.50	2.30	4.18	3.86	4.16	3.84	1.46	1.38	0.97	0.93	2.70	2.50
140	6.40	5.92	6.38	5.90	3.24	2.93	2.51	2.31	4.96	4.61	7.66	6.99	7.62	6.97	3.70	3.38	2.75	2.54	5.82	5.39
130	9.74	8.94	9.74	8.93	6.04	5.61	5.02	4.65	8.24	7.56	13.02	11.92	13.02	11.91	7.61	6.99	6.11	5.65	10.60	9.64
120	14.48	13.20	14.48	13.21	9.92	9.06	8.68	7.98	12.84	11.71	21.46	18.98	21.58	19.08	14.76	13.46	12.84	11.78	18.68	16.84

Table H-297. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
190	0.26	0.25	0.26	0.25	0.05	0.05	-	-	0.10	0.10	0.27	0.26	0.26	0.26	0.05	0.05	-	-	0.11	0.10
180	1.06	0.99	1.04	0.98	0.21	0.20	0.12	0.11	0.51	0.49	1.12	1.07	1.11	1.06	0.21	0.21	0.12	0.12	0.55	0.53
175	1.83	1.71	1.81	1.70	0.46	0.44	0.29	0.28	1.02	0.96	1.94	1.81	1.92	1.80	0.48	0.46	0.31	0.30	1.08	1.01
170	2.80	2.59	2.79	2.58	0.95	0.90	0.62	0.59	1.76	1.64	3.03	2.79	2.99	2.78	0.97	0.93	0.67	0.65	1.85	1.74
160	5.31	4.93	5.29	4.91	2.52	2.30	1.88	1.76	4.01	3.68	6.11	5.64	6.10	5.63	2.75	2.54	2.02	1.86	4.55	4.20
150	8.46	7.78	8.46	7.78	5.07	4.71	4.18	3.85	6.94	6.39	10.69	9.69	10.69	9.69	6.11	5.66	5.00	4.66	8.71	7.98
140	12.94	11.83	12.96	11.85	8.90	8.13	7.66	7.05	11.20	10.17	18.10	16.26	18.24	16.39	12.80	11.69	11.41	10.26	15.87	14.41
130	18.03	16.31	18.14	16.37	14.20	12.94	13.10	11.91	16.57	14.93	29.81	26.63	30.38	27.14	26.34	23.25	25.10	22.19	28.65	25.52
120	25.65	22.92	25.76	23.06	20.68	18.33	19.69	17.55	23.82	21.26	74.24	61.88	68.83	59.60	66.31	57.18	64.64	56.08	68.26	58.87

Table H-298. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.08	0.08	0.08	0.08	-	-	-	-	0.05	0.05	0.09	0.08	0.09	0.08	-	-	-	-	0.05	0.05
180	0.47	0.45	0.46	0.44	0.08	0.07	0.06	0.06	0.22	0.21	0.48	0.46	0.48	0.46	0.08	0.08	0.06	0.06	0.22	0.21
175	0.96	0.91	0.95	0.90	0.18	0.17	0.11	0.10	0.46	0.44	0.99	0.94	0.98	0.93	0.18	0.17	0.11	0.11	0.48	0.46
170	1.68	1.56	1.65	1.55	0.43	0.41	0.24	0.23	0.94	0.89	1.77	1.65	1.75	1.64	0.44	0.42	0.24	0.23	0.97	0.92
160	3.81	3.49	3.78	3.47	1.46	1.37	1.01	0.95	2.53	2.32	4.23	3.90	4.21	3.88	1.56	1.45	1.07	1.01	2.74	2.53
150	6.45	5.96	6.43	5.95	3.40	3.09	2.68	2.47	5.05	4.70	7.72	7.06	7.71	7.05	3.94	3.60	2.97	2.74	5.97	5.51
140	9.84	9.04	9.86	9.04	6.39	5.90	5.42	5.00	8.44	7.76	13.36	12.20	13.39	12.22	8.26	7.56	6.85	6.34	11.26	10.20
130	14.84	13.50	14.86	13.54	10.84	9.82	9.72	8.85	13.30	12.13	22.41	19.75	22.77	20.12	16.97	15.28	15.40	14.06	19.79	17.91
120	20.28	18.26	20.40	18.37	16.83	14.98	15.75	14.02	18.94	17.02	38.38	32.69	40.72	34.60	33.25	29.69	32.34	28.78	37.74	32.60

Table H-299. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
180	0.26	0.25	0.26	0.25	0.05	0.05	-	-	0.10	0.10	0.27	0.26	0.26	0.26	0.05	0.05	-	-	0.11	0.10
175	0.54	0.52	0.53	0.50	0.09	0.08	0.06	0.06	0.25	0.24	0.58	0.56	0.57	0.54	0.09	0.08	0.06	0.06	0.26	0.25
170	1.06	0.99	1.04	0.98	0.21	0.20	0.12	0.11	0.51	0.49	1.12	1.07	1.11	1.06	0.21	0.21	0.12	0.12	0.55	0.53
160	2.80	2.59	2.79	2.58	0.95	0.90	0.62	0.59	1.76	1.64	3.03	2.79	2.99	2.78	0.97	0.93	0.67	0.65	1.85	1.74
150	5.31	4.93	5.29	4.91	2.52	2.30	1.88	1.76	4.01	3.68	6.11	5.64	6.10	5.63	2.75	2.54	2.02	1.86	4.55	4.20
140	8.46	7.78	8.46	7.78	5.07	4.70	4.18	3.85	6.94	6.39	10.69	9.69	10.69	9.69	6.11	5.66	5.00	4.66	8.71	7.98
130	12.94	11.83	12.96	11.85	8.90	8.13	7.66	7.05	11.20	10.17	18.10	16.26	18.24	16.39	12.80	11.69	11.41	10.26	15.87	14.41
120	18.03	16.31	18.14	16.37	14.20	12.94	13.10	11.91	16.57	14.93	29.81	26.63	30.38	27.14	26.34	23.25	25.10	22.19	28.65	25.52

Table H-300. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
180	0.11	0.10	0.10	0.10	-	-	-	-	0.06	0.06	0.11	0.10	0.11	0.10	-	-	-	-	0.06	0.06
175	0.26	0.25	0.26	0.25	0.05	0.05	-	-	0.10	0.10	0.27	0.26	0.26	0.26	0.05	0.05	-	-	0.11	0.10
170	0.54	0.52	0.53	0.50	0.09	0.08	0.06	0.06	0.25	0.24	0.58	0.56	0.57	0.54	0.09	0.08	0.06	0.06	0.26	0.25
160	1.83	1.71	1.81	1.70	0.46	0.44	0.29	0.28	1.02	0.96	1.94	1.81	1.92	1.80	0.48	0.46	0.31	0.30	1.08	1.01
150	4.06	3.74	4.04	3.72	1.59	1.48	1.14	1.06	2.73	2.51	4.51	4.17	4.49	4.15	1.71	1.60	1.22	1.15	2.95	2.73
140	6.76	6.23	6.75	6.22	3.68	3.36	2.86	2.63	5.35	4.96	8.16	7.47	8.15	7.46	4.27	3.93	3.30	2.96	6.38	5.87
130	10.32	9.41	10.34	9.42	6.76	6.21	5.68	5.29	8.82	8.11	14.01	12.77	14.06	12.80	8.80	8.07	7.52	6.87	11.98	10.91
120	15.32	13.94	15.36	13.98	11.44	10.42	10.18	9.26	13.78	12.57	23.80	21.01	24.24	21.38	18.16	16.37	16.73	15.21	21.39	18.94

Table H-301. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.06	0.06	0.06	0.06	-	-	-	-	0.02	0.02	0.06	0.06	0.06	0.06	-	-	-	-	0.02	0.02
190	0.36	0.35	0.35	0.34	0.06	0.06	0.02	0.02	0.14	0.13	0.37	0.36	0.37	0.36	0.06	0.06	0.02	0.02	0.13	0.13
180	1.30	1.23	1.29	1.22	0.28	0.27	0.16	0.16	0.65	0.62	1.37	1.30	1.36	1.28	0.29	0.28	0.16	0.15	0.67	0.65
175	2.04	1.91	2.00	1.89	0.58	0.56	0.37	0.36	1.17	1.12	2.20	2.05	2.17	2.02	0.61	0.59	0.38	0.36	1.26	1.19
170	2.99	2.80	2.97	2.78	1.02	0.97	0.71	0.67	1.91	1.79	3.34	3.07	3.31	3.04	1.10	1.06	0.78	0.74	2.01	1.88
160	5.55	5.15	5.52	5.13	2.72	2.53	2.04	1.91	4.19	3.91	6.42	5.90	6.39	5.88	2.93	2.73	2.24	2.08	4.76	4.44
150	8.86	8.07	8.84	8.05	5.31	4.94	4.39	4.10	7.24	6.65	11.52	10.51	11.50	10.49	6.39	5.91	5.09	4.74	9.32	8.47
140	13.50	12.36	13.50	12.35	8.98	8.20	7.70	7.03	11.74	10.70	19.28	17.40	19.29	17.42	12.90	11.79	10.74	9.65	16.86	15.26
130	18.91	17.13	18.89	17.12	14.32	12.99	12.80	11.58	17.06	15.48	31.44	28.26	31.62	28.45	24.96	22.18	21.85	19.60	29.31	26.11
120	26.71	23.94	26.73	23.96	20.19	18.20	18.53	16.82	24.61	21.99	56.07	47.20	55.61	47.15	46.38	39.61	44.14	37.78	50.14	43.64

Table H-302. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
190	0.12	0.11	0.11	0.11	-	-	-	-	0.06	0.06	0.12	0.12	0.12	0.12	-	-	-	-	0.06	0.06
180	0.63	0.61	0.62	0.60	0.10	0.09	0.06	0.06	0.28	0.27	0.66	0.63	0.65	0.62	0.10	0.09	0.06	0.06	0.29	0.28
175	1.15	1.10	1.13	1.08	0.23	0.22	0.13	0.13	0.58	0.56	1.23	1.17	1.22	1.15	0.24	0.23	0.12	0.12	0.61	0.59
170	1.88	1.77	1.87	1.76	0.50	0.47	0.32	0.31	1.00	0.95	1.98	1.86	1.96	1.85	0.54	0.52	0.33	0.32	1.08	1.03
160	4.04	3.76	4.03	3.74	1.63	1.52	1.16	1.10	2.70	2.52	4.44	4.15	4.41	4.12	1.73	1.61	1.25	1.18	2.90	2.71
150	6.70	6.18	6.68	6.16	3.70	3.42	2.86	2.66	5.30	4.92	8.16	7.43	8.14	7.41	4.17	3.87	3.16	2.90	6.31	5.81
140	10.40	9.45	10.38	9.43	6.59	6.09	5.52	5.13	8.84	8.06	14.30	13.02	14.28	13.01	8.58	7.78	6.82	6.28	12.00	10.97
130	15.50	14.14	15.50	14.14	10.90	9.88	9.34	8.54	13.80	12.58	24.42	21.58	24.47	21.65	16.57	15.08	14.32	13.06	20.77	18.59
120	21.89	19.45	21.90	19.45	16.48	14.97	15.08	13.65	19.35	17.55	40.42	34.41	40.72	34.67	31.20	28.00	29.38	26.08	35.90	31.78

Table H-303. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	0.02	0.02	0.06	0.06	0.06	0.06	-	-	-	-	0.02	0.02
180	0.36	0.35	0.35	0.34	0.06	0.06	0.02	0.02	0.14	0.13	0.37	0.36	0.37	0.36	0.06	0.06	0.02	0.02	0.13	0.13
175	0.71	0.68	0.70	0.67	0.11	0.10	0.07	0.07	0.33	0.32	0.75	0.72	0.74	0.71	0.11	0.11	0.07	0.07	0.35	0.34
170	1.30	1.23	1.29	1.22	0.28	0.27	0.16	0.16	0.65	0.62	1.37	1.30	1.36	1.28	0.29	0.28	0.16	0.15	0.67	0.65
160	2.99	2.80	2.97	2.78	1.02	0.97	0.71	0.67	1.91	1.79	3.34	3.07	3.31	3.04	1.10	1.06	0.78	0.74	2.01	1.88
150	5.55	5.15	5.52	5.13	2.72	2.53	2.04	1.91	4.19	3.91	6.42	5.90	6.39	5.88	2.93	2.73	2.24	2.08	4.76	4.44
140	8.86	8.07	8.84	8.05	5.31	4.94	4.39	4.10	7.24	6.65	11.52	10.51	11.50	10.49	6.39	5.91	5.09	4.74	9.32	8.47
130	13.50	12.36	13.50	12.35	8.98	8.20	7.70	7.03	11.74	10.70	19.28	17.40	19.29	17.42	12.90	11.79	10.74	9.65	16.86	15.26
120	18.91	17.13	18.89	17.12	14.32	12.99	12.80	11.58	17.06	15.48	31.44	28.26	31.62	28.45	24.96	22.18	21.85	19.60	29.31	26.11

Table H-304. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	0.03	0.03	-	-	-	-	-	-	0.03	0.03	0.03	0.03	-	-	-	-	-	-
180	0.14	0.13	0.14	0.13	-	-	-	-	0.06	0.06	0.14	0.13	0.14	0.13	-	-	-	-	0.06	0.06
175	0.36	0.35	0.35	0.34	0.06	0.06	0.02	0.02	0.14	0.13	0.37	0.36	0.37	0.36	0.06	0.06	0.02	0.02	0.13	0.13
170	0.71	0.68	0.70	0.67	0.11	0.10	0.07	0.07	0.33	0.32	0.75	0.72	0.74	0.71	0.11	0.11	0.07	0.07	0.35	0.34
160	2.04	1.91	2.00	1.89	0.58	0.56	0.37	0.36	1.17	1.12	2.20	2.05	2.17	2.02	0.61	0.59	0.38	0.36	1.26	1.19
150	4.27	3.98	4.24	3.96	1.77	1.66	1.31	1.24	2.88	2.69	4.74	4.41	4.71	4.39	1.88	1.77	1.39	1.31	3.16	2.92
140	7.00	6.45	6.99	6.43	3.97	3.68	3.07	2.84	5.60	5.19	8.66	7.86	8.62	7.84	4.48	4.16	3.50	3.20	6.73	6.19
130	10.98	9.99	10.96	9.97	6.94	6.40	5.85	5.42	9.22	8.42	15.02	13.70	15.02	13.69	9.18	8.32	7.34	6.73	12.74	11.66
120	16.04	14.62	16.04	14.61	11.50	10.47	9.70	8.90	14.32	13.03	25.68	22.73	25.76	22.82	17.68	16.02	15.34	14.00	22.43	19.86

Table H-305. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
190	0.09	0.09	0.08	0.08	-	-	-	-	0.01	0.01	0.09	0.09	0.09	0.09	-	-	-	-	0.01	0.01
180	0.40	0.38	0.39	0.38	0.07	0.07	0.01	0.01	0.16	0.15	0.41	0.40	0.40	0.39	0.07	0.07	0.01	0.01	0.14	0.14
175	0.79	0.76	0.78	0.74	0.12	0.12	0.09	0.09	0.36	0.35	0.83	0.79	0.81	0.78	0.13	0.12	0.09	0.09	0.36	0.35
170	1.44	1.38	1.42	1.36	0.31	0.30	0.19	0.18	0.73	0.70	1.53	1.46	1.50	1.43	0.31	0.29	0.18	0.17	0.76	0.73
160	3.55	3.37	3.51	3.33	1.18	1.11	0.79	0.75	2.20	2.09	3.94	3.75	3.92	3.72	1.26	1.19	0.82	0.78	2.38	2.26
150	6.82	6.36	6.78	6.33	2.97	2.84	2.30	2.17	4.90	4.62	8.25	7.65	8.21	7.61	3.30	3.13	2.46	2.34	5.70	5.32
140	11.66	10.61	11.62	10.57	6.16	5.74	4.92	4.64	8.95	8.29	15.38	13.94	15.32	13.89	7.40	6.86	5.58	5.24	11.92	10.86
130	17.44	15.83	17.40	15.79	10.81	9.85	8.87	8.23	14.78	13.44	25.63	22.91	25.55	22.84	15.16	13.76	12.09	11.04	20.97	18.59
120	25.28	22.65	25.22	22.60	17.09	15.57	14.88	13.56	21.77	19.26	40.12	35.46	39.90	35.26	26.81	23.98	22.63	19.96	34.76	30.68

Table H-306. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.04	0.04	0.03	0.03	-	-	-	-	-	-	0.03	0.03	0.03	0.03	-	-	-	-	-	-
180	0.14	0.13	0.13	0.13	0.01	0.01	-	-	0.07	0.07	0.14	0.14	0.14	0.13	0.01	0.01	-	-	0.07	0.07
175	0.35	0.34	0.35	0.33	0.07	0.07	0.01	0.01	0.12	0.12	0.36	0.35	0.35	0.34	0.07	0.06	0.01	0.01	0.13	0.12
170	0.70	0.67	0.68	0.66	0.11	0.11	0.08	0.08	0.32	0.30	0.73	0.70	0.71	0.69	0.11	0.11	0.08	0.08	0.31	0.30
160	2.11	2.01	2.08	1.98	0.52	0.50	0.33	0.32	1.20	1.13	2.29	2.19	2.26	2.15	0.56	0.54	0.33	0.32	1.27	1.21
150	4.72	4.47	4.70	4.44	1.81	1.71	1.26	1.20	3.03	2.88	5.40	5.07	5.36	5.04	1.91	1.81	1.34	1.28	3.39	3.23
140	8.52	7.89	8.48	7.86	4.17	3.95	3.13	2.95	6.36	5.92	10.68	9.71	10.62	9.66	4.64	4.39	3.47	3.30	7.74	7.15
130	13.93	12.68	13.89	12.65	7.80	7.22	6.32	5.88	11.14	10.14	18.76	16.92	18.69	16.87	9.83	9.11	7.62	7.08	15.22	13.80
120	19.91	17.97	19.86	17.93	13.38	12.23	11.11	10.14	17.21	15.66	30.71	27.16	30.60	27.06	18.99	17.14	15.67	14.24	26.07	23.34

Table H-307. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
180	0.09	0.09	0.08	0.08	-	-	-	-	0.01	0.01	0.09	0.09	0.09	0.09	-	-	-	-	0.01	0.01
175	0.16	0.16	0.16	0.15	0.01	0.01	-	-	0.08	0.08	0.16	0.15	0.15	0.14	0.01	0.01	-	-	0.08	0.08
170	0.40	0.38	0.39	0.38	0.07	0.07	0.01	0.01	0.16	0.15	0.41	0.40	0.40	0.39	0.07	0.07	0.01	0.01	0.14	0.14
160	1.44	1.38	1.42	1.36	0.31	0.30	0.19	0.18	0.73	0.70	1.53	1.46	1.50	1.43	0.31	0.29	0.18	0.17	0.76	0.73
150	3.55	3.37	3.51	3.33	1.18	1.11	0.79	0.75	2.20	2.09	3.94	3.75	3.92	3.72	1.26	1.19	0.82	0.78	2.38	2.26
140	6.82	6.36	6.78	6.33	2.97	2.84	2.30	2.17	4.90	4.62	8.25	7.65	8.21	7.61	3.30	3.13	2.46	2.35	5.70	5.32
130	11.66	10.61	11.62	10.57	6.16	5.74	4.92	4.64	8.95	8.29	15.38	13.94	15.32	13.89	7.40	6.86	5.58	5.24	11.92	10.86
120	17.44	15.83	17.40	15.79	10.81	9.85	8.87	8.23	14.78	13.44	25.63	22.91	25.55	22.84	15.16	13.76	12.09	11.04	20.97	18.59

Table H-308. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.04	0.04	0.04	0.04	-	-	-	-	-	-	0.04	0.04	0.04	0.04	-	-	-	-	-	-
175	0.09	0.09	0.08	0.08	-	-	-	-	0.01	0.01	0.09	0.09	0.09	0.09	-	-	-	-	0.01	0.01
170	0.16	0.16	0.16	0.15	0.01	0.01	-	-	0.08	0.08	0.16	0.15	0.15	0.14	0.01	0.01	-	-	0.08	0.08
160	0.79	0.76	0.78	0.74	0.12	0.12	0.09	0.09	0.36	0.35	0.83	0.79	0.81	0.78	0.13	0.12	0.09	0.09	0.36	0.35
150	2.34	2.23	2.31	2.20	0.61	0.57	0.37	0.36	1.35	1.28	2.52	2.41	2.49	2.38	0.63	0.61	0.37	0.36	1.42	1.35
140	5.06	4.76	5.02	4.73	1.95	1.86	1.41	1.34	3.36	3.19	5.84	5.45	5.80	5.42	2.10	1.98	1.50	1.43	3.75	3.56
130	8.96	8.29	8.92	8.26	4.47	4.22	3.43	3.25	6.74	6.27	11.53	10.49	11.47	10.43	5.00	4.72	3.79	3.61	8.30	7.70
120	14.48	13.18	14.45	13.14	8.24	7.65	6.68	6.22	11.82	10.78	19.59	17.64	19.54	17.59	10.71	9.77	8.22	7.65	16.06	14.57

Table H-309. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	0.01	0.01	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-
190	0.12	0.12	0.12	0.11	0.01	0.01	-	-	0.07	0.07	0.12	0.12	0.12	0.12	0.01	0.01	-	-	0.07	0.07
180	0.62	0.59	0.61	0.58	0.11	0.10	0.07	0.07	0.29	0.28	0.64	0.62	0.63	0.61	0.11	0.11	0.07	0.07	0.29	0.28
175	1.18	1.12	1.16	1.10	0.22	0.21	0.12	0.12	0.59	0.57	1.25	1.19	1.22	1.17	0.22	0.21	0.12	0.12	0.63	0.60
170	1.99	1.90	1.98	1.89	0.50	0.48	0.31	0.30	1.16	1.10	2.15	2.05	2.12	2.02	0.53	0.51	0.31	0.30	1.22	1.16
160	4.66	4.42	4.63	4.39	1.77	1.67	1.24	1.17	3.00	2.87	5.32	5.01	5.28	4.98	1.86	1.77	1.30	1.24	3.32	3.16
150	8.52	7.89	8.47	7.86	4.11	3.89	3.05	2.89	6.26	5.86	10.54	9.59	10.47	9.54	4.50	4.27	3.35	3.18	7.58	7.05
140	13.84	12.59	13.81	12.56	7.59	7.07	6.10	5.74	10.97	9.95	18.41	16.60	18.35	16.54	9.66	8.94	7.41	6.90	14.91	13.51
130	19.69	17.72	19.65	17.68	13.11	11.96	10.81	9.82	16.91	15.35	30.39	26.82	30.25	26.71	18.67	16.85	15.38	13.93	25.68	22.94
120	27.72	24.77	27.66	24.73	19.44	17.52	17.12	15.54	24.76	22.07	49.69	44.72	49.35	44.40	33.37	29.38	27.89	24.81	43.47	38.48

Table H-310. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	0.01	0.01	0.06	0.06	0.06	0.06	-	-	-	-	0.01	0.01
180	0.23	0.22	0.23	0.22	0.05	0.05	0.01	0.01	0.11	0.10	0.23	0.23	0.23	0.22	0.05	0.04	0.01	0.01	0.11	0.11
175	0.48	0.46	0.47	0.46	0.09	0.09	0.07	0.07	0.23	0.22	0.52	0.50	0.50	0.48	0.10	0.09	0.07	0.07	0.22	0.22
170	1.01	0.97	1.00	0.96	0.21	0.20	0.11	0.11	0.48	0.47	1.08	1.03	1.06	1.01	0.19	0.19	0.11	0.11	0.52	0.49
160	2.87	2.75	2.85	2.72	0.90	0.86	0.55	0.53	1.80	1.70	3.12	2.97	3.08	2.93	0.96	0.91	0.59	0.56	1.89	1.79
150	6.04	5.66	6.00	5.63	2.55	2.43	1.86	1.77	4.24	4.02	7.10	6.62	7.06	6.58	2.70	2.58	1.95	1.86	4.72	4.48
140	10.30	9.42	10.25	9.38	5.28	4.99	4.22	4.00	7.95	7.38	13.63	12.38	13.57	12.34	6.16	5.79	4.64	4.40	9.90	9.15
130	16.08	14.58	16.03	14.54	9.45	8.75	7.76	7.21	13.39	12.20	22.78	20.07	22.68	19.98	13.11	11.94	9.89	9.15	18.43	16.63
120	23.30	20.58	23.23	20.52	15.54	14.09	13.37	12.19	19.45	17.53	36.96	32.49	36.79	32.33	23.89	21.19	19.33	17.40	31.69	27.90

Table H-311. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	0.01	0.01	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-
180	0.12	0.12	0.12	0.11	0.01	0.01	-	-	0.07	0.07	0.12	0.12	0.12	0.12	0.01	0.01	-	-	0.07	0.07
175	0.31	0.30	0.30	0.29	0.06	0.06	0.01	0.01	0.11	0.11	0.31	0.30	0.30	0.29	0.06	0.06	0.01	0.01	0.12	0.11
170	0.62	0.59	0.61	0.58	0.11	0.10	0.07	0.07	0.29	0.28	0.64	0.62	0.63	0.61	0.11	0.11	0.07	0.07	0.29	0.28
160	1.99	1.90	1.98	1.89	0.50	0.48	0.31	0.30	1.16	1.10	2.15	2.05	2.12	2.02	0.53	0.51	0.31	0.30	1.22	1.16
150	4.66	4.42	4.63	4.39	1.77	1.67	1.24	1.17	3.00	2.87	5.32	5.01	5.28	4.98	1.86	1.77	1.30	1.24	3.32	3.16
140	8.52	7.89	8.47	7.86	4.11	3.89	3.05	2.89	6.26	5.86	10.54	9.59	10.47	9.54	4.50	4.27	3.35	3.18	7.58	7.05
130	13.84	12.59	13.81	12.56	7.59	7.07	6.10	5.74	10.97	9.95	18.41	16.60	18.35	16.54	9.66	8.93	7.41	6.90	14.91	13.51
120	19.69	17.72	19.65	17.68	13.11	11.96	10.81	9.82	16.91	15.35	30.39	26.82	30.25	26.71	18.67	16.85	15.38	13.93	25.68	22.94

Table H-312. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	0.07	0.07	-	-	-	-	0.01	0.01	0.07	0.07	0.07	0.07	-	-	-	-	0.01	0.01
175	0.12	0.12	0.12	0.11	0.01	0.01	-	-	0.07	0.07	0.12	0.12	0.12	0.12	0.01	0.01	-	-	0.07	0.07
170	0.31	0.30	0.30	0.29	0.06	0.06	0.01	0.01	0.11	0.11	0.31	0.30	0.30	0.29	0.06	0.06	0.01	0.01	0.12	0.11
160	1.18	1.12	1.16	1.10	0.22	0.21	0.12	0.12	0.59	0.57	1.25	1.19	1.22	1.17	0.22	0.21	0.12	0.12	0.63	0.60
150	3.11	2.97	3.09	2.93	0.99	0.95	0.64	0.61	1.96	1.86	3.49	3.32	3.45	3.28	1.06	1.01	0.67	0.65	2.08	1.97
140	6.40	6.00	6.36	5.97	2.75	2.62	2.01	1.91	4.54	4.29	7.64	7.10	7.60	7.06	2.89	2.77	2.17	2.05	5.12	4.84
130	10.98	9.96	10.93	9.92	5.60	5.29	4.51	4.27	8.41	7.80	14.38	13.04	14.33	12.99	6.66	6.24	4.99	4.73	10.77	9.78
120	16.65	15.11	16.62	15.07	9.88	9.14	8.22	7.64	13.95	12.69	23.96	21.26	23.88	21.17	13.98	12.70	10.82	9.85	19.33	17.40

Table H-313. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.05	0.05	0.05	0.05	-	-	-	-	0.01	0.01	0.05	0.05	0.05	0.05	-	-	-	-	0.01	0.01
190	0.21	0.21	0.21	0.20	0.04	0.04	0.01	0.01	0.10	0.09	0.21	0.21	0.21	0.21	0.03	0.03	0.01	0.01	0.10	0.10
180	0.97	0.93	0.97	0.92	0.19	0.19	0.11	0.11	0.48	0.45	1.00	0.96	1.00	0.95	0.18	0.18	0.11	0.11	0.52	0.48
175	1.78	1.69	1.75	1.67	0.43	0.41	0.24	0.23	0.97	0.93	1.87	1.78	1.85	1.76	0.44	0.42	0.26	0.24	1.01	0.97
170	2.81	2.68	2.79	2.66	0.91	0.87	0.56	0.53	1.75	1.66	2.97	2.84	2.95	2.82	0.95	0.91	0.59	0.57	1.84	1.75
160	5.88	5.54	5.85	5.51	2.52	2.40	1.87	1.78	4.14	3.92	6.86	6.42	6.83	6.39	2.65	2.54	1.94	1.86	4.56	4.32
150	1-	9.25	9.97	9.22	5.21	4.91	4.21	3.99	7.76	7.22	13.21	12.03	13.15	11.98	5.99	5.64	4.60	4.36	9.63	8.93
140	15.82	14.35	15.78	14.31	9.40	8.70	7.75	7.20	13.18	12.03	22.18	19.53	22.08	19.45	12.82	11.70	9.75	9.04	18.07	16.33
130	22.96	20.25	22.90	20.20	15.59	14.12	13.48	12.29	19.38	17.44	36.54	32.09	36.36	31.96	23.81	21.16	19.38	17.52	31.38	27.66
120	30.76	27.27	30.71	27.22	23.55	20.89	20.34	18.24	27.88	24.87	66.50	54.63	64.54	53.60	43.51	38.68	38.35	33.70	52.64	47.61

Table H-314. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
190	0.09	0.09	0.09	0.09	-	-	-	-	0.04	0.04	0.09	0.09	0.09	0.09	-	-	-	-	0.04	0.04
180	0.40	0.38	0.39	0.38	0.08	0.08	0.05	0.05	0.18	0.18	0.41	0.40	0.41	0.39	0.08	0.08	0.04	0.04	0.18	0.18
175	0.90	0.87	0.90	0.86	0.16	0.15	0.10	0.09	0.41	0.40	0.94	0.90	0.93	0.89	0.14	0.14	0.10	0.10	0.42	0.41
170	1.60	1.53	1.58	1.51	0.37	0.36	0.21	0.21	0.91	0.87	1.68	1.60	1.66	1.58	0.38	0.37	0.21	0.21	0.95	0.91
160	3.97	3.77	3.94	3.74	1.44	1.36	0.96	0.92	2.55	2.43	4.38	4.16	4.35	4.13	1.51	1.44	1.00	0.96	2.67	2.56
150	7.44	6.93	7.40	6.90	3.47	3.28	2.65	2.53	5.35	5.06	9.02	8.35	8.98	8.31	3.75	3.56	2.81	2.68	6.28	5.90
140	12.53	11.42	12.49	11.39	6.62	6.21	5.39	5.08	9.58	8.87	16.27	14.74	16.21	14.69	8.22	7.65	6.20	5.83	12.88	11.75
130	18.26	16.47	18.22	16.43	11.88	10.81	9.65	8.92	15.53	14.09	26.94	24.09	26.86	24.02	16.44	14.93	13.35	12.19	22.73	20.10
120	25.99	23.29	25.96	23.25	18.28	16.50	16.13	14.57	23.02	20.33	44.55	39.69	44.26	39.42	30.06	26.62	25.53	22.85	38.92	34.17

Table H-315. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	0.05	0.05	-	-	-	-	0.01	0.01	0.05	0.05	0.05	0.05	-	-	-	-	0.01	0.01
180	0.21	0.21	0.21	0.20	0.04	0.04	0.01	0.01	0.10	0.09	0.21	0.21	0.21	0.21	0.03	0.03	0.01	0.01	0.10	0.09
175	0.45	0.43	0.45	0.43	0.09	0.09	0.06	0.06	0.21	0.20	0.50	0.46	0.46	0.44	0.09	0.09	0.05	0.05	0.21	0.20
170	0.97	0.93	0.97	0.92	0.19	0.19	0.11	0.11	0.48	0.45	1.00	0.96	1.00	0.95	0.18	0.18	0.11	0.11	0.52	0.48
160	2.81	2.68	2.79	2.66	0.91	0.87	0.56	0.53	1.75	1.66	2.97	2.84	2.95	2.82	0.96	0.91	0.59	0.57	1.84	1.75
150	5.88	5.54	5.85	5.51	2.52	2.40	1.87	1.78	4.14	3.92	6.86	6.42	6.83	6.39	2.65	2.54	1.94	1.86	4.56	4.32
140	10	9.25	9.97	9.22	5.21	4.91	4.21	3.99	7.76	7.22	13.21	12.03	13.15	11.98	5.99	5.64	4.60	4.36	9.63	8.93
130	15.82	14.35	15.78	14.31	9.40	8.70	7.75	7.20	13.18	12.03	22.18	19.53	22.08	19.45	12.82	11.70	9.75	9.04	18.07	16.33
120	22.96	20.25	22.90	20.20	15.59	14.12	13.48	12.29	19.38	17.44	36.54	32.09	36.36	31.96	23.81	21.16	19.38	17.52	31.38	27.66

Table H-316. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	0.01	0.01	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-
180	0.10	0.10	0.10	0.09	-	-	-	-	0.05	0.05	0.11	0.10	0.10	0.10	-	-	-	-	0.05	0.05
175	0.21	0.21	0.21	0.20	0.04	0.04	0.01	0.01	0.10	0.09	0.21	0.21	0.21	0.21	0.03	0.03	0.01	0.01	0.10	0.09
170	0.45	0.43	0.45	0.43	0.09	0.09	0.06	0.06	0.21	0.20	0.50	0.46	0.46	0.44	0.09	0.09	0.05	0.05	0.21	0.20
160	1.78	1.69	1.75	1.67	0.43	0.41	0.24	0.23	0.97	0.93	1.87	1.78	1.85	1.76	0.44	0.42	0.26	0.24	1.01	0.97
150	4.26	4.04	4.23	4.01	1.58	1.50	1.08	1.03	2.75	2.63	4.73	4.49	4.71	4.46	1.66	1.58	1.16	1.10	2.89	2.77
140	7.89	7.34	7.85	7.31	3.78	3.57	2.84	2.71	5.70	5.38	9.54	8.82	9.50	8.79	4.08	3.88	2.99	2.86	6.76	6.34
130	13.05	11.91	13.00	11.88	7.01	6.57	5.71	5.38	9.99	9.25	17.09	15.48	17.03	15.43	8.85	8.21	6.69	6.29	13.68	12.45
120	18.86	16.99	18.82	16.96	12.51	11.40	10.16	9.33	16.14	14.64	28.37	25.21	28.26	25.13	17.43	15.81	14.29	12.99	24.05	21.40

Table H-317. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted categories (Finneran et al. 2017, NMFS 2018) at location L02 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.06	0.06	0.06	0.06	-	-	-	-	0.01	0.01	0.06	0.06	0.06	0.06	-	-	-	-	0.01	0.01
190	0.31	0.29	0.30	0.29	0.05	0.05	0.01	0.01	0.11	0.11	0.31	0.30	0.31	0.30	0.05	0.05	0.01	0.01	0.11	0.11
180	1.18	1.13	1.16	1.10	0.21	0.21	0.12	0.11	0.57	0.56	1.24	1.19	1.22	1.17	0.21	0.21	0.12	0.12	0.60	0.58
175	1.98	1.89	1.96	1.87	0.52	0.50	0.29	0.28	1.08	1.03	2.10	2.00	2.07	1.97	0.54	0.52	0.30	0.29	1.12	1.07
170	3.05	2.90	3.03	2.88	0.95	0.91	0.61	0.58	1.87	1.79	3.36	3.20	3.32	3.16	0.98	0.94	0.63	0.61	1.95	1.86
160	6.26	5.88	6.23	5.85	2.65	2.53	1.94	1.85	4.38	4.14	7.34	6.81	7.29	6.78	2.81	2.68	2.07	1.97	4.95	4.67
150	10.64	9.72	10.58	9.68	5.64	5.30	4.47	4.23	8.30	7.74	14.24	12.97	14.19	12.93	6.72	6.27	5.08	4.79	10.69	9.78
140	16.62	15.13	16.58	15.10	10.08	9.36	8.48	7.89	14.05	12.86	25.07	22.31	24.98	22.25	14.53	13.27	11.41	10.45	20.13	18.06
130	24.64	21.97	24.59	21.92	16.86	15.32	14.51	13.30	21.21	18.77	39.98	35.56	39.82	35.42	27.44	24.49	23.16	20.50	35.09	31.15
120	32.90	29.28	32.84	29.22	25.53	22.79	22.65	19.94	29.90	26.72	71.05	57.82	69.64	56.74	47.37	43.06	42.86	38.76	59.38	50.74

Table H-318. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	0.01	0.01	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-
190	0.11	0.10	0.10	0.10	-	-	-	-	0.05	0.05	0.11	0.11	0.11	0.10	-	-	-	-	0.05	0.05
180	0.55	0.53	0.54	0.52	0.09	0.09	0.06	0.06	0.21	0.21	0.57	0.55	0.56	0.54	0.09	0.09	0.05	0.05	0.21	0.21
175	0.99	0.95	0.98	0.94	0.18	0.18	0.11	0.11	0.52	0.50	1.05	1.01	1.03	0.99	0.17	0.16	0.11	0.11	0.54	0.52
170	1.82	1.75	1.81	1.73	0.46	0.42	0.24	0.23	0.95	0.91	1.91	1.82	1.89	1.81	0.48	0.44	0.23	0.23	0.99	0.94
160	4.28	4.06	4.25	4.03	1.52	1.44	1.03	0.98	2.69	2.57	4.75	4.50	4.72	4.46	1.62	1.54	1.04	1.00	2.83	2.71
150	7.86	7.33	7.82	7.29	3.71	3.52	2.77	2.64	5.74	5.40	9.51	8.82	9.47	8.79	4.10	3.88	2.93	2.81	6.82	6.38
140	13.08	11.98	13.04	11.95	7.28	6.75	5.84	5.48	10.15	9.40	17.78	16.07	17.73	16.02	9.20	8.54	6.99	6.54	14.28	13.04
130	19.25	17.38	19.21	17.35	12.85	11.82	10.54	9.68	16.65	15.15	30.38	27.01	30.27	26.93	18.69	16.89	15.33	13.98	25.94	23.17
120	27.73	24.86	27.67	24.81	19.69	17.76	17.44	15.77	25.00	22.33	47.25	42.96	46.95	42.71	34.37	30.56	29.82	26.56	42.35	38.00

Table H-319. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	0.01	0.01	0.06	0.06	0.06	0.06	-	-	-	-	0.01	0.01
180	0.30	0.29	0.30	0.29	0.05	0.05	0.01	0.01	0.11	0.11	0.31	0.30	0.31	0.30	0.05	0.05	0.01	0.01	0.11	0.11
175	0.61	0.59	0.61	0.58	0.10	0.09	0.07	0.07	0.26	0.25	0.64	0.61	0.63	0.61	0.10	0.09	0.07	0.07	0.28	0.26
170	1.18	1.13	1.16	1.10	0.21	0.21	0.12	0.11	0.57	0.56	1.24	1.19	1.22	1.17	0.21	0.21	0.12	0.12	0.60	0.58
160	3.05	2.90	3.03	2.88	0.95	0.91	0.61	0.58	1.87	1.79	3.36	3.20	3.32	3.16	0.98	0.94	0.63	0.61	1.95	1.86
150	6.26	5.88	6.23	5.85	2.65	2.53	1.94	1.85	4.38	4.14	7.34	6.81	7.29	6.78	2.81	2.68	2.07	1.97	4.95	4.67
140	10.64	9.72	10.58	9.68	5.64	5.30	4.47	4.23	8.30	7.74	14.24	12.97	14.19	12.93	6.72	6.27	5.08	4.79	10.69	9.78
130	16.62	15.13	16.58	15.10	10.08	9.36	8.48	7.89	14.05	12.86	25.07	22.31	24.98	22.25	14.53	13.27	11.41	10.45	20.13	18.06
120	24.64	21.97	24.59	21.92	16.86	15.32	14.51	13.30	21.21	18.77	39.98	35.56	39.82	35.42	27.44	24.49	23.16	20.50	35.09	31.15

Table H-320. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	0.01	0.01	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-
180	0.12	0.11	0.11	0.11	-	-	-	-	0.06	0.06	0.12	0.12	0.12	0.11	0.01	0.01	-	-	0.05	0.05
175	0.30	0.29	0.30	0.29	0.05	0.05	0.01	0.01	0.11	0.11	0.31	0.30	0.31	0.30	0.05	0.05	0.01	0.01	0.11	0.11
170	0.61	0.59	0.61	0.58	0.10	0.09	0.07	0.07	0.26	0.25	0.64	0.61	0.63	0.61	0.10	0.09	0.07	0.07	0.28	0.26
160	1.98	1.89	1.96	1.87	0.52	0.50	0.29	0.28	1.08	1.03	2.10	2.00	2.07	1.97	0.54	0.52	0.30	0.29	1.12	1.07
150	4.58	4.34	4.56	4.31	1.71	1.62	1.16	1.10	2.88	2.75	5.12	4.84	5.08	4.81	1.78	1.71	1.26	1.20	3.06	2.92
140	8.30	7.73	8.26	7.69	4.00	3.79	2.98	2.84	6.14	5.75	10.05	9.31	9.99	9.27	4.47	4.21	3.25	3.09	7.40	6.87
130	13.65	12.48	13.60	12.44	7.76	7.20	6.24	5.84	10.90	9.98	18.72	16.88	18.66	16.83	9.82	9.12	7.64	7.09	15.18	13.84
120	19.88	17.93	19.83	17.89	13.46	12.37	11.30	10.36	17.36	15.75	31.88	28.27	31.77	28.18	19.74	17.78	16.35	14.91	27.30	24.37

Table H-321. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.07	0.07	0.07	0.07	-	-	-	-	0.01	0.01	0.07	0.07	0.07	0.07	-	-	-	-	0.01	0.01
190	0.38	0.36	0.37	0.36	0.07	0.07	0.02	0.02	0.13	0.13	0.41	0.39	0.39	0.37	0.07	0.07	0.02	0.02	0.14	0.14
180	1.44	1.38	1.42	1.36	0.33	0.32	0.21	0.20	0.76	0.73	1.51	1.45	1.49	1.43	0.33	0.32	0.19	0.19	0.80	0.76
175	2.30	2.20	2.27	2.17	0.66	0.63	0.43	0.41	1.34	1.28	2.45	2.34	2.41	2.31	0.72	0.68	0.47	0.45	1.41	1.35
170	3.45	3.27	3.40	3.24	1.26	1.20	0.83	0.80	2.12	2.02	3.74	3.56	3.70	3.52	1.33	1.27	0.87	0.83	2.29	2.18
160	6.49	6.08	6.45	6.04	2.95	2.81	2.36	2.25	4.58	4.35	7.42	6.86	7.36	6.81	3.21	3.04	2.53	2.41	5.06	4.77
150	10.77	9.76	10.71	9.71	5.92	5.55	4.86	4.60	8.37	7.76	14.11	12.82	14.06	12.77	6.78	6.28	5.44	5.09	10.40	9.51
140	16.80	15.24	16.77	15.20	10.25	9.37	8.63	7.98	14.25	12.93	25.02	22.40	24.93	22.32	14.61	13.25	11.34	10.35	20.20	18.21
130	24.94	22.30	24.88	22.24	17.07	15.46	14.84	13.41	21.38	19.05	41.15	36.29	40.89	36.07	28.59	25.38	24.03	21.43	36.25	31.92
120	33.78	29.74	33.71	29.68	25.92	23.14	22.86	20.29	30.77	27.14	85.16	69.40	82.59	67.24	52.30	47.33	46.33	41.68	73.09	59.80

Table H-322. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	0.01	0.01	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-
190	0.13	0.12	0.12	0.12	0.01	0.01	-	-	0.07	0.07	0.13	0.13	0.13	0.13	0.01	0.01	-	-	0.07	0.07
180	0.71	0.69	0.70	0.67	0.12	0.11	0.08	0.08	0.32	0.31	0.75	0.72	0.73	0.71	0.12	0.12	0.08	0.08	0.32	0.31
175	1.31	1.25	1.30	1.24	0.25	0.24	0.14	0.13	0.63	0.60	1.37	1.31	1.35	1.29	0.28	0.25	0.14	0.14	0.68	0.64
170	2.09	2.00	2.07	1.97	0.55	0.52	0.36	0.35	1.22	1.16	2.23	2.14	2.21	2.11	0.58	0.55	0.36	0.35	1.28	1.23
160	4.58	4.34	4.54	4.31	1.84	1.74	1.34	1.28	2.91	2.77	5.02	4.74	4.98	4.70	1.93	1.85	1.45	1.38	3.09	2.94
150	8.04	7.45	8.00	7.42	4.07	3.86	3.15	3.00	5.90	5.54	9.43	8.72	9.39	8.68	4.42	4.20	3.51	3.31	6.82	6.31
140	13.21	12.03	13.16	11.99	7.43	6.90	6.16	5.78	10.25	9.37	17.66	16.05	17.60	15.99	9.08	8.40	7.12	6.58	14.17	12.87
130	19.33	17.54	19.28	17.50	13.05	11.89	10.72	9.70	16.86	15.27	30.76	27.16	30.63	27.06	18.93	17.22	15.56	14.11	26.25	23.46
120	28.37	25.20	28.30	25.15	19.82	17.95	17.59	15.91	25.37	22.66	50.02	45.11	49.59	44.71	36.40	32.05	31.43	27.78	44.86	40.10

Table H-323. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.07	0.07	0.07	-	-	-	-	0.01	0.01	0.07	0.07	0.07	0.07	-	-	-	-	0.01	0.01
180	0.38	0.36	0.37	0.36	0.07	0.07	0.02	0.02	0.13	0.13	0.41	0.39	0.39	0.37	0.07	0.07	0.02	0.02	0.14	0.14
175	0.80	0.77	0.80	0.76	0.13	0.12	0.09	0.09	0.35	0.34	0.83	0.80	0.82	0.79	0.13	0.13	0.09	0.09	0.36	0.35
170	1.44	1.38	1.42	1.36	0.33	0.32	0.21	0.20	0.76	0.73	1.51	1.45	1.49	1.43	0.33	0.32	0.19	0.19	0.80	0.76
160	3.45	3.27	3.40	3.24	1.26	1.20	0.83	0.80	2.12	2.02	3.74	3.56	3.70	3.52	1.33	1.27	0.87	0.83	2.29	2.18
150	6.49	6.08	6.45	6.04	2.95	2.81	2.36	2.25	4.58	4.35	7.42	6.86	7.36	6.81	3.21	3.04	2.53	2.41	5.06	4.77
140	10.77	9.76	10.71	9.71	5.92	5.55	4.86	4.60	8.37	7.76	14.11	12.82	14.06	12.77	6.78	6.28	5.44	5.09	10.40	9.51
130	16.80	15.24	16.77	15.20	10.25	9.37	8.63	7.98	14.25	12.93	25.02	22.40	24.93	22.32	14.61	13.25	11.34	10.35	20.20	18.21
120	24.94	22.30	24.88	22.24	17.07	15.46	14.84	13.41	21.38	19.05	41.15	36.29	40.89	36.07	28.59	25.38	24.03	21.43	36.25	31.92

Table H-324. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
180	0.14	0.14	0.14	0.14	0.01	0.01	-	-	0.08	0.07	0.15	0.14	0.14	0.14	0.01	0.01	-	-	0.08	0.07
175	0.38	0.36	0.37	0.36	0.07	0.07	0.02	0.02	0.13	0.13	0.41	0.39	0.39	0.37	0.07	0.07	0.02	0.02	0.14	0.14
170	0.80	0.77	0.80	0.76	0.13	0.12	0.09	0.09	0.35	0.34	0.83	0.80	0.82	0.79	0.13	0.13	0.09	0.09	0.36	0.35
160	2.30	2.20	2.27	2.17	0.66	0.63	0.43	0.41	1.34	1.27	2.45	2.34	2.41	2.31	0.72	0.68	0.47	0.45	1.41	1.35
150	4.88	4.61	4.83	4.58	1.99	1.90	1.50	1.42	3.15	2.98	5.38	5.05	5.34	5.02	2.13	2.03	1.62	1.53	3.43	3.25
140	8.45	7.83	8.41	7.79	4.35	4.12	3.47	3.28	6.26	5.87	9.94	9.19	9.91	9.15	4.77	4.50	3.79	3.59	7.34	6.76
130	13.78	12.53	13.74	12.49	7.88	7.31	6.52	6.10	10.99	9.97	18.60	16.89	18.55	16.84	9.71	8.98	7.66	7.08	15.13	13.71
120	19.95	18.09	19.91	18.06	13.71	12.45	11.48	10.40	17.52	15.88	32.30	28.45	32.16	28.35	20.10	18.17	16.68	15.14	27.77	24.72

Table H-325. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.09	0.09	0.09	0.09	-	-	-	-	0.02	0.02	0.10	0.09	0.09	0.09	-	-	-	-	0.02	0.02
180	0.44	0.42	0.43	0.41	0.08	0.08	0.02	0.02	0.14	0.14	0.45	0.43	0.44	0.42	0.08	0.08	0.02	0.02	0.14	0.14
175	0.85	0.81	0.83	0.80	0.13	0.13	0.09	0.09	0.39	0.38	0.88	0.85	0.86	0.83	0.13	0.13	0.09	0.09	0.38	0.37
170	1.55	1.49	1.53	1.46	0.31	0.30	0.20	0.20	0.78	0.75	1.64	1.57	1.62	1.55	0.33	0.32	0.15	0.14	0.81	0.78
160	3.88	3.68	3.83	3.64	1.25	1.20	0.82	0.78	2.36	2.26	4.24	4.04	4.20	4.00	1.33	1.27	0.86	0.82	2.52	2.41
150	7.38	6.88	7.34	6.84	3.18	3.03	2.42	2.31	5.18	4.90	8.94	8.27	8.88	8.22	3.49	3.32	2.58	2.46	5.91	5.57
140	12.80	11.63	12.76	11.59	6.41	6.01	5.13	4.84	9.48	8.77	16.79	14.98	16.72	14.92	7.61	7.08	5.73	5.40	12.82	11.53
130	18.93	17.03	18.89	16.98	11.58	10.49	9.25	8.56	15.87	14.28	27.54	24.46	27.44	24.37	16.04	14.25	12.63	11.33	22.69	19.93
120	27.19	24.42	27.12	24.36	18.16	16.34	15.73	14.11	23.72	21.08	43.54	38.93	43.32	38.73	28.09	24.84	23.52	20.68	36.80	32.57

Table H-326. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	0.03	0.03	-	-	-	-	-	-	0.03	0.03	0.03	0.03	-	-	-	-	-	-
180	0.14	0.14	0.14	0.14	-	-	-	-	0.08	0.08	0.15	0.14	0.14	0.14	-	-	-	-	0.08	0.08
175	0.38	0.37	0.37	0.36	0.07	0.07	0.02	0.02	0.13	0.13	0.38	0.37	0.37	0.36	0.07	0.07	-	-	0.13	0.13
170	0.76	0.73	0.75	0.72	0.12	0.12	0.09	0.09	0.33	0.31	0.78	0.75	0.76	0.74	0.12	0.12	0.09	0.09	0.33	0.32
160	2.31	2.21	2.28	2.18	0.55	0.53	0.35	0.34	1.28	1.22	2.47	2.36	2.44	2.33	0.59	0.57	0.36	0.34	1.34	1.29
150	5.11	4.82	5.07	4.79	1.89	1.81	1.33	1.28	3.30	3.14	5.79	5.45	5.74	5.41	1.98	1.90	1.41	1.35	3.63	3.45
140	9.19	8.53	9.17	8.50	4.37	4.16	3.34	3.17	6.68	6.26	11.91	10.73	11.84	10.67	4.81	4.56	3.65	3.47	8.13	7.55
130	15.18	13.68	15.13	13.64	8.18	7.59	6.54	6.13	12.11	10.98	20.15	18.03	20.04	17.96	10.34	9.36	7.79	7.24	16.35	14.55
120	22.34	19.68	22.26	19.60	14.20	12.80	11.80	10.68	18.46	16.62	32.74	28.95	32.61	28.84	19.82	17.73	16.45	14.60	27.72	24.57

Table H-327. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.09	0.09	0.09	0.09	-	-	-	-	0.02	0.02	0.10	0.09	0.09	0.09	-	-	-	-	0.02	0.02
175	0.18	0.17	0.17	0.17	-	-	-	-	0.09	0.09	0.16	0.16	0.16	0.15	-	-	-	-	0.09	0.09
170	0.44	0.42	0.43	0.41	0.08	0.08	0.02	0.02	0.14	0.14	0.45	0.43	0.44	0.42	0.08	0.08	0.02	0.02	0.14	0.14
160	1.55	1.49	1.53	1.46	0.31	0.30	0.20	0.20	0.78	0.75	1.64	1.57	1.62	1.55	0.33	0.32	0.15	0.14	0.81	0.78
150	3.88	3.68	3.83	3.64	1.25	1.20	0.82	0.78	2.36	2.26	4.24	4.04	4.20	4.00	1.33	1.27	0.86	0.82	2.52	2.41
140	7.38	6.88	7.34	6.84	3.18	3.03	2.42	2.31	5.18	4.90	8.94	8.27	8.88	8.22	3.49	3.32	2.58	2.46	5.91	5.57
130	12.80	11.63	12.76	11.59	6.41	6.01	5.13	4.84	9.48	8.77	16.79	14.98	16.72	14.92	7.61	7.08	5.73	5.40	12.82	11.53
120	18.93	17.03	18.89	16.99	11.58	10.49	9.25	8.56	15.87	14.28	27.54	24.46	27.44	24.37	16.04	14.25	12.63	11.33	22.69	19.93

Table H-328. Monopile foundation (9.6 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.05	0.05	0.05	0.05	-	-	-	-	-	-	0.05	0.05	0.04	0.04	-	-	-	-	-	-
175	0.09	0.09	0.09	0.09	-	-	-	-	0.02	0.02	0.10	0.09	0.09	0.09	-	-	-	-	0.02	0.02
170	0.18	0.17	0.17	0.17	-	-	-	-	0.09	0.09	0.16	0.16	0.16	0.15	-	-	-	-	0.09	0.09
160	0.85	0.81	0.83	0.80	0.13	0.13	0.09	0.09	0.39	0.38	0.88	0.85	0.86	0.83	0.13	0.13	0.09	0.09	0.38	0.37
150	2.54	2.43	2.51	2.40	0.63	0.60	0.39	0.38	1.43	1.37	2.70	2.58	2.66	2.55	0.68	0.65	0.40	0.38	1.50	1.44
140	5.44	5.13	5.40	5.10	2.06	1.97	1.48	1.42	3.63	3.45	6.23	5.86	6.18	5.82	2.22	2.12	1.58	1.51	3.96	3.78
130	9.65	8.92	9.60	8.89	4.68	4.43	3.64	3.47	7.10	6.63	12.72	11.46	12.66	11.40	5.18	4.90	3.96	3.77	8.77	8.11
120	15.78	14.22	15.73	14.17	8.64	8.01	6.93	6.48	12.74	11.56	21.54	18.97	21.43	18.89	11.37	10.20	8.46	7.82	17.26	15.37

Table H-329. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
190	0.13	0.13	0.13	0.13	-	-	-	-	0.08	0.07	0.14	0.13	0.13	0.13	-	-	-	-	0.07	0.07
180	0.65	0.63	0.63	0.61	0.12	0.11	0.09	0.09	0.31	0.30	0.71	0.68	0.69	0.65	0.12	0.12	0.09	0.08	0.31	0.30
175	1.28	1.22	1.26	1.21	0.24	0.24	0.13	0.13	0.62	0.59	1.34	1.28	1.32	1.27	0.24	0.23	0.14	0.13	0.66	0.63
170	2.16	2.07	2.12	2.03	0.54	0.52	0.34	0.33	1.25	1.20	2.32	2.22	2.28	2.19	0.58	0.56	0.35	0.34	1.31	1.25
160	4.99	4.72	4.96	4.69	1.89	1.81	1.36	1.30	3.25	3.09	5.62	5.29	5.57	5.25	1.97	1.90	1.43	1.37	3.54	3.37
150	9.11	8.46	9.07	8.42	4.36	4.13	3.38	3.22	6.57	6.16	11.54	10.41	11.47	10.35	4.74	4.49	3.69	3.49	7.89	7.33
140	14.98	13.53	14.94	13.49	8.07	7.50	6.52	6.09	11.90	10.79	19.55	17.53	19.49	17.49	1-	9.17	7.71	7.16	15.84	14.09
130	21.92	19.25	21.85	19.20	14.14	12.74	11.91	10.78	18.22	16.39	31.68	27.94	31.58	27.85	19.63	17.56	16.51	14.66	26.96	23.91
120	29.81	26.71	29.76	26.66	21.53	19.02	18.82	16.92	26.63	23.89	51.76	46.50	51.34	46.11	35.46	31.10	30.37	26.73	45.57	40.81

Table H-330. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.07	0.07	0.06	-	-	-	-	-	-	0.07	0.06	0.07	0.06	-	-	-	-	-	-
180	0.25	0.24	0.25	0.24	0.05	0.05	-	-	0.12	0.11	0.25	0.24	0.25	0.24	0.03	0.03	-	-	0.12	0.12
175	0.53	0.51	0.52	0.50	0.11	0.11	0.08	0.07	0.24	0.24	0.56	0.54	0.55	0.53	0.11	0.11	0.07	0.07	0.24	0.23
170	1.15	1.10	1.13	1.08	0.23	0.22	0.12	0.12	0.53	0.51	1.21	1.16	1.19	1.14	0.22	0.21	0.13	0.13	0.55	0.54
160	3.07	2.92	3.03	2.89	0.95	0.91	0.60	0.58	1.89	1.81	3.38	3.22	3.34	3.18	0.98	0.95	0.64	0.62	1.98	1.90
150	6.45	6.04	6.41	6.01	2.73	2.61	1.98	1.90	4.48	4.24	7.56	7.05	7.52	7.01	2.88	2.75	2.15	2.06	4.91	4.65
140	11.40	10.37	11.36	10.32	5.61	5.28	4.53	4.28	8.40	7.82	14.70	13.14	14.64	13.09	6.34	5.94	4.95	4.68	10.55	9.52
130	17.40	15.68	17.34	15.64	9.97	9.20	8.30	7.71	14.40	12.97	24.37	21.58	24.30	21.51	13.85	12.37	10.54	9.49	19.38	17.35
120	25.35	22.62	25.30	22.57	16.80	15.08	14.58	13.12	21.37	18.86	38.50	34.10	38.33	33.93	25.37	22.41	20.92	18.48	32.83	28.84

Table H-331. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
180	0.13	0.13	0.13	0.13	-	-	-	-	0.08	0.07	0.14	0.13	0.13	0.13	-	-	-	-	0.07	0.07
175	0.33	0.32	0.33	0.31	0.07	0.06	-	-	0.12	0.12	0.33	0.32	0.33	0.32	0.06	0.06	-	-	0.13	0.13
170	0.65	0.63	0.63	0.61	0.12	0.11	0.09	0.09	0.31	0.30	0.71	0.68	0.69	0.65	0.12	0.12	0.09	0.08	0.31	0.30
160	2.16	2.07	2.12	2.03	0.54	0.52	0.34	0.33	1.25	1.20	2.32	2.22	2.28	2.19	0.58	0.56	0.35	0.34	1.31	1.25
150	4.99	4.72	4.96	4.69	1.89	1.81	1.36	1.30	3.25	3.09	5.62	5.29	5.57	5.25	1.97	1.90	1.43	1.37	3.54	3.37
140	9.11	8.46	9.07	8.42	4.36	4.13	3.38	3.22	6.57	6.16	11.54	10.41	11.47	10.35	4.74	4.49	3.69	3.49	7.89	7.33
130	14.98	13.53	14.94	13.49	8.07	7.50	6.52	6.09	11.90	10.79	19.55	17.53	19.49	17.49	1-	9.17	7.71	7.16	15.84	14.09
120	21.92	19.25	21.85	19.20	14.14	12.74	11.91	10.78	18.22	16.39	31.68	27.94	31.58	27.85	19.63	17.56	16.51	14.66	26.96	23.91

Table H-332. Monopile foundation (9.6 m diameter, IHC S-5500, 800 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.08	0.08	0.08	0.07	-	-	-	-	-	-	0.08	0.08	0.08	0.07	-	-	-	-	-	-
175	0.13	0.13	0.13	0.13	-	-	-	-	0.08	0.07	0.14	0.13	0.13	0.13	-	-	-	-	0.07	0.07
170	0.33	0.32	0.33	0.31	0.07	0.06	-	-	0.12	0.12	0.33	0.32	0.33	0.32	0.06	0.06	-	-	0.13	0.13
160	1.28	1.22	1.26	1.21	0.24	0.24	0.13	0.13	0.62	0.59	1.34	1.28	1.32	1.27	0.24	0.23	0.14	0.13	0.66	0.63
150	3.40	3.24	3.36	3.21	1.10	1.06	0.69	0.66	2.07	1.98	3.73	3.56	3.70	3.52	1.17	1.12	0.76	0.73	2.24	2.13
140	6.84	6.40	6.80	6.36	2.92	2.79	2.26	2.15	4.79	4.53	8.13	7.57	8.09	7.53	3.12	2.97	2.41	2.30	5.31	5.01
130	12.05	10.96	12.01	10.92	5.96	5.60	4.82	4.56	8.88	8.25	15.49	13.83	15.43	13.78	6.85	6.40	5.31	5.00	11.50	10.34
120	18.06	16.25	18.00	16.21	10.76	9.73	8.80	8.15	15.01	13.51	25.49	22.63	25.43	22.56	14.79	13.16	11.58	10.39	20.40	18.14

Table H-333. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
190	0.23	0.23	0.23	0.22	0.02	0.02	-	-	0.11	0.10	0.23	0.23	0.23	0.22	0.02	0.02	-	-	0.11	0.11
180	1.12	1.08	1.10	1.06	0.20	0.20	0.12	0.11	0.49	0.47	1.16	1.12	1.14	1.10	0.18	0.17	0.12	0.11	0.50	0.48
175	1.88	1.80	1.87	1.78	0.44	0.42	0.24	0.24	1.09	1.05	1.95	1.87	1.94	1.86	0.46	0.44	0.24	0.23	1.12	1.08
170	2.94	2.82	2.92	2.80	0.92	0.87	0.57	0.54	1.82	1.74	3.16	3.01	3.12	2.97	0.94	0.89	0.61	0.58	1.89	1.82
160	6.25	5.85	6.22	5.82	2.63	2.51	1.92	1.83	4.29	4.07	7.22	6.74	7.18	6.69	2.77	2.64	1.99	1.91	4.65	4.41
150	10.95	9.99	10.89	9.94	5.42	5.10	4.37	4.14	8.14	7.57	14.29	12.82	14.23	12.78	6.22	5.83	4.81	4.54	10.16	9.30
140	17.02	15.36	16.97	15.33	9.82	9.08	8.15	7.58	14.12	12.75	24.45	21.65	24.43	21.63	14.19	12.67	11.05	9.97	19.57	17.55
130	25.07	22.31	25.01	22.28	16.82	15.11	14.70	13.22	21.22	18.73	40.22	35.93	40.14	35.89	27.17	24.12	23.51	20.85	34.76	30.61
120	33.09	29.58	33.09	29.56	25.77	23.03	23.24	20.58	30.10	26.86	70.03	61.46	68.54	60.27	51.35	46.32	47.41	42.79	60.26	54.35

Table H-334. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.10	0.10	0.10	0.10	-	-	-	-	0.02	0.02	0.11	0.10	0.10	0.10	-	-	-	-	0.02	0.02
180	0.43	0.42	0.43	0.41	0.08	0.08	0.03	0.03	0.20	0.20	0.46	0.44	0.45	0.43	0.09	0.08	0.03	0.03	0.19	0.19
175	0.96	0.90	0.94	0.87	0.14	0.13	0.10	0.10	0.43	0.42	0.98	0.91	0.96	0.88	0.14	0.14	0.11	0.10	0.46	0.44
170	1.70	1.63	1.67	1.60	0.37	0.35	0.23	0.22	0.92	0.86	1.78	1.71	1.76	1.68	0.37	0.36	0.21	0.20	0.92	0.87
160	4.19	3.98	4.16	3.95	1.48	1.42	1.00	0.96	2.66	2.54	4.58	4.34	4.54	4.31	1.56	1.49	1.05	0.99	2.78	2.66
150	7.97	7.40	7.93	7.36	3.63	3.45	2.76	2.63	5.58	5.25	9.49	8.78	9.45	8.75	3.92	3.71	2.90	2.78	6.44	6.05
140	13.44	12.23	13.39	12.19	6.89	6.42	5.62	5.28	10.01	9.26	17.68	15.83	17.65	15.80	8.69	8.04	6.56	6.15	13.92	12.48
130	19.64	17.62	19.60	17.60	12.73	11.54	10.30	9.38	16.69	15.01	29.55	26.13	29.53	26.12	18.42	16.50	15.42	13.74	25.18	22.29
120	28.04	25.14	28.01	25.12	19.66	17.68	17.65	15.86	25.04	22.31	48.74	43.95	48.57	43.81	35.16	31.00	30.72	27.18	43.86	39.35

Table H-335. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
180	0.23	0.23	0.23	0.22	0.02	0.02	-	-	0.11	0.10	0.23	0.23	0.23	0.22	0.02	0.02	-	-	0.11	0.11
175	0.48	0.47	0.48	0.46	0.09	0.09	0.06	0.06	0.23	0.22	0.50	0.48	0.50	0.48	0.10	0.09	0.06	0.06	0.22	0.21
170	1.12	1.08	1.10	1.06	0.20	0.20	0.12	0.11	0.49	0.47	1.16	1.12	1.14	1.10	0.18	0.17	0.12	0.11	0.50	0.48
160	2.94	2.82	2.92	2.80	0.92	0.87	0.57	0.54	1.82	1.74	3.16	3.01	3.12	2.97	0.94	0.89	0.61	0.58	1.89	1.82
150	6.25	5.85	6.22	5.82	2.63	2.51	1.92	1.83	4.29	4.07	7.22	6.74	7.18	6.69	2.77	2.64	1.99	1.91	4.65	4.41
140	10.95	9.99	10.89	9.94	5.42	5.10	4.37	4.14	8.14	7.57	14.29	12.82	14.23	12.78	6.22	5.83	4.81	4.54	10.16	9.30
130	17.02	15.36	16.97	15.33	9.82	9.08	8.15	7.58	14.12	12.75	24.45	21.65	24.43	21.63	14.19	12.67	11.05	9.97	19.57	17.55
120	25.07	22.31	25.01	22.28	16.82	15.11	14.70	13.22	21.22	18.73	40.22	35.93	40.14	35.89	27.17	24.12	23.51	20.85	34.76	30.61

Table H-336. Monopile foundation (9.6 m diameter, IHC S-5500, 1400 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 15 dB.

Level (L_P)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.12	0.11	0.11	0.11	-	-	-	-	0.06	0.06	0.12	0.11	0.12	0.11	-	-	-	-	0.05	0.05
175	0.23	0.23	0.23	0.22	0.02	0.02	-	-	0.11	0.10	0.23	0.23	0.23	0.22	0.02	0.02	-	-	0.11	0.11
170	0.48	0.47	0.48	0.46	0.09	0.09	0.06	0.06	0.23	0.22	0.50	0.48	0.50	0.48	0.10	0.09	0.06	0.06	0.22	0.21
160	1.88	1.80	1.87	1.78	0.44	0.42	0.24	0.24	1.09	1.05	1.95	1.87	1.94	1.86	0.46	0.44	0.24	0.23	1.12	1.08
150	4.50	4.26	4.47	4.23	1.64	1.57	1.17	1.12	2.84	2.72	4.96	4.69	4.92	4.66	1.72	1.65	1.22	1.17	2.98	2.84
140	8.41	7.81	8.38	7.78	3.92	3.72	2.95	2.81	5.96	5.58	10.07	9.26	10.01	9.23	4.22	4.01	3.17	3.01	6.96	6.52
130	14.02	12.72	13.97	12.69	7.35	6.82	5.96	5.60	10.79	9.82	18.54	16.62	18.51	16.59	9.36	8.65	7.16	6.67	14.85	13.25
120	20.43	18.18	20.37	18.15	13.39	12.12	11.12	10.07	17.35	15.61	30.97	27.35	30.96	27.34	19.45	17.47	16.55	14.77	26.50	23.52

Table H-337. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.07	0.06	0.07	0.06	-	-	-	-	-	-	0.07	0.06	0.07	0.06	-	-	-	-	-	-
190	0.33	0.31	0.32	0.31	0.06	0.06	-	-	0.12	0.11	0.33	0.32	0.32	0.31	0.05	0.05	-	-	0.12	0.12
180	1.26	1.21	1.24	1.19	0.24	0.23	0.13	0.13	0.63	0.60	1.32	1.26	1.30	1.24	0.24	0.23	0.14	0.13	0.65	0.63
175	2.12	2.02	2.09	1.98	0.49	0.47	0.32	0.31	1.19	1.14	2.24	2.14	2.21	2.11	0.53	0.50	0.34	0.33	1.24	1.19
170	3.27	3.09	3.23	3.05	1.07	1.03	0.66	0.64	1.95	1.86	3.51	3.33	3.46	3.29	1.12	1.07	0.70	0.68	2.04	1.94
160	6.56	6.14	6.54	6.10	2.76	2.63	2.06	1.95	4.44	4.21	7.45	6.95	7.40	6.90	2.89	2.75	2.22	2.12	4.81	4.57
150	11.26	10.35	11.20	10.29	5.70	5.37	4.55	4.31	8.56	7.91	14.61	13.15	14.57	13.11	6.43	6.06	5.01	4.74	10.45	9.56
140	17.59	15.92	17.53	15.88	10.54	9.63	8.74	8.07	14.70	13.35	25.95	23.13	25.92	23.09	14.71	13.19	11.26	10.26	20.85	18.50
130	26.20	23.50	26.15	23.46	17.75	16.06	15.39	13.91	22.89	20.29	42.92	38.47	42.82	38.39	28.54	25.35	24.23	21.47	36.94	32.88
120	35.15	31.70	35.09	31.65	27.17	24.39	24.47	21.82	32.01	28.68	71.07	62.24	70.01	61.37	50.74	45.97	46.40	41.92	61.11	54.87

Table H-338. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.12	0.11	0.11	0.11	-	-	-	-	0.06	0.06	0.12	0.11	0.12	0.11	-	-	-	-	0.05	0.05
180	0.57	0.55	0.55	0.52	0.10	0.10	0.07	0.07	0.23	0.22	0.60	0.57	0.58	0.56	0.10	0.10	0.06	0.06	0.23	0.22
175	1.15	1.10	1.13	1.08	0.20	0.20	0.12	0.12	0.48	0.46	1.19	1.14	1.17	1.12	0.18	0.17	0.12	0.12	0.51	0.49
170	1.93	1.84	1.91	1.82	0.43	0.42	0.26	0.25	1.08	1.03	2.00	1.91	1.98	1.89	0.44	0.43	0.26	0.26	1.11	1.06
160	4.47	4.24	4.43	4.21	1.61	1.54	1.15	1.10	2.77	2.65	4.87	4.61	4.82	4.57	1.71	1.64	1.20	1.15	2.89	2.75
150	8.28	7.68	8.24	7.64	3.81	3.61	2.89	2.75	5.84	5.48	9.59	8.90	9.55	8.87	4.07	3.88	3.06	2.90	6.61	6.22
140	13.73	12.54	13.69	12.50	7.44	6.88	5.94	5.59	10.60	9.70	18.30	16.46	18.26	16.42	8.90	8.30	6.74	6.35	14.46	12.99
130	20.53	18.31	20.46	18.27	13.38	12.24	11.08	10.09	17.48	15.85	31.77	28.17	31.71	28.13	19.09	17.16	15.71	14.08	26.83	23.88
120	29.59	26.52	29.54	26.48	21.16	18.80	18.40	16.64	26.54	23.81	50.45	45.73	50.28	45.58	36.28	32.21	31.37	27.86	45.28	40.81

Table H-339. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.07	0.06	0.07	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.06	0.07	0.06	0.00	0.00	0.00	0.00	0.00	0.00
180	0.33	0.31	0.32	0.31	0.06	0.06	0.00	0.00	0.12	0.11	0.33	0.32	0.32	0.31	0.05	0.05	0.00	0.00	0.12	0.12
175	0.66	0.64	0.65	0.63	0.11	0.11	0.08	0.08	0.26	0.25	0.68	0.66	0.68	0.65	0.12	0.11	0.08	0.07	0.26	0.25
170	1.26	1.21	1.24	1.19	0.24	0.23	0.13	0.13	0.63	0.60	1.32	1.26	1.30	1.24	0.24	0.23	0.14	0.13	0.65	0.63
160	3.27	3.09	3.23	3.05	1.07	1.03	0.66	0.64	1.95	1.86	3.51	3.33	3.46	3.29	1.12	1.07	0.70	0.68	2.04	1.94
150	6.56	6.14	6.54	6.10	2.76	2.63	2.06	1.95	4.44	4.21	7.45	6.95	7.40	6.90	2.89	2.75	2.22	2.12	4.81	4.57
140	11.26	10.35	11.20	10.29	5.70	5.37	4.55	4.31	8.56	7.91	14.61	13.15	14.57	13.11	6.43	6.06	5.01	4.74	10.45	9.56
130	17.59	15.92	17.53	15.88	10.54	9.63	8.74	8.07	14.70	13.35	25.95	23.13	25.92	23.09	14.71	13.19	11.26	10.26	20.85	18.50
120	26.20	23.50	26.15	23.46	17.75	16.06	15.39	13.91	22.89	20.29	42.92	38.47	42.82	38.39	28.54	25.35	24.23	21.47	36.94	32.88

Table H-340. Monopile foundation (9.6 m diameter, IHC S-5500, 1700 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.12	0.12	0.12	0.12	0.00	0.00	0.00	0.00	0.07	0.06	0.13	0.13	0.13	0.13	0.00	0.00	0.00	0.00	0.07	0.06
175	0.33	0.31	0.32	0.31	0.06	0.06	0.00	0.00	0.12	0.11	0.33	0.32	0.32	0.31	0.05	0.05	0.00	0.00	0.12	0.12
170	0.66	0.64	0.65	0.63	0.11	0.11	0.08	0.08	0.26	0.25	0.68	0.66	0.68	0.65	0.12	0.11	0.08	0.07	0.26	0.25
160	2.12	2.02	2.09	1.98	0.49	0.47	0.32	0.31	1.19	1.14	2.24	2.14	2.21	2.11	0.53	0.50	0.34	0.33	1.24	1.19
150	4.79	4.53	4.76	4.50	1.79	1.71	1.26	1.21	2.97	2.83	5.25	4.95	5.20	4.91	1.88	1.79	1.34	1.29	3.16	2.99
140	8.72	8.08	8.68	8.04	4.07	3.87	3.13	2.95	6.24	5.84	10.24	9.40	10.17	9.35	4.39	4.17	3.40	3.21	7.15	6.69
130	14.34	13.06	14.30	13.02	7.94	7.34	6.34	5.94	11.34	10.39	19.28	17.31	19.24	17.27	9.58	8.90	7.35	6.87	15.46	13.85
120	21.64	19.09	21.57	19.04	14.10	12.82	11.84	10.80	18.28	16.50	33.39	29.59	33.34	29.54	20.23	18.13	16.86	15.13	28.34	25.18

Table H-341. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.02	0.02	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.02	0.02
190	0.38	0.37	0.38	0.37	0.07	0.07	0.02	0.02	0.13	0.13	0.39	0.38	0.39	0.38	0.07	0.07	0.02	0.02	0.14	0.13
180	1.50	1.44	1.48	1.42	0.29	0.27	0.14	0.14	0.72	0.69	1.56	1.49	1.53	1.47	0.30	0.28	0.15	0.15	0.74	0.72
175	2.44	2.31	2.41	2.28	0.65	0.63	0.40	0.39	1.36	1.31	2.55	2.42	2.53	2.40	0.68	0.66	0.42	0.41	1.45	1.39
170	3.70	3.51	3.66	3.48	1.23	1.18	0.79	0.76	2.24	2.13	3.95	3.77	3.90	3.72	1.29	1.24	0.90	0.84	2.37	2.25
160	7.12	6.62	7.08	6.59	3.04	2.89	2.38	2.26	4.90	4.64	8.23	7.66	8.18	7.62	3.28	3.10	2.53	2.41	5.42	5.13
150	12.22	11.22	12.16	11.17	6.28	5.89	5.01	4.74	9.24	8.56	16.01	14.36	15.95	14.32	7.28	6.81	5.57	5.27	12.07	10.97
140	18.67	16.81	18.63	16.77	11.66	10.68	9.44	8.74	15.73	14.25	28.07	24.96	28.03	24.93	16.41	14.69	12.96	11.77	23.30	20.58
130	27.42	24.60	27.38	24.56	18.91	17.07	16.51	14.93	24.38	21.71	45.60	41.17	45.52	41.10	31.28	27.73	26.90	23.92	40.26	36.01
120	36.73	33.17	36.69	33.11	28.59	25.63	25.88	23.20	33.45	30.00	76.68	67.27	75.31	66.05	55.25	50.04	50.57	45.82	67.87	59.76

Table H-342. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.13	0.13	0.13	0.12	-	-	-	-	0.07	0.07	0.13	0.13	0.13	0.13	-	-	-	-	0.07	0.06
180	0.69	0.66	0.68	0.65	0.12	0.11	0.08	0.08	0.29	0.28	0.72	0.69	0.71	0.68	0.12	0.12	0.08	0.08	0.31	0.29
175	1.30	1.25	1.28	1.23	0.24	0.24	0.13	0.13	0.65	0.63	1.37	1.31	1.34	1.29	0.25	0.24	0.14	0.14	0.68	0.66
170	2.21	2.09	2.18	2.06	0.57	0.52	0.35	0.34	1.24	1.18	2.32	2.21	2.29	2.18	0.61	0.59	0.37	0.36	1.29	1.23
160	4.91	4.64	4.87	4.61	1.87	1.77	1.32	1.26	3.09	2.92	5.39	5.09	5.36	5.05	1.95	1.86	1.42	1.36	3.30	3.13
150	8.90	8.25	8.86	8.21	4.18	3.99	3.25	3.07	6.42	6.01	10.72	9.77	10.65	9.71	4.53	4.31	3.52	3.33	7.46	6.97
140	14.64	13.31	14.60	13.28	8.16	7.56	6.54	6.12	11.66	10.72	19.77	17.74	19.73	17.71	9.94	9.22	7.69	7.19	16.04	14.35
130	22.15	19.53	22.09	19.48	14.48	13.13	12.18	11.15	18.64	16.82	34.30	30.41	34.25	30.38	21.20	18.77	17.54	15.75	29.19	25.90
120	30.89	27.67	30.86	27.63	22.89	20.34	19.55	17.66	27.83	24.97	54.23	49.09	53.95	48.88	39.83	35.74	34.88	30.97	48.30	43.73

Table H-343. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.08	0.08	0.08	0.08	-	-	-	-	0.02	0.02	0.08	0.08	0.08	0.08	-	-	-	-	0.02	0.02
180	0.38	0.37	0.38	0.37	0.07	0.07	0.02	0.02	0.13	0.13	0.39	0.38	0.39	0.38	0.07	0.07	0.02	0.02	0.14	0.13
175	0.75	0.72	0.75	0.72	0.12	0.12	0.09	0.09	0.37	0.36	0.78	0.75	0.77	0.74	0.13	0.13	0.09	0.09	0.38	0.37
170	1.50	1.44	1.48	1.42	0.29	0.27	0.14	0.14	0.72	0.69	1.56	1.49	1.53	1.47	0.30	0.28	0.15	0.15	0.74	0.72
160	3.70	3.51	3.66	3.48	1.23	1.18	0.79	0.76	2.24	2.13	3.95	3.77	3.90	3.72	1.29	1.24	0.90	0.84	2.37	2.25
150	7.12	6.62	7.08	6.59	3.04	2.89	2.38	2.26	4.90	4.64	8.23	7.66	8.18	7.62	3.28	3.10	2.53	2.41	5.42	5.13
140	12.22	11.22	12.16	11.17	6.28	5.89	5.01	4.74	9.24	8.56	16.01	14.36	15.95	14.32	7.28	6.81	5.57	5.27	12.07	10.97
130	18.67	16.81	18.63	16.77	11.66	10.68	9.44	8.74	15.73	14.25	28.07	24.96	28.03	24.93	16.41	14.69	12.96	11.77	23.30	20.58
120	27.42	24.60	27.38	24.56	18.91	17.07	16.51	14.93	24.38	21.71	45.60	41.17	45.52	41.10	31.28	27.73	26.90	23.92	40.26	36.01

Table H-344. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
180	0.14	0.14	0.14	0.13	-	-	-	-	0.08	0.07	0.15	0.14	0.14	0.14	-	-	-	-	0.08	0.07
175	0.38	0.37	0.38	0.37	0.07	0.07	0.02	0.02	0.13	0.13	0.39	0.38	0.39	0.38	0.07	0.07	0.02	0.02	0.14	0.13
170	0.75	0.72	0.75	0.72	0.12	0.12	0.09	0.09	0.37	0.36	0.78	0.75	0.77	0.74	0.13	0.13	0.09	0.09	0.38	0.37
160	2.44	2.31	2.41	2.28	0.65	0.63	0.40	0.39	1.36	1.31	2.55	2.42	2.53	2.40	0.68	0.66	0.42	0.41	1.45	1.39
150	5.25	4.95	5.21	4.91	2.00	1.91	1.51	1.44	3.38	3.21	5.80	5.46	5.76	5.42	2.14	2.04	1.58	1.51	3.61	3.43
140	9.30	8.64	9.26	8.60	4.49	4.26	3.56	3.37	6.84	6.38	11.63	10.58	11.57	10.53	4.90	4.65	3.83	3.62	8.08	7.54
130	15.26	13.86	15.22	13.82	8.66	8.02	6.96	6.49	12.35	11.35	21.16	18.68	21.09	18.64	11.06	10.06	8.36	7.81	17.06	15.27
120	23.17	20.52	23.11	20.47	15.21	13.74	12.87	11.77	19.36	17.45	36.02	32.02	35.98	31.98	22.94	20.26	18.68	16.82	30.78	27.28

H.3.1.2. 11 m Diameter Pile

Table H-345. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	0.01	0.01	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-
190	0.10	0.09	0.09	0.09	-	-	-	-	0.05	0.04	0.10	0.09	0.10	0.09	-	-	-	-	0.05	0.04
180	0.50	0.48	0.49	0.47	0.07	0.07	0.05	0.05	0.18	0.18	0.53	0.50	0.51	0.49	0.08	0.07	0.05	0.05	0.19	0.18
175	0.97	0.94	0.97	0.92	0.15	0.15	0.09	0.08	0.42	0.41	1.01	0.97	0.99	0.95	0.15	0.15	0.09	0.09	0.44	0.42
170	1.69	1.60	1.66	1.57	0.38	0.37	0.19	0.19	0.83	0.79	1.78	1.69	1.76	1.66	0.39	0.38	0.20	0.19	0.87	0.83
160	3.79	3.52	3.74	3.48	1.28	1.21	0.85	0.81	2.30	2.14	4.15	3.87	4.12	3.84	1.35	1.28	0.90	0.86	2.47	2.31
150	6.57	6.01	6.54	5.98	2.97	2.78	2.33	2.18	4.79	4.41	7.80	7.04	7.76	7.00	3.35	3.09	2.51	2.36	5.64	5.17
140	10.49	9.29	10.43	9.25	5.98	5.44	4.82	4.43	8.37	7.56	14.01	12.59	13.96	12.54	7.55	6.80	5.83	5.32	11.46	10.07
130	15.44	13.95	15.40	13.92	10.27	9.11	8.65	7.78	13.54	12.16	23.54	20.87	23.33	20.68	14.96	13.47	12.51	11.13	19.51	17.57
120	21.59	19.22	21.52	19.16	15.91	14.35	14.16	12.69	18.99	17.18	36.68	33.06	35.68	32.24	26.79	23.94	23.05	20.47	32.47	29.01

Table H-346. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
190	0.04	0.04	0.04	0.04	-	-	-	-	-	-	0.04	0.04	0.04	0.04	-	-	-	-	-	-
180	0.20	0.19	0.19	0.19	0.01	0.01	-	-	0.07	0.07	0.21	0.20	0.20	0.20	0.01	0.01	-	-	0.08	0.07
175	0.44	0.42	0.43	0.42	0.07	0.07	0.04	0.04	0.16	0.15	0.45	0.44	0.45	0.43	0.07	0.07	0.04	0.04	0.16	0.15
170	0.88	0.84	0.86	0.83	0.13	0.12	0.08	0.08	0.39	0.37	0.92	0.88	0.90	0.86	0.12	0.12	0.08	0.08	0.40	0.39
160	2.41	2.26	2.39	2.23	0.64	0.61	0.40	0.39	1.32	1.25	2.57	2.42	2.54	2.39	0.67	0.64	0.42	0.40	1.38	1.31
150	4.80	4.45	4.77	4.43	1.86	1.74	1.35	1.28	3.08	2.86	5.41	4.98	5.38	4.95	1.96	1.84	1.43	1.35	3.47	3.22
140	7.99	7.23	7.96	7.20	4.11	3.80	3.11	2.88	6.08	5.54	9.81	8.79	9.77	8.76	4.72	4.36	3.53	3.27	7.48	6.75
130	12.69	11.34	12.65	11.31	7.46	6.75	6.17	5.61	10.13	9.05	17.02	15.32	16.95	15.25	9.98	8.94	7.91	7.13	14.38	12.93
120	17.59	15.89	17.53	15.85	12.76	11.36	10.77	9.44	15.56	14.05	28.35	25.31	28.02	25.05	18.74	16.84	15.82	14.23	24.91	22.18

Table H-347. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	0.01	0.01	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-
180	0.10	0.09	0.09	0.09	-	-	-	-	0.05	0.04	0.10	0.09	0.10	0.09	-	-	-	-	0.05	0.04
175	0.24	0.23	0.24	0.23	0.04	0.04	0.01	0.01	0.08	0.08	0.25	0.24	0.24	0.23	0.04	0.04	0.01	0.01	0.08	0.08
170	0.50	0.48	0.49	0.47	0.07	0.07	0.05	0.05	0.18	0.18	0.53	0.50	0.51	0.49	0.08	0.07	0.05	0.05	0.19	0.18
160	1.69	1.60	1.66	1.57	0.38	0.37	0.19	0.19	0.83	0.79	1.78	1.69	1.76	1.66	0.39	0.38	0.20	0.19	0.87	0.83
150	3.79	3.52	3.74	3.48	1.28	1.21	0.85	0.81	2.30	2.14	4.15	3.87	4.12	3.84	1.35	1.28	0.90	0.86	2.47	2.31
140	6.57	6.01	6.54	5.98	2.96	2.78	2.33	2.18	4.79	4.41	7.80	7.04	7.76	7.00	3.35	3.09	2.51	2.36	5.64	5.17
130	10.49	9.29	10.43	9.25	5.98	5.44	4.82	4.43	8.37	7.56	14.01	12.59	13.96	12.54	7.55	6.80	5.83	5.32	11.46	10.07
120	15.44	13.95	15.40	13.92	10.27	9.11	8.65	7.78	13.54	12.16	23.54	20.87	23.33	20.68	14.96	13.47	12.51	11.13	19.51	17.57

Table H-348. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
180	0.05	0.05	0.05	0.05	-	-	-	-	0.01	0.01	0.05	0.05	0.05	0.05	-	-	-	-	0.01	0.01
175	0.10	0.09	0.09	0.09	-	-	-	-	0.05	0.04	0.10	0.09	0.10	0.09	-	-	-	-	0.05	0.04
170	0.24	0.23	0.24	0.23	0.04	0.04	0.01	0.01	0.08	0.08	0.25	0.24	0.24	0.23	0.04	0.04	0.01	0.01	0.08	0.08
160	0.97	0.94	0.97	0.92	0.15	0.15	0.09	0.08	0.42	0.41	1.01	0.97	0.99	0.95	0.15	0.15	0.09	0.09	0.44	0.42
150	2.60	2.44	2.57	2.42	0.72	0.69	0.43	0.42	1.46	1.38	2.77	2.60	2.74	2.58	0.76	0.72	0.45	0.43	1.54	1.46
140	5.09	4.70	5.05	4.67	1.99	1.87	1.51	1.41	3.36	3.13	5.77	5.28	5.74	5.25	2.16	2.01	1.59	1.50	3.81	3.54
130	8.37	7.57	8.32	7.54	4.37	4.04	3.40	3.15	6.40	5.84	10.53	9.29	10.47	9.25	5.13	4.72	3.87	3.58	8.04	7.24
120	13.12	11.78	13.09	11.75	7.90	7.14	6.52	5.93	10.83	9.51	17.88	16.09	17.80	16.02	10.97	9.63	8.54	7.68	15.14	13.63

Table H-349. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.03	0.03	0.03	0.03	-	-	-	-	-	-	0.03	0.03	0.02	0.02	-	-	-	-	-	-
190	0.11	0.11	0.11	0.11	0.01	0.01	-	-	0.06	0.06	0.12	0.11	0.12	0.11	0.01	0.01	-	-	0.06	0.06
180	0.59	0.57	0.58	0.56	0.10	0.09	0.07	0.07	0.27	0.26	0.62	0.59	0.61	0.58	0.10	0.09	0.07	0.07	0.27	0.26
175	1.11	1.04	1.08	1.03	0.21	0.20	0.11	0.11	0.55	0.52	1.18	1.11	1.15	1.09	0.22	0.21	0.12	0.11	0.58	0.55
170	1.85	1.75	1.83	1.73	0.48	0.45	0.29	0.28	1.03	0.97	1.96	1.85	1.93	1.83	0.47	0.46	0.30	0.28	1.10	1.03
160	4.16	3.87	4.13	3.84	1.59	1.49	1.11	1.04	2.70	2.53	4.66	4.31	4.63	4.28	1.67	1.58	1.19	1.12	2.89	2.73
150	7.25	6.60	7.22	6.57	3.64	3.38	2.75	2.59	5.53	5.06	8.88	7.99	8.84	7.96	4.09	3.78	2.97	2.79	6.57	6.00
140	11.95	10.60	11.91	10.56	6.77	6.17	5.56	5.08	9.44	8.49	15.52	13.97	15.47	13.92	8.65	7.79	6.70	6.10	12.97	11.58
130	16.86	15.24	16.82	15.20	11.74	10.37	9.62	8.64	14.77	13.32	25.54	22.78	25.44	22.68	16.44	14.76	13.73	12.34	21.59	19.08
120	23.75	21.21	23.70	21.15	17.22	15.51	15.30	13.78	20.56	18.38	41.98	35.82	41.38	35.41	28.65	25.52	24.79	22.01	34.88	31.42

Table H-350. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	0.01	0.01	0.06	0.06	0.06	0.06	-	-	-	-	0.01	0.01
180	0.25	0.24	0.24	0.24	0.05	0.05	0.01	0.01	0.10	0.09	0.26	0.25	0.25	0.24	0.05	0.05	0.01	0.01	0.10	0.09
175	0.50	0.48	0.49	0.47	0.08	0.08	0.06	0.06	0.21	0.20	0.53	0.51	0.52	0.50	0.09	0.08	0.06	0.06	0.22	0.21
170	0.98	0.93	0.97	0.92	0.19	0.18	0.11	0.10	0.46	0.44	1.02	0.97	1.00	0.96	0.18	0.18	0.11	0.11	0.48	0.45
160	2.63	2.47	2.60	2.45	0.81	0.77	0.51	0.48	1.59	1.50	2.81	2.65	2.78	2.63	0.86	0.82	0.54	0.52	1.69	1.59
150	5.31	4.88	5.28	4.85	2.26	2.11	1.67	1.57	3.72	3.46	6.12	5.59	6.09	5.56	2.45	2.29	1.78	1.68	4.19	3.89
140	8.87	8.00	8.84	7.98	4.77	4.39	3.79	3.52	6.88	6.29	11.54	10.14	11.48	10.09	5.58	5.10	4.26	3.94	8.65	7.81
130	13.84	12.46	13.81	12.43	8.47	7.65	6.95	6.33	11.75	10.39	18.63	16.77	18.58	16.72	11.67	10.29	8.99	8.09	15.88	14.28
120	19.00	17.18	18.96	17.15	13.86	12.45	12.09	10.72	16.97	15.31	30.41	27.08	30.26	26.93	20.01	18.00	17.26	15.46	26.81	23.92

Table H-351. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	0.03	0.03	-	-	-	-	-	-	0.03	0.03	0.02	0.02	-	-	-	-	-	-
180	0.11	0.11	0.11	0.11	0.01	0.01	-	-	0.06	0.06	0.12	0.11	0.12	0.11	0.01	0.01	-	-	0.06	0.06
175	0.29	0.28	0.29	0.28	0.06	0.06	0.01	0.01	0.11	0.11	0.30	0.29	0.29	0.28	0.06	0.06	0.01	0.01	0.11	0.11
170	0.59	0.57	0.58	0.56	0.10	0.09	0.07	0.07	0.27	0.26	0.62	0.59	0.61	0.58	0.10	0.09	0.07	0.07	0.27	0.26
160	1.85	1.75	1.83	1.73	0.48	0.45	0.29	0.28	1.03	0.97	1.96	1.85	1.93	1.83	0.47	0.46	0.30	0.28	1.10	1.03
150	4.16	3.87	4.13	3.84	1.59	1.49	1.11	1.04	2.70	2.53	4.66	4.31	4.63	4.28	1.67	1.58	1.19	1.12	2.89	2.73
140	7.25	6.60	7.22	6.57	3.64	3.38	2.75	2.59	5.53	5.06	8.88	7.99	8.84	7.96	4.09	3.78	2.97	2.79	6.57	6.00
130	11.95	10.60	11.91	10.56	6.77	6.17	5.56	5.08	9.44	8.49	15.52	13.97	15.47	13.92	8.65	7.79	6.70	6.10	12.97	11.58
120	16.86	15.24	16.82	15.20	11.74	10.37	9.62	8.64	14.77	13.32	25.54	22.78	25.44	22.68	16.44	14.76	13.73	12.34	21.59	19.08

Table H-352. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
180	0.06	0.06	0.06	0.06	-	-	-	-	0.01	0.01	0.07	0.07	0.07	0.06	-	-	-	-	0.01	0.01
175	0.11	0.11	0.11	0.11	0.01	0.01	-	-	0.06	0.06	0.12	0.11	0.12	0.11	0.01	0.01	-	-	0.06	0.06
170	0.29	0.28	0.29	0.28	0.06	0.06	0.01	0.01	0.11	0.11	0.30	0.29	0.29	0.28	0.06	0.06	0.01	0.01	0.11	0.11
160	1.11	1.04	1.08	1.03	0.21	0.20	0.11	0.11	0.55	0.52	1.18	1.11	1.15	1.09	0.22	0.21	0.12	0.11	0.58	0.55
150	2.81	2.65	2.80	2.63	0.93	0.88	0.62	0.59	1.75	1.65	3.04	2.84	2.99	2.82	0.97	0.93	0.65	0.62	1.86	1.75
140	5.62	5.15	5.58	5.12	2.47	2.31	1.83	1.72	4.02	3.73	6.50	5.93	6.47	5.91	2.65	2.49	1.93	1.82	4.54	4.20
130	9.28	8.35	9.25	8.33	5.07	4.66	4.08	3.78	7.28	6.62	12.25	10.85	12.21	10.81	6.02	5.49	4.59	4.23	9.25	8.31
120	14.31	12.90	14.27	12.87	8.93	8.04	7.38	6.68	12.31	10.95	19.41	17.48	19.36	17.43	12.47	11.10	9.61	8.63	16.70	15.01

Table H-353. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.04	0.04	0.04	0.04	-	-	-	-	-	-	0.04	0.04	0.04	0.04	-	-	-	-	-	-
190	0.16	0.16	0.16	0.15	0.01	0.01	-	-	0.08	0.07	0.16	0.16	0.16	0.16	0.01	0.01	-	-	0.08	0.08
180	0.75	0.72	0.74	0.71	0.13	0.13	0.08	0.08	0.36	0.35	0.78	0.75	0.77	0.74	0.12	0.11	0.08	0.08	0.37	0.36
175	1.36	1.29	1.34	1.28	0.31	0.29	0.18	0.17	0.73	0.69	1.44	1.36	1.42	1.35	0.32	0.31	0.17	0.17	0.76	0.73
170	2.17	2.04	2.16	2.01	0.64	0.61	0.40	0.38	1.31	1.23	2.37	2.22	2.34	2.19	0.67	0.64	0.41	0.40	1.38	1.30
160	4.68	4.32	4.64	4.30	1.89	1.77	1.39	1.31	3.09	2.89	5.33	4.89	5.31	4.87	1.99	1.87	1.46	1.38	3.50	3.26
150	8.00	7.26	7.97	7.23	4.18	3.87	3.17	2.95	6.17	5.62	9.90	8.86	9.86	8.83	4.73	4.36	3.60	3.34	7.50	6.79
140	12.87	11.52	12.84	11.49	7.50	6.80	6.19	5.63	10.33	9.17	17.01	15.30	16.95	15.25	9.83	8.82	7.75	6.99	14.31	12.87
130	17.84	16.12	17.82	16.08	12.75	11.38	10.67	9.39	15.72	14.19	27.94	24.93	27.80	24.81	18.28	16.40	15.37	13.80	24.40	21.66
120	25.07	22.52	25.01	22.46	18.27	16.47	16.34	14.72	22.28	19.77	47.06	39.85	46.40	39.24	31.63	28.13	27.42	24.43	41.16	35.19

Table H-354. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
190	0.07	0.07	0.07	0.07	-	-	-	-	0.02	0.02	0.07	0.07	0.07	0.07	-	-	-	-	0.02	0.02
180	0.32	0.31	0.31	0.30	0.06	0.06	0.03	0.03	0.12	0.12	0.33	0.32	0.32	0.31	0.06	0.06	0.02	0.02	0.12	0.11
175	0.65	0.63	0.64	0.62	0.11	0.10	0.07	0.07	0.31	0.30	0.69	0.66	0.67	0.65	0.11	0.11	0.08	0.07	0.32	0.30
170	1.22	1.15	1.20	1.14	0.26	0.25	0.15	0.15	0.63	0.61	1.29	1.23	1.28	1.21	0.26	0.25	0.15	0.14	0.66	0.63
160	2.96	2.79	2.94	2.78	1.02	0.96	0.69	0.66	1.90	1.79	3.32	3.10	3.28	3.06	1.10	1.03	0.74	0.71	2.01	1.89
150	5.91	5.39	5.87	5.37	2.64	2.48	1.96	1.85	4.27	3.96	6.86	6.26	6.83	6.23	2.84	2.67	2.12	1.98	4.89	4.50
140	9.64	8.66	9.60	8.64	5.35	4.90	4.33	3.99	7.65	6.92	12.86	11.46	12.81	11.42	6.42	5.87	4.91	4.52	9.77	8.76
130	14.70	13.27	14.67	13.23	9.30	8.35	7.72	6.98	12.73	11.36	20.35	18.17	20.22	18.11	13.19	11.81	10.31	9.16	17.54	15.76
120	19.94	18.03	19.91	18.00	14.79	13.32	13.05	11.68	17.98	16.22	33.23	29.67	32.97	29.44	23.16	20.50	19.08	17.13	29.55	26.25

Table H-355. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
190	0.04	0.04	0.04	0.04	-	-	-	-	-	-	0.04	0.04	0.04	0.04	-	-	-	-	-	-
180	0.16	0.16	0.16	0.15	0.01	0.01	-	-	0.08	0.07	0.16	0.16	0.16	0.16	0.01	0.01	-	-	0.08	0.08
175	0.36	0.35	0.35	0.34	0.07	0.07	0.04	0.04	0.16	0.16	0.37	0.36	0.37	0.35	0.07	0.07	0.04	0.04	0.16	0.15
170	0.75	0.72	0.74	0.71	0.13	0.13	0.08	0.08	0.36	0.35	0.78	0.75	0.77	0.74	0.12	0.11	0.08	0.08	0.37	0.36
160	2.17	2.04	2.16	2.01	0.64	0.61	0.40	0.38	1.31	1.23	2.37	2.22	2.34	2.19	0.67	0.64	0.41	0.40	1.38	1.30
150	4.68	4.32	4.64	4.30	1.89	1.77	1.38	1.31	3.09	2.89	5.33	4.89	5.31	4.87	1.99	1.87	1.46	1.38	3.50	3.26
140	8.00	7.26	7.97	7.23	4.18	3.87	3.17	2.95	6.17	5.62	9.90	8.86	9.86	8.83	4.73	4.36	3.60	3.34	7.50	6.79
130	12.87	11.52	12.84	11.49	7.50	6.80	6.19	5.63	10.33	9.17	17.01	15.30	16.95	15.25	9.83	8.82	7.74	6.99	14.31	12.87
120	17.84	16.12	17.82	16.08	12.75	11.38	10.67	9.39	15.72	14.19	27.94	24.93	27.80	24.81	18.28	16.40	15.37	13.80	24.40	21.66

Table H-356. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	0.01	0.01	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-
180	0.08	0.08	0.08	0.07	-	-	-	-	0.04	0.04	0.08	0.08	0.08	0.08	-	-	-	-	0.03	0.03
175	0.16	0.16	0.16	0.15	0.01	0.01	-	-	0.08	0.07	0.16	0.16	0.16	0.16	0.01	0.01	-	-	0.08	0.08
170	0.36	0.35	0.35	0.34	0.07	0.07	0.04	0.04	0.16	0.16	0.37	0.36	0.37	0.35	0.07	0.07	0.04	0.04	0.16	0.15
160	1.36	1.29	1.34	1.28	0.31	0.29	0.18	0.17	0.73	0.69	1.44	1.36	1.42	1.35	0.32	0.31	0.17	0.17	0.76	0.73
150	3.25	3.03	3.22	3.00	1.17	1.10	0.79	0.75	2.06	1.93	3.66	3.41	3.62	3.38	1.24	1.17	0.83	0.79	2.24	2.09
140	6.22	5.68	6.19	5.65	2.84	2.66	2.16	2.01	4.55	4.21	7.32	6.64	7.28	6.61	3.08	2.86	2.35	2.19	5.29	4.84
130	10.02	9.00	9.98	8.98	5.68	5.18	4.59	4.23	8.07	7.30	13.47	12.07	13.43	12.03	6.90	6.28	5.31	4.87	10.56	9.30
120	15.18	13.72	15.14	13.69	9.73	8.74	8.17	7.38	13.21	11.84	21.73	19.23	21.62	19.13	13.92	12.51	11.30	9.94	18.38	16.54

Table H-357. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.06	0.06	0.06	0.06	-	-	-	-	0.01	0.01	0.06	0.06	0.06	0.06	-	-	-	-	0.01	0.01
190	0.30	0.29	0.30	0.29	0.06	0.06	0.01	0.01	0.11	0.11	0.32	0.30	0.31	0.29	0.06	0.06	0.01	0.01	0.12	0.11
180	1.16	1.09	1.14	1.08	0.24	0.23	0.15	0.14	0.61	0.58	1.22	1.17	1.21	1.15	0.24	0.23	0.14	0.13	0.64	0.61
175	1.90	1.79	1.87	1.77	0.52	0.49	0.33	0.31	1.08	1.02	1.99	1.89	1.98	1.87	0.53	0.50	0.36	0.35	1.15	1.09
170	2.87	2.70	2.85	2.68	0.98	0.93	0.66	0.63	1.80	1.69	3.11	2.89	3.08	2.86	1.04	0.98	0.69	0.66	1.89	1.79
160	5.67	5.21	5.65	5.19	2.57	2.39	1.88	1.77	4.10	3.80	6.54	5.97	6.51	5.94	2.74	2.56	2.00	1.89	4.61	4.27
150	9.33	8.43	9.31	8.40	5.29	4.86	4.25	3.93	7.52	6.78	12.53	11.15	12.49	11.10	6.28	5.73	4.79	4.41	9.54	8.56
140	14.56	13.15	14.52	13.12	9.31	8.40	7.80	7.03	12.67	11.37	20.61	18.37	20.52	18.30	13.16	11.76	10.16	9.06	17.69	15.90
130	20.39	18.27	20.32	18.23	15.04	13.56	13.19	11.86	18.32	16.52	33.19	29.75	33.03	29.63	23.30	20.69	19.09	17.21	29.64	26.41
120	28.53	25.68	28.48	25.63	21.83	19.37	19.12	17.25	26.26	23.63	53.26	47.09	52.51	46.62	38.74	34.24	32.93	29.52	48.84	41.98

Table H-358. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	0.01	0.01	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-
190	0.11	0.10	0.10	0.09	0.01	0.01	-	-	0.06	0.06	0.11	0.11	0.11	0.10	0.01	0.01	-	-	0.06	0.06
180	0.53	0.50	0.51	0.48	0.09	0.08	0.07	0.06	0.23	0.22	0.57	0.54	0.56	0.53	0.09	0.09	0.07	0.07	0.24	0.23
175	1.02	0.97	1.01	0.95	0.20	0.19	0.11	0.11	0.51	0.48	1.08	1.03	1.07	1.01	0.20	0.19	0.11	0.11	0.52	0.49
170	1.75	1.65	1.73	1.63	0.47	0.45	0.27	0.25	0.98	0.93	1.84	1.74	1.83	1.72	0.48	0.46	0.27	0.26	1.03	0.97
160	3.95	3.68	3.93	3.66	1.50	1.41	1.04	0.98	2.57	2.40	4.37	4.07	4.34	4.04	1.59	1.50	1.12	1.05	2.74	2.57
150	6.97	6.35	6.94	6.33	3.50	3.24	2.67	2.50	5.31	4.88	8.42	7.60	8.40	7.57	3.93	3.62	2.85	2.67	6.28	5.73
140	11.52	10.22	11.47	10.18	6.73	6.11	5.48	5.02	9.22	8.33	15.37	13.83	15.31	13.78	8.47	7.63	6.54	5.96	12.81	11.42
130	16.80	15.16	16.77	15.13	11.70	10.40	9.57	8.63	14.77	13.33	25.79	23.07	25.71	22.98	16.50	14.84	13.68	12.28	21.94	19.44
120	24.09	21.54	24.04	21.49	17.47	15.75	15.45	13.92	21.11	18.80	42.00	36.04	41.64	35.80	28.58	25.51	24.57	21.87	34.94	31.63

Table H-359. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	0.01	0.01	0.06	0.06	0.06	0.06	-	-	-	-	0.01	0.01
180	0.30	0.29	0.30	0.29	0.06	0.06	0.01	0.01	0.11	0.11	0.32	0.30	0.31	0.29	0.06	0.06	0.01	0.01	0.12	0.11
175	0.64	0.61	0.63	0.60	0.10	0.10	0.07	0.07	0.28	0.27	0.66	0.64	0.66	0.63	0.11	0.11	0.07	0.07	0.28	0.27
170	1.16	1.09	1.14	1.08	0.24	0.23	0.15	0.14	0.61	0.58	1.22	1.17	1.21	1.15	0.24	0.23	0.14	0.13	0.64	0.61
160	2.87	2.70	2.85	2.68	0.98	0.93	0.66	0.63	1.80	1.69	3.11	2.89	3.08	2.86	1.04	0.98	0.69	0.66	1.89	1.79
150	5.67	5.21	5.65	5.19	2.57	2.39	1.88	1.77	4.10	3.80	6.54	5.97	6.51	5.94	2.74	2.56	2.00	1.89	4.61	4.27
140	9.33	8.43	9.31	8.40	5.29	4.86	4.25	3.93	7.52	6.78	12.53	11.15	12.49	11.10	6.28	5.73	4.79	4.41	9.54	8.56
130	14.56	13.15	14.52	13.12	9.31	8.40	7.80	7.03	12.67	11.37	20.61	18.37	20.52	18.30	13.16	11.76	10.16	9.06	17.69	15.90
120	20.39	18.27	20.32	18.23	15.04	13.56	13.19	11.86	18.32	16.52	33.19	29.75	33.03	29.63	23.30	20.69	19.09	17.21	29.64	26.41

Table H-360. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L04 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
180	0.12	0.11	0.11	0.11	0.01	0.01	-	-	0.06	0.06	0.12	0.11	0.12	0.11	0.01	0.01	-	-	0.07	0.07
175	0.30	0.29	0.30	0.29	0.06	0.06	0.01	0.01	0.11	0.11	0.32	0.30	0.31	0.29	0.06	0.06	0.01	0.01	0.12	0.11
170	0.64	0.61	0.63	0.60	0.10	0.10	0.07	0.07	0.28	0.27	0.66	0.64	0.66	0.63	0.11	0.11	0.07	0.07	0.28	0.27
160	1.90	1.79	1.87	1.77	0.52	0.49	0.33	0.31	1.08	1.02	1.99	1.89	1.98	1.87	0.53	0.50	0.36	0.35	1.15	1.09
150	4.21	3.93	4.18	3.90	1.66	1.55	1.17	1.10	2.75	2.58	4.70	4.35	4.67	4.32	1.76	1.66	1.25	1.18	2.95	2.76
140	7.36	6.66	7.33	6.63	3.79	3.51	2.87	2.68	5.64	5.18	8.96	8.07	8.92	8.04	4.23	3.92	3.11	2.87	6.74	6.13
130	12.08	10.78	12.04	10.75	7.11	6.44	5.83	5.32	9.65	8.71	16.17	14.55	16.12	14.51	9.07	8.17	7.04	6.39	13.54	12.13
120	17.39	15.68	17.35	15.65	12.30	11.00	1-	9.02	15.35	13.84	26.94	24.11	26.85	24.03	17.43	15.68	14.48	13.03	23.37	20.74

Table H-361. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.10	0.09	0.10	0.09	-	-	-	-	0.05	0.05	0.10	0.10	0.10	0.09	-	-	-	-	0.05	0.05
180	0.49	0.48	0.48	0.47	0.08	0.07	0.06	0.06	0.19	0.18	0.52	0.50	0.51	0.48	0.08	0.08	0.05	0.05	0.18	0.18
175	0.98	0.94	0.96	0.93	0.16	0.16	0.09	0.08	0.44	0.42	1.02	0.98	1.00	0.96	0.15	0.15	0.10	0.09	0.46	0.44
170	1.70	1.62	1.67	1.59	0.39	0.37	0.20	0.19	0.84	0.80	1.78	1.71	1.76	1.68	0.40	0.38	0.20	0.19	0.87	0.83
160	3.80	3.54	3.76	3.50	1.29	1.23	0.87	0.83	2.28	2.16	4.16	3.88	4.12	3.85	1.36	1.29	0.91	0.87	2.46	2.32
150	6.55	6.09	6.51	6.06	2.96	2.79	2.34	2.20	4.74	4.42	7.78	7.19	7.74	7.16	3.28	3.06	2.50	2.36	5.54	5.16
140	10.29	9.45	10.24	9.40	5.84	5.45	4.72	4.41	8.32	7.71	13.89	12.75	13.85	12.71	7.29	6.74	5.59	5.20	11.02	10.08
130	15.57	14.25	15.52	14.22	9.92	9.16	8.45	7.82	13.40	12.34	23.25	21.04	23.14	20.95	14.40	13.21	11.67	10.68	19.28	17.60
120	22.04	19.91	21.97	19.85	15.81	14.48	13.82	12.72	19.20	17.53	36.53	32.45	36.30	32.26	25.34	22.99	20.83	18.85	32.33	28.80

Table H-362. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	0.05	0.05	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	-	-	-	-	-
180	0.17	0.17	0.17	0.17	-	-	-	-	0.08	0.07	0.19	0.19	0.17	0.17	-	-	-	-	0.08	0.08
175	0.45	0.43	0.44	0.42	0.07	0.07	0.05	0.05	0.16	0.16	0.46	0.44	0.46	0.44	0.07	0.07	0.04	0.04	0.15	0.15
170	0.88	0.84	0.86	0.83	0.12	0.12	0.08	0.08	0.40	0.38	0.92	0.88	0.90	0.86	0.12	0.12	0.09	0.08	0.41	0.40
160	2.42	2.29	2.40	2.26	0.62	0.59	0.42	0.40	1.32	1.26	2.58	2.44	2.54	2.41	0.66	0.63	0.43	0.42	1.39	1.32
150	4.82	4.48	4.78	4.45	1.85	1.77	1.36	1.29	3.06	2.86	5.40	5.02	5.36	4.99	1.96	1.86	1.43	1.37	3.43	3.20
140	7.97	7.39	7.95	7.36	4.06	3.78	3.10	2.88	6.00	5.59	9.72	8.96	9.68	8.93	4.61	4.29	3.44	3.22	7.36	6.82
130	12.53	11.54	12.49	11.50	7.35	6.82	6.00	5.59	9.93	9.18	17.01	15.54	16.96	15.48	9.63	8.87	7.58	7.00	14.10	12.94
120	17.81	16.27	17.77	16.24	12.41	11.43	10.24	9.39	15.63	14.31	28.19	25.39	28.06	25.29	18.01	16.46	14.94	13.70	24.31	22.04

Table H-363. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.10	0.09	0.10	0.09	-	-	-	-	0.05	0.05	0.10	0.10	0.10	0.09	-	-	-	-	0.05	0.05
175	0.24	0.23	0.23	0.22	0.03	0.03	-	-	0.09	0.08	0.24	0.24	0.24	0.23	0.02	0.02	-	-	0.09	0.08
170	0.49	0.48	0.48	0.47	0.08	0.07	0.06	0.06	0.19	0.18	0.52	0.50	0.51	0.48	0.08	0.08	0.05	0.05	0.18	0.18
160	1.70	1.62	1.67	1.59	0.39	0.37	0.20	0.19	0.84	0.80	1.78	1.71	1.76	1.68	0.40	0.38	0.20	0.19	0.87	0.83
150	3.80	3.54	3.76	3.50	1.29	1.23	0.87	0.83	2.28	2.16	4.16	3.88	4.12	3.85	1.36	1.29	0.91	0.87	2.46	2.32
140	6.55	6.09	6.51	6.06	2.96	2.79	2.34	2.20	4.74	4.42	7.78	7.19	7.74	7.16	3.28	3.06	2.50	2.36	5.54	5.16
130	10.29	9.45	10.24	9.40	5.84	5.45	4.72	4.41	8.32	7.71	13.89	12.75	13.85	12.71	7.29	6.74	5.59	5.20	11.02	10.08
120	15.57	14.25	15.52	14.22	9.92	9.16	8.45	7.82	13.40	12.34	23.25	21.04	23.14	20.95	14.40	13.21	11.67	10.68	19.28	17.60

Table H-364. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	0.05	0.05	-	-	-	-	-	-	0.06	0.06	0.05	0.05	-	-	-	-	-	-
175	0.10	0.09	0.10	0.09	-	-	-	-	0.05	0.05	0.10	0.10	0.10	0.09	-	-	-	-	0.05	0.05
170	0.24	0.23	0.23	0.22	0.03	0.03	-	-	0.09	0.08	0.24	0.24	0.24	0.23	0.02	0.02	-	-	0.09	0.08
160	0.98	0.94	0.96	0.93	0.16	0.16	0.09	0.08	0.44	0.42	1.02	0.98	1.00	0.96	0.15	0.15	0.10	0.09	0.46	0.44
150	2.62	2.47	2.58	2.44	0.74	0.71	0.45	0.44	1.45	1.39	2.77	2.62	2.74	2.60	0.76	0.73	0.48	0.46	1.53	1.46
140	5.10	4.74	5.06	4.70	1.99	1.89	1.50	1.43	3.36	3.12	5.74	5.34	5.70	5.30	2.14	2.04	1.58	1.51	3.75	3.51
130	8.36	7.74	8.31	7.70	4.32	4.03	3.36	3.13	6.33	5.90	10.31	9.43	10.25	9.38	4.99	4.65	3.76	3.52	7.93	7.33
120	12.99	11.98	12.97	11.95	7.80	7.22	6.37	5.92	10.55	9.66	17.87	16.32	17.82	16.27	10.29	9.40	8.19	7.55	14.91	13.66

Table H-365. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.03	0.03	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
190	0.11	0.11	0.11	0.11	-	-	-	-	0.06	0.06	0.12	0.12	0.12	0.11	-	-	-	-	0.06	0.06
180	0.62	0.60	0.61	0.59	0.10	0.09	0.07	0.06	0.27	0.26	0.65	0.62	0.63	0.61	0.10	0.10	0.07	0.07	0.27	0.27
175	1.18	1.13	1.16	1.11	0.21	0.20	0.11	0.11	0.56	0.54	1.25	1.19	1.22	1.17	0.23	0.22	0.12	0.12	0.59	0.57
170	1.92	1.84	1.90	1.82	0.48	0.46	0.29	0.28	1.06	1.02	2.04	1.94	2.01	1.91	0.51	0.49	0.29	0.28	1.13	1.08
160	4.24	3.97	4.22	3.94	1.62	1.55	1.15	1.10	2.73	2.59	4.74	4.41	4.70	4.38	1.72	1.64	1.22	1.17	2.91	2.76
150	7.25	6.73	7.22	6.70	3.62	3.38	2.78	2.62	5.42	5.06	8.83	8.15	8.79	8.12	4.04	3.77	2.96	2.80	6.47	6.02
140	11.63	10.67	11.59	10.62	6.63	6.15	5.42	5.04	9.24	8.53	15.45	14.12	15.40	14.07	8.54	7.89	6.58	6.11	12.66	11.64
130	16.70	15.27	16.65	15.24	11.32	10.34	9.39	8.65	14.53	13.34	25.68	23.26	25.54	23.13	16.35	14.92	13.45	12.37	21.67	19.52
120	23.66	21.44	23.59	21.37	17.00	15.55	15.03	13.79	20.37	18.51	40.36	35.76	39.74	35.25	28.70	25.79	24.47	22.21	35.70	31.72

Table H-366. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
180	0.26	0.25	0.26	0.25	0.05	0.05	-	-	0.10	0.09	0.26	0.26	0.26	0.26	0.05	0.05	-	-	0.10	0.10
175	0.54	0.51	0.52	0.50	0.09	0.08	0.06	0.06	0.21	0.21	0.56	0.54	0.55	0.53	0.09	0.09	0.06	0.06	0.23	0.22
170	1.03	0.99	1.01	0.97	0.19	0.19	0.11	0.11	0.48	0.47	1.10	1.05	1.08	1.03	0.19	0.18	0.11	0.11	0.51	0.49
160	2.72	2.58	2.70	2.56	0.86	0.82	0.51	0.49	1.64	1.57	2.90	2.75	2.88	2.72	0.90	0.86	0.55	0.53	1.74	1.66
150	5.34	4.98	5.32	4.95	2.28	2.16	1.70	1.62	3.74	3.49	6.12	5.69	6.08	5.66	2.47	2.32	1.80	1.71	4.16	3.90
140	8.81	8.14	8.78	8.11	4.68	4.37	3.76	3.51	6.77	6.29	11.20	10.25	11.15	10.19	5.48	5.09	4.18	3.90	8.55	7.90
130	13.60	12.50	13.56	12.47	8.31	7.67	6.79	6.30	11.33	10.36	18.69	17.05	18.62	16.99	11.30	10.35	8.87	8.20	15.82	14.44
120	18.91	17.28	18.88	17.25	13.55	12.44	11.67	10.68	16.77	15.34	31.03	27.69	30.77	27.48	19.99	18.25	17.09	15.60	26.94	24.36

Table H-367. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
180	0.11	0.11	0.11	0.11	-	-	-	-	0.06	0.06	0.12	0.12	0.12	0.11	-	-	-	-	0.06	0.06
175	0.30	0.29	0.29	0.29	0.06	0.06	-	-	0.11	0.11	0.31	0.30	0.30	0.29	0.06	0.06	-	-	0.11	0.11
170	0.62	0.60	0.61	0.59	0.10	0.09	0.07	0.06	0.27	0.26	0.65	0.62	0.63	0.61	0.10	0.10	0.07	0.07	0.27	0.27
160	1.92	1.84	1.90	1.82	0.48	0.46	0.29	0.28	1.06	1.02	2.04	1.94	2.01	1.91	0.51	0.49	0.29	0.28	1.13	1.08
150	4.24	3.97	4.22	3.94	1.62	1.55	1.15	1.10	2.73	2.59	4.74	4.41	4.70	4.38	1.72	1.64	1.22	1.17	2.91	2.76
140	7.25	6.73	7.22	6.70	3.62	3.38	2.78	2.62	5.42	5.06	8.83	8.15	8.79	8.12	4.04	3.77	2.96	2.80	6.47	6.02
130	11.63	10.67	11.59	10.62	6.63	6.15	5.42	5.04	9.24	8.53	15.45	14.12	15.40	14.07	8.54	7.89	6.58	6.11	12.66	11.64
120	16.70	15.27	16.65	15.24	11.32	10.34	9.39	8.65	14.53	13.34	25.68	23.26	25.54	23.13	16.35	14.92	13.45	12.37	21.67	19.52

Table H-368. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
175	0.11	0.11	0.11	0.11	-	-	-	-	0.06	0.06	0.12	0.12	0.12	0.11	-	-	-	-	0.06	0.06
170	0.30	0.29	0.29	0.29	0.06	0.06	-	-	0.11	0.11	0.31	0.30	0.30	0.29	0.06	0.06	-	-	0.11	0.11
160	1.18	1.13	1.16	1.11	0.21	0.20	0.11	0.11	0.56	0.54	1.25	1.19	1.22	1.17	0.23	0.22	0.12	0.12	0.59	0.57
150	2.90	2.75	2.88	2.73	0.93	0.90	0.61	0.58	1.78	1.70	3.17	2.96	3.12	2.92	0.98	0.93	0.65	0.62	1.88	1.80
140	5.64	5.25	5.60	5.22	2.50	2.36	1.84	1.76	4.00	3.75	6.51	6.04	6.47	6.01	2.67	2.53	1.95	1.86	4.50	4.20
130	9.18	8.48	9.16	8.45	4.96	4.64	4.02	3.76	7.15	6.63	11.93	10.94	11.88	10.89	5.90	5.49	4.50	4.20	9.10	8.41
120	14.09	12.95	14.04	12.91	8.74	8.06	7.20	6.65	11.91	10.93	19.49	17.78	19.42	17.72	12.13	11.15	9.46	8.73	16.67	15.21

Table H-369. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.04	0.04	0.04	0.04	-	-	-	-	-	-	0.04	0.04	0.03	0.03	-	-	-	-	-	-
190	0.15	0.15	0.14	0.14	-	-	-	-	0.07	0.07	0.15	0.14	0.14	0.14	-	-	-	-	0.07	0.07
180	0.77	0.73	0.75	0.73	0.11	0.11	0.08	0.08	0.33	0.32	0.79	0.76	0.79	0.75	0.12	0.12	0.08	0.08	0.34	0.33
175	1.37	1.32	1.36	1.30	0.28	0.27	0.17	0.17	0.74	0.71	1.44	1.39	1.43	1.37	0.29	0.28	0.16	0.16	0.76	0.73
170	2.21	2.08	2.18	2.06	0.58	0.56	0.38	0.35	1.29	1.23	2.39	2.25	2.36	2.22	0.62	0.60	0.39	0.37	1.35	1.29
160	4.66	4.34	4.62	4.32	1.82	1.73	1.33	1.27	3.00	2.83	5.26	4.89	5.22	4.86	1.92	1.83	1.40	1.34	3.34	3.13
150	7.92	7.33	7.89	7.30	4.00	3.76	3.04	2.85	5.97	5.57	9.64	8.88	9.60	8.85	4.52	4.23	3.38	3.16	7.27	6.72
140	12.54	11.54	12.51	11.50	7.36	6.80	5.99	5.57	9.94	9.17	16.84	15.37	16.78	15.31	9.57	8.81	7.50	6.93	13.99	12.84
130	17.75	16.23	17.72	16.20	12.48	11.47	10.31	9.42	15.63	14.31	28.38	25.50	28.14	25.32	18.01	16.46	15.01	13.74	24.33	22.03
120	25.29	22.97	25.23	22.91	18.30	16.72	16.27	14.89	22.42	20.31	44.41	39.51	43.40	38.57	31.93	28.41	27.44	24.72	39.09	34.60

Table H-370. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
180	0.31	0.30	0.31	0.30	0.06	0.06	0.02	0.02	0.11	0.11	0.32	0.31	0.31	0.30	0.06	0.06	-	-	0.12	0.12
175	0.66	0.64	0.65	0.62	0.10	0.10	0.07	0.07	0.29	0.28	0.71	0.68	0.68	0.65	0.11	0.11	0.07	0.07	0.30	0.29
170	1.25	1.19	1.22	1.17	0.24	0.23	0.13	0.13	0.60	0.58	1.30	1.25	1.29	1.23	0.24	0.23	0.12	0.12	0.63	0.61
160	2.98	2.82	2.96	2.81	0.98	0.93	0.65	0.62	1.86	1.77	3.32	3.11	3.28	3.07	1.02	0.98	0.72	0.68	1.95	1.86
150	5.82	5.43	5.79	5.40	2.58	2.44	1.91	1.82	4.13	3.88	6.75	6.26	6.72	6.23	2.75	2.60	2.02	1.92	4.70	4.39
140	9.44	8.72	9.42	8.69	5.14	4.81	4.14	3.88	7.47	6.91	12.43	11.40	12.38	11.36	6.21	5.76	4.70	4.38	9.50	8.75
130	14.51	13.32	14.48	13.29	9.12	8.41	7.58	7.00	12.39	11.39	20.30	18.43	20.15	18.33	12.78	11.73	9.90	9.11	17.37	15.87
120	19.95	18.23	19.92	18.20	14.70	13.48	12.82	11.78	17.97	16.42	34.11	30.30	33.74	29.98	22.85	20.67	18.82	17.19	29.87	26.72

Table H-371. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.04	0.04	0.04	0.04	-	-	-	-	-	-	0.04	0.04	0.03	0.03	-	-	-	-	-	-
180	0.15	0.15	0.14	0.14	-	-	-	-	0.07	0.07	0.15	0.14	0.14	0.14	-	-	-	-	0.07	0.07
175	0.35	0.34	0.34	0.34	0.06	0.06	0.04	0.04	0.15	0.15	0.36	0.35	0.35	0.34	0.06	0.06	0.02	0.02	0.13	0.13
170	0.77	0.73	0.75	0.73	0.11	0.11	0.08	0.08	0.33	0.32	0.79	0.76	0.79	0.75	0.12	0.12	0.08	0.08	0.34	0.33
160	2.21	2.08	2.18	2.06	0.58	0.56	0.38	0.35	1.29	1.23	2.39	2.25	2.36	2.22	0.62	0.60	0.39	0.37	1.35	1.29
150	4.66	4.34	4.62	4.32	1.82	1.73	1.33	1.27	3.00	2.83	5.26	4.89	5.22	4.86	1.92	1.83	1.40	1.34	3.34	3.13
140	7.92	7.33	7.89	7.30	4.00	3.76	3.04	2.85	5.97	5.57	9.64	8.88	9.60	8.85	4.52	4.23	3.38	3.16	7.27	6.72
130	12.54	11.54	12.51	11.50	7.36	6.80	5.99	5.57	9.94	9.17	16.84	15.37	16.78	15.31	9.57	8.81	7.50	6.93	13.99	12.84
120	17.75	16.23	17.72	16.20	12.48	11.47	10.31	9.42	15.63	14.31	28.38	25.50	28.14	25.32	18.01	16.46	15.01	13.74	24.33	22.03

Table H-372. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	0.07	0.07	-	-	-	-	0.03	0.03	0.08	0.07	0.07	0.07	-	-	-	-	0.03	0.03
175	0.15	0.15	0.14	0.14	-	-	-	-	0.07	0.07	0.15	0.14	0.14	0.14	-	-	-	-	0.07	0.07
170	0.35	0.34	0.34	0.34	0.06	0.06	0.04	0.04	0.15	0.15	0.36	0.35	0.35	0.34	0.06	0.06	0.02	0.02	0.13	0.13
160	1.37	1.32	1.36	1.30	0.28	0.27	0.17	0.17	0.74	0.71	1.44	1.39	1.43	1.37	0.29	0.28	0.16	0.16	0.76	0.73
150	3.28	3.07	3.24	3.03	1.12	1.08	0.77	0.74	2.01	1.91	3.64	3.41	3.60	3.38	1.19	1.14	0.80	0.77	2.19	2.06
140	6.14	5.72	6.11	5.69	2.76	2.60	2.08	1.95	4.40	4.12	7.17	6.64	7.13	6.61	2.92	2.78	2.26	2.12	5.08	4.73
130	9.81	9.05	9.78	9.02	5.48	5.11	4.40	4.12	7.90	7.31	13.09	12.02	13.04	11.97	6.69	6.19	5.08	4.74	10.03	9.23
120	15.04	13.78	15.00	13.75	9.54	8.80	8.03	7.41	12.91	11.88	21.73	19.58	21.58	19.45	13.56	12.44	10.78	9.83	18.27	16.69

Table H-373. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
190	0.24	0.24	0.24	0.23	0.05	0.05	-	-	0.10	0.09	0.26	0.24	0.25	0.24	0.04	0.04	-	-	0.10	0.09
180	1.02	0.98	1.01	0.97	0.19	0.18	0.10	0.10	0.48	0.46	1.09	1.04	1.08	1.02	0.18	0.18	0.11	0.11	0.49	0.48
175	1.74	1.66	1.72	1.64	0.44	0.43	0.23	0.22	0.96	0.92	1.84	1.75	1.82	1.74	0.46	0.44	0.23	0.23	0.99	0.95
170	2.68	2.55	2.66	2.53	0.81	0.77	0.50	0.48	1.60	1.53	2.86	2.71	2.84	2.69	0.84	0.80	0.52	0.50	1.70	1.63
160	5.34	4.97	5.30	4.94	2.26	2.13	1.68	1.60	3.72	3.49	6.08	5.65	6.04	5.62	2.45	2.30	1.78	1.70	4.17	3.89
150	8.83	8.16	8.80	8.13	4.74	4.44	3.79	3.55	6.84	6.37	11.26	10.29	11.20	10.24	5.46	5.09	4.22	3.94	8.57	7.92
140	13.81	12.67	13.77	12.64	8.42	7.80	6.88	6.41	11.54	10.60	18.81	17.11	18.75	17.05	11.15	10.20	8.74	8.08	15.80	14.39
130	19.33	17.61	19.29	17.57	13.80	12.67	11.89	10.92	17.15	15.65	30.49	27.21	30.21	27.00	19.62	17.86	16.69	15.21	26.39	23.85
120	27.30	24.79	27.21	24.72	19.75	18.01	17.82	16.24	24.70	22.42	44.87	40.10	43.79	39.02	33.57	29.79	30.04	26.84	39.78	35.27

Table H-374. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.09	0.08	0.08	0.08	-	-	-	-	0.05	0.05	0.09	0.08	0.09	0.08	-	-	-	-	0.05	0.05
180	0.46	0.44	0.46	0.44	0.08	0.07	0.05	0.05	0.19	0.18	0.48	0.46	0.48	0.46	0.08	0.08	0.05	0.05	0.19	0.18
175	0.91	0.88	0.89	0.85	0.16	0.16	0.09	0.08	0.44	0.43	0.96	0.92	0.95	0.91	0.15	0.15	0.10	0.09	0.46	0.44
170	1.58	1.51	1.56	1.49	0.38	0.36	0.20	0.20	0.80	0.77	1.67	1.60	1.64	1.58	0.41	0.39	0.20	0.20	0.85	0.81
160	3.68	3.45	3.66	3.42	1.30	1.24	0.90	0.85	2.30	2.17	4.06	3.81	4.04	3.78	1.39	1.32	0.95	0.90	2.48	2.34
150	6.56	6.11	6.53	6.08	3.05	2.86	2.38	2.26	4.86	4.54	7.81	7.22	7.77	7.19	3.42	3.19	2.56	2.43	5.62	5.25
140	10.53	9.65	10.48	9.61	6.00	5.61	4.90	4.57	8.52	7.89	14.08	12.88	14.03	12.84	7.30	6.77	5.64	5.25	11.17	10.21
130	15.93	14.56	15.89	14.53	10.18	9.36	8.64	7.99	13.75	12.62	23.27	20.95	23.13	20.82	14.34	13.12	11.60	10.63	19.20	17.45
120	22.62	20.41	22.56	20.34	16.11	14.73	14.14	12.99	19.50	17.77	35.61	31.60	35.17	31.24	25.00	22.65	20.89	18.81	31.51	28.08

Table H-375. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
180	0.24	0.24	0.24	0.23	0.05	0.05	-	-	0.10	0.09	0.26	0.24	0.25	0.24	0.04	0.04	-	-	0.10	0.09
175	0.50	0.48	0.50	0.48	0.09	0.08	0.06	0.06	0.21	0.20	0.54	0.52	0.53	0.51	0.09	0.08	0.06	0.06	0.21	0.21
170	1.02	0.98	1.01	0.97	0.19	0.18	0.10	0.10	0.48	0.46	1.09	1.04	1.08	1.02	0.18	0.18	0.11	0.11	0.49	0.48
160	2.68	2.55	2.66	2.53	0.81	0.77	0.50	0.48	1.60	1.53	2.86	2.71	2.84	2.69	0.84	0.80	0.52	0.50	1.70	1.63
150	5.34	4.97	5.30	4.94	2.26	2.13	1.68	1.60	3.72	3.49	6.08	5.65	6.04	5.62	2.45	2.30	1.78	1.70	4.17	3.89
140	8.83	8.16	8.80	8.13	4.74	4.44	3.79	3.55	6.84	6.37	11.26	10.29	11.20	10.24	5.46	5.09	4.22	3.94	8.57	7.92
130	13.81	12.67	13.77	12.64	8.42	7.80	6.88	6.41	11.54	10.60	18.81	17.11	18.75	17.05	11.15	10.20	8.74	8.08	15.80	14.39
120	19.33	17.61	19.29	17.57	13.80	12.67	11.89	10.92	17.15	15.65	30.49	27.21	30.21	27.00	19.62	17.86	16.69	15.21	26.39	23.85

Table H-376. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.10	0.10	0.10	0.09	-	-	-	-	0.06	0.06	0.11	0.10	0.10	0.10	-	-	-	-	0.06	0.06
175	0.24	0.24	0.24	0.23	0.05	0.05	-	-	0.10	0.09	0.26	0.24	0.25	0.24	0.04	0.04	-	-	0.10	0.09
170	0.50	0.48	0.50	0.48	0.09	0.08	0.06	0.06	0.21	0.20	0.54	0.52	0.53	0.51	0.09	0.08	0.06	0.06	0.21	0.21
160	1.74	1.66	1.72	1.64	0.44	0.43	0.23	0.22	0.96	0.92	1.84	1.75	1.82	1.74	0.46	0.44	0.23	0.23	0.99	0.95
150	3.96	3.71	3.94	3.68	1.44	1.38	1.00	0.95	2.52	2.39	4.38	4.08	4.34	4.05	1.53	1.46	1.05	0.99	2.69	2.55
140	6.88	6.41	6.85	6.38	3.35	3.13	2.60	2.46	5.16	4.82	8.31	7.68	8.27	7.64	3.73	3.49	2.76	2.61	6.04	5.63
130	11.15	10.23	11.11	10.18	6.36	5.93	5.20	4.85	8.94	8.27	14.83	13.54	14.78	13.49	7.88	7.30	6.06	5.65	11.97	10.97
120	16.47	15.05	16.44	15.02	10.87	9.96	9.07	8.40	14.31	13.11	24.48	22.10	24.33	21.96	15.18	13.85	12.43	11.41	19.99	18.19

Table H-377. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
190	0.31	0.30	0.31	0.30	0.06	0.06	-	-	0.11	0.11	0.32	0.31	0.31	0.30	0.06	0.06	-	-	0.12	0.12
180	1.23	1.17	1.21	1.16	0.23	0.22	0.13	0.13	0.60	0.58	1.29	1.24	1.27	1.22	0.24	0.24	0.12	0.12	0.65	0.62
175	1.98	1.89	1.96	1.87	0.52	0.50	0.30	0.29	1.12	1.07	2.12	2.01	2.08	1.98	0.52	0.50	0.31	0.30	1.19	1.14
170	2.97	2.81	2.94	2.79	0.99	0.95	0.67	0.64	1.84	1.76	3.28	3.06	3.24	3.02	1.05	1.00	0.70	0.67	1.94	1.85
160	5.78	5.38	5.74	5.35	2.60	2.46	1.92	1.83	4.16	3.90	6.61	6.16	6.58	6.13	2.76	2.62	2.02	1.93	4.68	4.36
150	9.38	8.68	9.35	8.65	5.24	4.88	4.24	3.96	7.46	6.92	12.38	11.36	12.34	11.31	6.12	5.69	4.72	4.39	9.41	8.70
140	14.63	13.40	14.59	13.37	9.06	8.38	7.52	6.96	12.45	11.44	20.09	18.25	19.98	18.18	12.43	11.40	9.59	8.88	17.13	15.59
130	20.40	18.47	20.33	18.42	14.64	13.41	12.69	11.66	18.10	16.51	32.41	28.79	32.12	28.56	21.61	19.39	18.09	16.48	28.31	25.40
120	28.60	25.81	28.51	25.75	20.99	18.92	18.61	16.95	25.82	23.51	48.72	43.66	47.12	42.12	35.60	31.56	31.74	28.25	42.60	37.76

Table H-378. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	-	-	-	-	-	-	-	-
190	0.11	0.11	0.11	0.11	-	-	-	-	0.06	0.06	0.11	0.11	0.11	0.11	-	-	-	-	0.06	0.06
180	0.57	0.54	0.55	0.52	0.09	0.08	0.06	0.06	0.24	0.23	0.60	0.58	0.58	0.56	0.09	0.09	0.06	0.06	0.25	0.24
175	1.09	1.04	1.08	1.03	0.20	0.20	0.11	0.11	0.51	0.50	1.16	1.11	1.15	1.09	0.20	0.19	0.11	0.11	0.53	0.51
170	1.82	1.74	1.81	1.73	0.45	0.44	0.26	0.25	1.01	0.96	1.91	1.83	1.90	1.81	0.47	0.45	0.27	0.26	1.07	1.02
160	4.10	3.84	4.08	3.81	1.52	1.45	1.05	1.00	2.64	2.49	4.52	4.21	4.48	4.18	1.62	1.54	1.13	1.08	2.79	2.65
150	7.03	6.54	6.99	6.51	3.54	3.31	2.70	2.56	5.34	4.98	8.54	7.89	8.49	7.85	3.92	3.67	2.88	2.72	6.26	5.83
140	11.45	10.52	11.41	10.48	6.56	6.10	5.38	5.01	9.15	8.47	15.27	13.93	15.22	13.88	8.18	7.58	6.30	5.86	12.40	11.37
130	16.82	15.36	16.79	15.32	11.20	10.25	9.25	8.56	14.62	13.39	25.16	22.70	25.02	22.57	15.66	14.27	12.85	11.79	20.81	18.73
120	24.00	21.75	23.94	21.69	16.97	15.51	14.94	13.68	20.71	18.70	37.75	33.38	37.27	32.98	26.93	24.29	22.88	20.65	33.49	29.72

Table H-379. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
180	0.31	0.30	0.31	0.30	0.06	0.06	-	-	0.11	0.11	0.32	0.31	0.31	0.30	0.06	0.06	-	-	0.12	0.12
175	0.68	0.65	0.67	0.64	0.10	0.10	0.07	0.07	0.28	0.27	0.71	0.68	0.69	0.67	0.11	0.11	0.07	0.07	0.29	0.28
170	1.23	1.17	1.21	1.16	0.23	0.22	0.13	0.13	0.60	0.58	1.29	1.24	1.27	1.22	0.24	0.24	0.12	0.12	0.65	0.62
160	2.97	2.81	2.94	2.79	0.99	0.95	0.67	0.64	1.84	1.76	3.28	3.06	3.24	3.02	1.05	1.00	0.70	0.67	1.94	1.85
150	5.78	5.38	5.74	5.35	2.60	2.46	1.92	1.83	4.16	3.90	6.61	6.16	6.58	6.13	2.76	2.62	2.02	1.93	4.68	4.36
140	9.38	8.68	9.35	8.65	5.24	4.88	4.24	3.96	7.46	6.92	12.38	11.36	12.34	11.31	6.12	5.69	4.72	4.39	9.41	8.70
130	14.63	13.40	14.59	13.37	9.06	8.38	7.52	6.96	12.45	11.44	20.09	18.25	19.98	18.18	12.43	11.40	9.59	8.88	17.13	15.59
120	20.40	18.47	20.33	18.42	14.64	13.41	12.69	11.66	18.10	16.51	32.41	28.79	32.12	28.56	21.61	19.39	18.09	16.48	28.31	25.40

Table H-380. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	0.03	0.03	-	-	-	-	-	-	0.03	0.03	0.02	0.02	-	-	-	-	-	-
180	0.12	0.12	0.12	0.12	-	-	-	-	0.06	0.06	0.12	0.12	0.12	0.12	-	-	-	-	0.06	0.06
175	0.31	0.30	0.31	0.30	0.06	0.06	-	-	0.11	0.11	0.32	0.31	0.31	0.30	0.06	0.06	-	-	0.12	0.12
170	0.68	0.65	0.67	0.64	0.10	0.10	0.07	0.07	0.28	0.27	0.71	0.68	0.69	0.67	0.11	0.11	0.07	0.07	0.29	0.28
160	1.98	1.89	1.95	1.87	0.52	0.50	0.30	0.29	1.12	1.07	2.12	2.01	2.08	1.98	0.52	0.50	0.31	0.30	1.19	1.14
150	4.36	4.08	4.34	4.05	1.69	1.61	1.19	1.15	2.82	2.67	4.84	4.50	4.80	4.47	1.78	1.70	1.27	1.22	3.00	2.84
140	7.43	6.89	7.40	6.86	3.84	3.58	2.90	2.73	5.66	5.27	9.05	8.36	9.00	8.32	4.24	3.95	3.12	2.92	6.70	6.23
130	12.03	11.06	12.00	11.02	6.92	6.43	5.70	5.30	9.56	8.84	16.04	14.62	15.98	14.56	8.77	8.11	6.76	6.28	13.14	12.04
120	17.39	15.88	17.35	15.84	11.82	10.85	9.66	8.94	15.18	13.89	26.28	23.70	26.12	23.57	16.52	15.05	13.64	12.50	22.17	19.90

Table H-381. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.07	0.07	0.07	0.07	-	-	-	-	0.03	0.03	0.08	0.07	0.07	0.07	-	-	-	-	0.03	0.03
190	0.41	0.40	0.41	0.39	0.06	0.06	0.04	0.04	0.17	0.16	0.43	0.41	0.41	0.40	0.06	0.06	0.03	0.03	0.16	0.16
180	1.43	1.37	1.42	1.36	0.29	0.28	0.18	0.17	0.72	0.69	1.50	1.44	1.49	1.42	0.31	0.30	0.17	0.17	0.75	0.72
175	2.26	2.13	2.23	2.10	0.65	0.63	0.42	0.41	1.32	1.26	2.42	2.28	2.39	2.25	0.68	0.66	0.43	0.42	1.40	1.34
170	3.34	3.10	3.30	3.07	1.17	1.11	0.79	0.75	2.06	1.95	3.66	3.41	3.62	3.38	1.24	1.18	0.85	0.81	2.23	2.09
160	6.10	5.66	6.06	5.63	2.82	2.67	2.18	2.04	4.48	4.16	7.04	6.54	7.00	6.51	2.98	2.83	2.32	2.19	5.10	4.73
150	9.73	9.00	9.70	8.97	5.58	5.18	4.56	4.24	7.90	7.30	13.34	12.24	13.30	12.19	6.78	6.27	5.20	4.82	10.34	9.42
140	15.24	13.95	15.20	13.92	9.56	8.83	8.02	7.41	13.08	12.01	22.73	20.44	22.59	20.31	13.98	12.79	11.12	10.09	18.84	17.21
130	21.74	19.54	21.67	19.47	15.47	14.16	13.44	12.34	18.94	17.29	36.20	32.02	35.79	31.66	25.15	22.65	20.45	18.54	31.96	28.37
120	29.90	26.82	29.84	26.76	22.68	20.43	19.57	17.87	27.20	24.59	58.29	52.96	55.23	49.86	41.10	36.27	36.40	32.19	49.51	44.47

Table H-382. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.03	0.03	0.03	0.03	-	-	-	-	-	-	0.03	0.03	0.03	0.03	-	-	-	-	-	-
190	0.13	0.13	0.12	0.12	-	-	-	-	0.06	0.06	0.13	0.13	0.13	0.13	-	-	-	-	0.06	0.06
180	0.70	0.67	0.69	0.67	0.11	0.11	0.07	0.07	0.31	0.30	0.73	0.70	0.72	0.69	0.11	0.11	0.07	0.07	0.31	0.30
175	1.29	1.24	1.27	1.22	0.26	0.26	0.16	0.16	0.66	0.64	1.36	1.30	1.35	1.28	0.27	0.26	0.15	0.15	0.68	0.66
170	2.05	1.94	2.02	1.92	0.55	0.53	0.33	0.32	1.16	1.11	2.20	2.08	2.16	2.05	0.58	0.55	0.34	0.33	1.24	1.19
160	4.40	4.11	4.38	4.08	1.74	1.66	1.26	1.20	2.86	2.70	4.88	4.53	4.84	4.50	1.83	1.74	1.33	1.26	3.02	2.86
150	7.41	6.87	7.38	6.83	3.90	3.61	2.92	2.76	5.68	5.27	9.08	8.41	9.04	8.38	4.30	4.00	3.18	2.98	6.80	6.30
140	12.04	11.06	12.00	11.02	6.96	6.45	5.74	5.32	9.58	8.86	16.50	15.07	16.44	15.02	9.12	8.42	7.04	6.49	13.66	12.50
130	17.51	16.02	17.47	15.98	12.00	11.00	9.78	9.02	15.34	14.05	27.83	24.97	27.66	24.82	17.58	16.08	14.54	13.33	23.90	21.52
120	25.22	22.80	25.16	22.74	17.94	16.40	15.84	14.49	22.22	19.98	43.06	38.13	42.29	37.35	30.89	27.45	26.57	23.91	37.97	33.52

Table H-383. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.07	0.07	0.07	-	-	-	-	0.03	0.03	0.08	0.07	0.07	0.07	-	-	-	-	0.03	0.03
180	0.41	0.40	0.41	0.39	0.06	0.06	0.04	0.04	0.17	0.16	0.43	0.41	0.41	0.40	0.06	0.06	0.03	0.03	0.16	0.16
175	0.80	0.76	0.78	0.74	0.14	0.14	0.08	0.08	0.39	0.38	0.85	0.82	0.84	0.80	0.12	0.12	0.08	0.08	0.41	0.40
170	1.43	1.37	1.42	1.36	0.29	0.28	0.18	0.17	0.72	0.69	1.50	1.44	1.49	1.42	0.31	0.30	0.17	0.17	0.75	0.72
160	3.34	3.10	3.30	3.07	1.17	1.11	0.79	0.75	2.06	1.95	3.66	3.41	3.62	3.38	1.24	1.18	0.85	0.81	2.23	2.09
150	6.10	5.66	6.06	5.63	2.82	2.67	2.18	2.04	4.48	4.16	7.04	6.54	7.00	6.51	2.98	2.83	2.32	2.19	5.10	4.73
140	9.73	9.00	9.70	8.97	5.58	5.18	4.56	4.24	7.90	7.30	13.34	12.24	13.30	12.19	6.78	6.27	5.20	4.82	10.34	9.42
130	15.24	13.95	15.20	13.92	9.56	8.83	8.02	7.41	13.08	12.01	22.73	20.44	22.59	20.31	13.98	12.79	11.12	10.09	18.84	17.21
120	21.74	19.54	21.67	19.47	15.47	14.16	13.44	12.34	18.94	17.29	36.20	32.02	35.79	31.66	25.15	22.65	20.45	18.54	31.96	28.37

Table H-384. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L05 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.04	0.04	0.04	0.04	-	-	-	-	-	-	0.04	0.04	0.03	0.03	-	-	-	-	-	-
180	0.16	0.15	0.15	0.15	-	-	-	-	0.07	0.07	0.15	0.15	0.15	0.15	-	-	-	-	0.08	0.07
175	0.41	0.40	0.41	0.39	0.06	0.06	0.04	0.04	0.17	0.16	0.43	0.41	0.41	0.40	0.06	0.06	0.03	0.03	0.16	0.16
170	0.80	0.76	0.78	0.74	0.14	0.14	0.08	0.08	0.39	0.38	0.85	0.82	0.84	0.80	0.12	0.12	0.08	0.08	0.41	0.40
160	2.26	2.13	2.23	2.10	0.65	0.63	0.42	0.41	1.32	1.26	2.42	2.28	2.39	2.25	0.68	0.66	0.43	0.42	1.40	1.34
150	4.68	4.35	4.64	4.32	1.87	1.78	1.40	1.34	3.08	2.87	5.20	4.83	5.18	4.80	1.95	1.87	1.48	1.41	3.38	3.17
140	7.81	7.23	7.77	7.19	4.16	3.87	3.18	2.95	6.00	5.57	9.60	8.88	9.58	8.84	4.64	4.30	3.50	3.27	7.34	6.76
130	12.56	11.56	12.54	11.53	7.38	6.82	6.08	5.63	1-	9.22	17.36	15.85	17.29	15.79	9.72	8.96	7.64	7.02	14.44	13.24
120	18.12	16.56	18.08	16.52	12.58	11.55	10.36	9.46	15.92	14.57	29.16	26.04	28.94	25.86	18.53	16.94	15.44	14.14	25.23	22.71

Table H-385. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.09	0.08	0.09	0.08	-	-	-	-	0.05	0.05	0.09	0.09	0.09	0.08	-	-	-	-	0.05	0.05
180	0.48	0.46	0.46	0.44	0.07	0.07	0.05	0.05	0.18	0.18	0.49	0.48	0.48	0.47	0.07	0.07	0.05	0.05	0.18	0.17
175	0.94	0.91	0.93	0.89	0.15	0.15	0.09	0.08	0.42	0.40	0.98	0.94	0.96	0.93	0.15	0.14	0.09	0.09	0.43	0.42
170	1.64	1.57	1.62	1.55	0.36	0.34	0.19	0.18	0.81	0.78	1.73	1.65	1.71	1.63	0.38	0.36	0.19	0.18	0.85	0.82
160	3.79	3.54	3.76	3.51	1.26	1.20	0.86	0.81	2.27	2.14	4.14	3.88	4.12	3.85	1.33	1.27	0.90	0.86	2.43	2.30
150	6.68	6.18	6.65	6.15	2.97	2.79	2.30	2.17	4.77	4.45	7.85	7.21	7.81	7.17	3.27	3.05	2.46	2.33	5.47	5.10
140	10.56	9.59	10.51	9.55	5.83	5.40	4.72	4.41	8.36	7.69	13.77	12.55	13.71	12.51	7.04	6.52	5.42	5.05	10.75	9.72
130	15.68	14.27	15.64	14.23	9.84	9.04	8.37	7.69	13.35	12.22	22.46	20.26	22.29	20.10	13.99	12.75	11.33	10.25	18.77	17.07
120	21.92	19.66	21.84	19.58	15.64	14.22	13.71	12.52	19.01	17.29	35.09	31.52	34.61	31.07	24.88	22.55	20.68	18.64	31.09	27.93

Table H-386. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	0.05	0.05	-	-	-	-	-	-	0.05	0.05	0.04	0.04	-	-	-	-	-	-
180	0.17	0.17	0.17	0.16	-	-	-	-	0.07	0.07	0.17	0.17	0.17	0.16	-	-	-	-	0.07	0.07
175	0.41	0.40	0.40	0.39	0.06	0.06	0.04	0.04	0.16	0.16	0.43	0.41	0.42	0.41	0.06	0.06	0.04	0.04	0.15	0.15
170	0.84	0.80	0.82	0.78	0.11	0.11	0.08	0.08	0.36	0.35	0.88	0.84	0.86	0.82	0.12	0.11	0.08	0.08	0.38	0.37
160	2.37	2.24	2.34	2.21	0.61	0.58	0.40	0.39	1.29	1.24	2.53	2.39	2.49	2.36	0.64	0.62	0.41	0.40	1.36	1.30
150	4.85	4.52	4.81	4.49	1.84	1.74	1.32	1.27	3.07	2.88	5.40	5.04	5.37	5.00	1.93	1.84	1.40	1.35	3.42	3.19
140	8.15	7.49	8.11	7.46	4.07	3.80	3.10	2.88	6.04	5.60	9.74	8.93	9.70	8.90	4.53	4.23	3.45	3.21	7.26	6.68
130	12.71	11.63	12.67	11.59	7.30	6.71	5.97	5.53	9.94	9.14	16.70	15.19	16.63	15.13	9.37	8.59	7.31	6.74	13.77	12.54
120	17.88	16.24	17.82	16.19	12.29	11.21	10.09	9.24	15.53	14.13	27.32	24.62	27.08	24.45	17.58	15.97	14.62	13.31	23.45	21.18

Table H-387. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.09	0.08	0.09	0.08	-	-	-	-	0.05	0.05	0.09	0.09	0.09	0.08	-	-	-	-	0.05	0.05
175	0.22	0.21	0.19	0.18	0.03	0.03	-	-	0.08	0.08	0.23	0.22	0.22	0.21	0.02	0.02	-	-	0.09	0.08
170	0.48	0.46	0.46	0.44	0.07	0.07	0.05	0.05	0.18	0.18	0.49	0.48	0.48	0.47	0.07	0.07	0.05	0.05	0.18	0.17
160	1.64	1.57	1.62	1.55	0.36	0.34	0.19	0.18	0.81	0.78	1.73	1.65	1.71	1.63	0.38	0.36	0.19	0.18	0.85	0.82
150	3.79	3.54	3.76	3.51	1.26	1.20	0.86	0.81	2.27	2.14	4.14	3.88	4.12	3.85	1.33	1.27	0.90	0.86	2.43	2.30
140	6.68	6.18	6.65	6.15	2.97	2.79	2.30	2.17	4.77	4.45	7.85	7.21	7.81	7.17	3.27	3.05	2.46	2.33	5.47	5.10
130	10.56	9.59	10.51	9.55	5.83	5.40	4.72	4.41	8.36	7.69	13.77	12.55	13.71	12.51	7.04	6.52	5.42	5.05	10.75	9.72
120	15.68	14.27	15.64	14.23	9.84	9.04	8.37	7.69	13.35	12.22	22.46	20.26	22.29	20.10	13.99	12.75	11.33	10.25	18.77	17.07

Table H-388. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.05	0.05	0.05	0.05	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	-	-	-	-	-
175	0.09	0.08	0.09	0.08	-	-	-	-	0.05	0.05	0.09	0.09	0.09	0.08	-	-	-	-	0.05	0.05
170	0.22	0.21	0.19	0.18	0.03	0.03	-	-	0.08	0.08	0.23	0.22	0.22	0.21	0.02	0.02	-	-	0.09	0.08
160	0.94	0.91	0.93	0.89	0.15	0.15	0.09	0.08	0.42	0.40	0.98	0.94	0.96	0.93	0.15	0.14	0.09	0.09	0.43	0.42
150	2.57	2.44	2.55	2.41	0.71	0.68	0.44	0.42	1.43	1.37	2.73	2.59	2.70	2.56	0.74	0.71	0.45	0.44	1.50	1.44
140	5.12	4.78	5.09	4.75	1.97	1.88	1.46	1.40	3.38	3.15	5.77	5.36	5.73	5.33	2.13	2.01	1.54	1.48	3.75	3.50
130	8.53	7.83	8.48	7.80	4.33	4.04	3.39	3.15	6.39	5.92	10.33	9.38	10.27	9.34	4.87	4.54	3.76	3.50	7.79	7.17
120	13.16	12.05	13.12	12.01	7.74	7.11	6.32	5.85	10.56	9.59	17.51	15.92	17.44	15.86	9.92	9.09	7.89	7.27	14.51	13.21

Table H-389. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.03	0.03	0.03	0.03	-	-	-	-	-	-	0.03	0.03	0.02	0.02	-	-	-	-	-	-
190	0.12	0.11	0.11	0.11	-	-	-	-	0.06	0.06	0.12	0.12	0.12	0.11	-	-	-	-	0.06	0.06
180	0.64	0.62	0.63	0.60	0.10	0.10	0.07	0.06	0.26	0.25	0.67	0.65	0.65	0.63	0.10	0.10	0.07	0.07	0.27	0.26
175	1.19	1.14	1.17	1.12	0.21	0.21	0.11	0.11	0.54	0.51	1.26	1.20	1.23	1.18	0.22	0.21	0.12	0.12	0.58	0.55
170	1.94	1.84	1.92	1.83	0.46	0.45	0.28	0.27	1.06	1.01	2.06	1.95	2.02	1.92	0.48	0.47	0.29	0.28	1.12	1.07
160	4.34	4.06	4.31	4.03	1.58	1.51	1.12	1.07	2.74	2.59	4.84	4.52	4.81	4.49	1.69	1.60	1.19	1.14	2.93	2.76
150	7.59	6.97	7.54	6.93	3.69	3.44	2.77	2.62	5.59	5.21	9.23	8.44	9.19	8.41	4.10	3.84	2.96	2.80	6.70	6.22
140	12.24	11.14	12.21	11.10	6.91	6.38	5.59	5.20	9.66	8.85	16.11	14.65	16.05	14.60	8.90	8.15	6.76	6.28	13.23	12.04
130	17.45	15.88	17.41	15.84	12.00	10.88	9.81	8.98	15.22	13.86	26.76	24.20	26.66	24.10	16.78	15.26	13.83	12.59	22.67	20.49
120	25.00	22.64	24.95	22.58	17.77	16.14	15.67	14.25	21.84	19.65	40.72	36.86	40.38	36.55	29.05	26.19	24.79	22.49	36.02	32.41

Table H-390. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
180	0.26	0.25	0.26	0.25	0.05	0.05	-	-	0.10	0.10	0.26	0.26	0.26	0.25	0.05	0.05	-	-	0.10	0.10
175	0.53	0.51	0.52	0.50	0.09	0.08	0.06	0.06	0.22	0.21	0.57	0.54	0.55	0.53	0.09	0.08	0.06	0.06	0.22	0.21
170	1.05	1.00	1.02	0.98	0.19	0.19	0.11	0.10	0.47	0.45	1.10	1.06	1.08	1.04	0.19	0.18	0.11	0.11	0.49	0.47
160	2.76	2.61	2.73	2.58	0.80	0.77	0.50	0.48	1.62	1.54	2.93	2.78	2.91	2.75	0.86	0.82	0.52	0.50	1.71	1.63
150	5.49	5.12	5.46	5.09	2.28	2.14	1.67	1.59	3.81	3.54	6.34	5.87	6.29	5.84	2.46	2.32	1.78	1.68	4.24	3.98
140	9.18	8.41	9.16	8.38	4.80	4.48	3.85	3.57	7.05	6.51	11.86	10.75	11.81	10.70	5.60	5.24	4.24	3.98	8.96	8.20
130	14.20	12.94	14.17	12.91	8.73	7.99	7.08	6.54	12.00	10.90	19.44	17.71	19.38	17.65	11.83	10.72	9.18	8.41	16.41	14.92
120	19.70	17.96	19.66	17.93	14.20	12.91	12.31	11.18	17.57	15.97	31.79	28.55	31.65	28.42	20.74	18.73	17.42	15.83	27.80	25.12

Table H-391. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	0.03	0.03	-	-	-	-	-	-	0.03	0.03	0.02	0.02	-	-	-	-	-	-
180	0.12	0.11	0.11	0.11	-	-	-	-	0.06	0.06	0.12	0.12	0.12	0.11	-	-	-	-	0.06	0.06
175	0.30	0.29	0.29	0.29	0.06	0.06	-	-	0.11	0.11	0.31	0.30	0.30	0.29	0.06	0.06	-	-	0.11	0.11
170	0.64	0.62	0.63	0.60	0.10	0.10	0.07	0.06	0.26	0.25	0.67	0.65	0.65	0.63	0.10	0.10	0.07	0.07	0.27	0.26
160	1.94	1.84	1.92	1.83	0.46	0.45	0.28	0.27	1.06	1.01	2.06	1.95	2.02	1.92	0.48	0.47	0.29	0.28	1.12	1.07
150	4.34	4.06	4.31	4.03	1.58	1.51	1.12	1.07	2.74	2.59	4.84	4.52	4.81	4.49	1.69	1.60	1.19	1.14	2.93	2.76
140	7.59	6.97	7.54	6.93	3.69	3.44	2.77	2.62	5.59	5.21	9.23	8.44	9.19	8.41	4.10	3.84	2.96	2.80	6.70	6.22
130	12.24	11.14	12.21	11.10	6.91	6.38	5.59	5.20	9.66	8.85	16.11	14.65	16.05	14.60	8.90	8.15	6.76	6.28	13.23	12.04
120	17.45	15.88	17.41	15.84	12.00	10.88	9.81	8.98	15.22	13.86	26.76	24.20	26.66	24.10	16.78	15.26	13.83	12.59	22.67	20.49

Table H-392. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
175	0.12	0.11	0.11	0.11	-	-	-	-	0.06	0.06	0.12	0.12	0.12	0.11	-	-	-	-	0.06	0.06
170	0.30	0.29	0.29	0.29	0.06	0.06	-	-	0.11	0.11	0.31	0.30	0.30	0.29	0.06	0.06	-	-	0.11	0.11
160	1.19	1.14	1.18	1.12	0.21	0.21	0.11	0.11	0.54	0.52	1.26	1.20	1.23	1.18	0.22	0.21	0.12	0.12	0.58	0.55
150	2.94	2.78	2.91	2.76	0.92	0.88	0.60	0.57	1.78	1.68	3.23	3.03	3.18	2.99	0.96	0.92	0.64	0.61	1.88	1.79
140	5.81	5.41	5.78	5.38	2.49	2.34	1.82	1.73	4.07	3.81	6.73	6.24	6.70	6.20	2.66	2.52	1.94	1.84	4.60	4.30
130	9.56	8.76	9.53	8.74	5.11	4.77	4.10	3.82	7.50	6.89	12.54	11.40	12.49	11.36	6.07	5.66	4.58	4.29	9.51	8.70
120	14.72	13.40	14.68	13.37	9.18	8.40	7.56	6.94	12.54	11.42	20.40	18.47	20.29	18.40	12.61	11.47	9.77	8.94	17.32	15.73

Table H-393. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.04	0.04	0.04	0.04	-	-	-	-	-	-	0.04	0.04	0.04	0.04	-	-	-	-	-	-
190	0.16	0.16	0.16	0.15	-	-	-	-	0.07	0.07	0.16	0.15	0.15	0.15	-	-	-	-	0.07	0.07
180	0.79	0.76	0.77	0.74	0.11	0.11	0.08	0.08	0.37	0.36	0.83	0.80	0.82	0.78	0.12	0.12	0.08	0.08	0.38	0.37
175	1.40	1.34	1.38	1.33	0.28	0.27	0.17	0.17	0.69	0.67	1.48	1.42	1.45	1.39	0.29	0.28	0.17	0.16	0.73	0.69
170	2.28	2.14	2.25	2.11	0.61	0.58	0.40	0.38	1.27	1.22	2.44	2.31	2.41	2.28	0.64	0.62	0.41	0.40	1.34	1.28
160	4.75	4.46	4.72	4.43	1.84	1.75	1.34	1.28	3.07	2.88	5.36	5.01	5.33	4.98	1.94	1.84	1.40	1.35	3.44	3.22
150	8.17	7.51	8.13	7.47	4.13	3.88	3.17	2.94	6.13	5.71	9.96	9.13	9.93	9.10	4.65	4.36	3.52	3.28	7.53	6.95
140	12.93	11.84	12.90	11.80	7.55	6.96	6.14	5.72	10.39	9.45	17.56	15.96	17.49	15.90	9.84	9.02	7.71	7.12	14.49	13.20
130	18.36	16.75	18.33	16.71	12.76	11.66	10.63	9.64	16.07	14.65	28.82	25.97	28.65	25.83	18.62	16.93	15.43	14.06	25.00	22.68
120	26.18	23.69	26.11	23.64	18.70	17.05	16.59	15.11	23.38	21.07	45.68	40.46	44.66	39.72	31.88	28.66	27.78	25.09	39.12	35.39

Table H-394. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
180	0.34	0.34	0.34	0.33	0.06	0.06	0.02	0.02	0.11	0.11	0.36	0.35	0.35	0.34	0.06	0.06	0.02	0.02	0.12	0.12
175	0.68	0.66	0.67	0.65	0.11	0.10	0.07	0.07	0.29	0.28	0.72	0.68	0.70	0.67	0.11	0.11	0.07	0.07	0.29	0.29
170	1.28	1.22	1.26	1.20	0.24	0.23	0.15	0.15	0.62	0.60	1.34	1.28	1.32	1.27	0.25	0.24	0.12	0.12	0.65	0.62
160	3.08	2.90	3.04	2.87	0.96	0.92	0.66	0.64	1.87	1.77	3.42	3.21	3.38	3.18	1.02	0.96	0.69	0.66	1.96	1.87
150	5.96	5.55	5.93	5.52	2.63	2.48	1.93	1.83	4.23	3.97	6.93	6.42	6.90	6.39	2.79	2.64	2.05	1.93	4.80	4.51
140	9.72	8.93	9.69	8.90	5.29	4.95	4.27	4.01	7.71	7.10	12.92	11.78	12.88	11.74	6.35	5.93	4.81	4.53	9.82	9.00
130	14.95	13.67	14.92	13.64	9.35	8.59	7.76	7.15	12.77	11.68	21.39	19.25	21.26	19.14	13.16	11.99	10.24	9.32	18.03	16.39
120	21.04	18.98	20.96	18.92	14.97	13.68	13.04	11.93	18.47	16.85	33.98	30.60	33.72	30.34	23.58	21.35	19.38	17.64	30.08	27.09

Table H-395. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.04	0.04	0.04	0.04	-	-	-	-	-	-	0.04	0.04	0.04	0.04	-	-	-	-	-	-
180	0.16	0.16	0.16	0.15	-	-	-	-	0.07	0.07	0.16	0.15	0.15	0.15	-	-	-	-	0.07	0.07
175	0.40	0.39	0.40	0.38	0.06	0.06	0.04	0.04	0.16	0.15	0.41	0.40	0.40	0.39	0.06	0.06	0.04	0.04	0.15	0.15
170	0.79	0.76	0.77	0.74	0.11	0.11	0.08	0.08	0.37	0.36	0.83	0.80	0.82	0.78	0.12	0.12	0.09	0.08	0.38	0.37
160	2.28	2.14	2.25	2.11	0.61	0.58	0.40	0.38	1.27	1.22	2.44	2.31	2.41	2.28	0.64	0.62	0.41	0.40	1.34	1.28
150	4.75	4.46	4.72	4.43	1.84	1.75	1.34	1.28	3.07	2.88	5.36	5.01	5.33	4.98	1.94	1.84	1.40	1.35	3.44	3.22
140	8.17	7.51	8.13	7.47	4.13	3.88	3.17	2.94	6.13	5.71	9.96	9.13	9.93	9.10	4.65	4.36	3.52	3.28	7.53	6.95
130	12.93	11.84	12.90	11.80	7.55	6.96	6.14	5.72	10.39	9.44	17.56	15.96	17.49	15.90	9.84	9.02	7.71	7.12	14.49	13.20
120	18.36	16.75	18.33	16.71	12.76	11.66	10.63	9.64	16.07	14.65	28.82	25.97	28.65	25.83	18.62	16.93	15.43	14.06	25.00	22.68

Table H-396. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	0.07	0.07	-	-	-	-	0.03	0.03	0.08	0.07	0.07	0.07	-	-	-	-	0.03	0.03
175	0.16	0.16	0.16	0.15	-	-	-	-	0.07	0.07	0.16	0.15	0.15	0.15	-	-	-	-	0.07	0.07
170	0.40	0.39	0.40	0.38	0.06	0.06	0.04	0.04	0.16	0.15	0.41	0.40	0.40	0.39	0.06	0.06	0.04	0.04	0.15	0.15
160	1.40	1.34	1.38	1.33	0.28	0.27	0.17	0.17	0.69	0.67	1.48	1.42	1.45	1.39	0.29	0.28	0.17	0.16	0.73	0.69
150	3.38	3.17	3.34	3.14	1.10	1.04	0.76	0.73	2.02	1.91	3.75	3.52	3.71	3.48	1.17	1.11	0.81	0.78	2.20	2.07
140	6.30	5.85	6.26	5.82	2.80	2.65	2.13	1.99	4.51	4.23	7.43	6.84	7.39	6.80	2.98	2.83	2.31	2.16	5.18	4.87
130	10.15	9.27	10.10	9.24	5.62	5.25	4.54	4.26	8.16	7.50	13.60	12.41	13.55	12.36	6.85	6.37	5.19	4.88	10.57	9.57
120	15.49	14.15	15.46	14.12	9.77	8.97	8.22	7.56	13.28	12.15	22.69	20.50	22.58	20.38	13.96	12.72	11.17	10.11	18.92	17.21

Table H-397. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	-	-	-	-	-
190	0.08	0.08	0.08	0.08	-	-	-	-	0.05	0.04	0.23	0.22	0.22	0.21	0.04	0.04	-	-	0.09	0.09
180	0.44	0.42	0.43	0.41	0.07	0.07	0.05	0.05	0.18	0.17	0.99	0.95	0.98	0.94	0.18	0.17	0.10	0.10	0.48	0.46
175	0.85	0.81	0.83	0.79	0.16	0.15	0.09	0.08	0.41	0.39	1.75	1.67	1.72	1.64	0.44	0.43	0.24	0.23	0.91	0.88
170	1.50	1.44	1.48	1.42	0.32	0.31	0.19	0.19	0.76	0.73	2.73	2.59	2.70	2.56	0.82	0.78	0.50	0.48	1.59	1.52
160	3.49	3.26	3.45	3.23	1.24	1.19	0.83	0.79	2.21	2.07	5.78	5.39	5.75	5.36	2.35	2.22	1.70	1.62	3.90	3.66
150	6.35	5.89	6.32	5.86	2.94	2.78	2.33	2.18	4.64	4.34	11.10	9.97	11.04	9.92	5.17	4.85	4.02	3.78	8.35	7.63
140	10.40	9.42	10.36	9.38	5.84	5.42	4.73	4.43	8.33	7.62	18.88	17.07	18.81	17.02	11.22	10.06	8.67	7.90	15.85	14.32
130	15.85	14.41	15.81	14.38	10.11	9.20	8.50	7.77	13.69	12.46	30.92	27.84	30.79	27.72	19.96	18.09	16.93	15.28	26.91	24.38
120	22.55	20.33	22.48	20.27	16.11	14.64	14.14	12.84	19.50	17.74	48.92	43.38	48.46	42.92	34.14	30.77	29.69	26.78	41.74	38.34

Table H-398. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.08	0.08	0.08	0.08	-	-	-	-	0.05	0.04	0.09	0.08	0.09	0.08	-	-	-	-	0.04	0.04
180	0.44	0.42	0.43	0.41	0.07	0.07	0.05	0.05	0.18	0.17	0.46	0.44	0.45	0.43	0.07	0.07	0.05	0.05	0.18	0.17
175	0.85	0.81	0.83	0.79	0.16	0.15	0.09	0.08	0.41	0.39	0.89	0.85	0.88	0.84	0.15	0.15	0.09	0.09	0.43	0.42
170	1.50	1.44	1.48	1.42	0.32	0.31	0.19	0.19	0.76	0.73	1.58	1.51	1.56	1.49	0.33	0.32	0.19	0.19	0.81	0.78
160	3.49	3.26	3.45	3.23	1.24	1.19	0.83	0.79	2.21	2.07	3.83	3.59	3.79	3.56	1.30	1.25	0.88	0.85	2.36	2.23
150	6.35	5.89	6.32	5.86	2.94	2.78	2.33	2.18	4.64	4.34	7.53	6.90	7.48	6.86	3.21	3.01	2.48	2.34	5.28	4.94
140	10.40	9.42	10.36	9.38	5.84	5.42	4.73	4.43	8.33	7.62	13.98	12.67	13.93	12.63	7.04	6.50	5.39	5.03	11.07	9.92
130	15.85	14.41	15.81	14.38	10.11	9.20	8.50	7.77	13.69	12.46	23.50	21.13	23.40	21.03	14.50	13.11	11.75	10.55	19.41	17.57
120	22.55	20.33	22.48	20.27	16.11	14.64	14.14	12.84	19.50	17.74	36.54	32.96	36.35	32.75	25.57	23.14	21.18	18.89	32.36	29.10

Table H-399. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	0.05	0.05	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	-	-	-	-	-
180	0.20	0.20	0.20	0.20	0.05	0.05	-	-	0.09	0.08	0.23	0.22	0.22	0.21	0.04	0.04	-	-	0.09	0.09
175	0.49	0.47	0.48	0.47	0.08	0.08	0.06	0.06	0.20	0.20	0.51	0.50	0.50	0.48	0.09	0.08	0.06	0.06	0.20	0.20
170	0.95	0.91	0.93	0.90	0.18	0.18	0.10	0.10	0.46	0.44	0.99	0.95	0.98	0.94	0.18	0.17	0.10	0.10	0.48	0.46
160	2.57	2.44	2.55	2.41	0.76	0.74	0.48	0.46	1.52	1.45	2.73	2.59	2.70	2.56	0.82	0.78	0.50	0.48	1.59	1.52
150	5.10	4.77	5.07	4.74	2.21	2.07	1.59	1.52	3.52	3.30	5.78	5.39	5.75	5.36	2.35	2.22	1.70	1.62	3.90	3.66
140	8.65	7.92	8.62	7.89	4.57	4.29	3.66	3.43	6.62	6.13	11.10	9.97	11.04	9.92	5.17	4.85	4.02	3.78	8.35	7.63
130	13.73	12.50	13.69	12.47	8.27	7.57	6.72	6.22	11.45	10.34	18.88	17.07	18.81	17.02	11.22	10.06	8.67	7.90	15.85	14.32
120	19.29	17.55	19.25	17.51	13.80	12.54	11.86	10.71	17.13	15.56	30.92	27.84	30.79	27.72	19.96	18.09	16.93	15.28	26.91	24.38

Table H-400. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L06 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.10	0.10	0.10	0.09	-	-	-	-	0.05	0.05	0.10	0.10	0.10	0.10	-	-	-	-	0.05	0.05
175	0.20	0.20	0.20	0.20	0.05	0.05	-	-	0.09	0.08	0.23	0.22	0.22	0.21	0.04	0.04	-	-	0.09	0.09
170	0.49	0.47	0.48	0.47	0.08	0.08	0.06	0.06	0.20	0.20	0.51	0.50	0.50	0.48	0.09	0.08	0.06	0.06	0.20	0.20
160	1.64	1.57	1.62	1.55	0.43	0.41	0.22	0.21	0.86	0.83	1.75	1.67	1.72	1.64	0.44	0.43	0.24	0.23	0.91	0.88
150	3.78	3.53	3.73	3.50	1.36	1.30	0.93	0.90	2.41	2.26	4.13	3.88	4.10	3.84	1.46	1.40	0.98	0.93	2.56	2.42
140	6.68	6.18	6.65	6.16	3.23	3.01	2.50	2.36	4.93	4.61	8.06	7.38	8.02	7.34	3.56	3.32	2.66	2.52	5.71	5.32
130	11.04	9.96	10.99	9.92	6.19	5.73	5.02	4.70	8.78	8.03	14.72	13.33	14.68	13.29	7.68	7.03	5.82	5.41	11.92	10.73
120	16.41	14.92	16.38	14.89	10.82	9.72	8.98	8.19	14.24	12.94	24.70	22.33	24.61	22.23	15.37	13.88	12.58	11.36	20.44	18.37

Table H-401. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
190	0.11	0.11	0.11	0.10	-	-	-	-	0.06	0.06	0.11	0.11	0.11	0.11	-	-	-	-	0.05	0.05
180	0.58	0.56	0.57	0.55	0.08	0.08	0.06	0.06	0.20	0.20	0.60	0.58	0.59	0.57	0.09	0.08	0.06	0.06	0.20	0.19
175	1.09	1.04	1.05	1.01	0.18	0.17	0.11	0.10	0.48	0.46	1.15	1.10	1.12	1.07	0.16	0.16	0.11	0.11	0.49	0.48
170	1.88	1.79	1.85	1.76	0.37	0.36	0.22	0.21	0.92	0.88	1.95	1.86	1.92	1.84	0.39	0.38	0.21	0.21	0.95	0.92
160	4.26	4.00	4.21	3.97	1.40	1.34	0.94	0.90	2.53	2.40	4.62	4.34	4.57	4.29	1.48	1.42	0.97	0.94	2.66	2.53
150	7.47	6.90	7.42	6.86	3.31	3.11	2.55	2.43	5.18	4.83	8.88	8.15	8.83	8.10	3.62	3.40	2.71	2.57	6.00	5.54
140	12.25	11.16	12.19	11.11	6.36	5.88	5.16	4.80	9.21	8.44	16.26	14.56	16.21	14.50	7.88	7.20	5.92	5.46	12.64	11.44
130	17.93	16.15	17.87	16.10	11.32	10.24	9.21	8.44	15.17	13.72	27.86	24.88	27.76	24.78	16.60	14.78	13.12	11.83	23.38	20.69
120	26.13	23.33	26.06	23.27	17.96	16.13	15.63	14.06	22.65	20.16	45.94	41.14	45.72	40.88	29.94	26.74	25.14	22.39	38.98	35.26

Table H-402. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	0.05	0.05	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	-	-	-	-	-
180	0.19	0.19	0.19	0.19	0.02	0.02	-	-	0.08	0.08	0.19	0.19	0.19	0.18	0.02	0.02	-	-	0.09	0.08
175	0.50	0.48	0.49	0.47	0.08	0.07	0.04	0.04	0.18	0.17	0.52	0.50	0.51	0.49	0.08	0.07	0.03	0.03	0.17	0.17
170	0.96	0.92	0.95	0.91	0.13	0.12	0.09	0.09	0.39	0.38	0.99	0.95	0.98	0.93	0.13	0.13	0.09	0.09	0.41	0.40
160	2.69	2.56	2.66	2.52	0.66	0.64	0.41	0.40	1.45	1.39	2.82	2.68	2.79	2.65	0.69	0.67	0.43	0.41	1.52	1.46
150	5.43	5.06	5.37	5.02	2.01	1.92	1.50	1.43	3.44	3.24	6.08	5.63	6.02	5.59	2.19	2.07	1.57	1.50	3.77	3.53
140	9.10	8.37	9.06	8.33	4.43	4.15	3.45	3.25	6.56	6.09	11.45	10.39	11.39	10.32	4.89	4.57	3.79	3.55	8.11	7.43
130	14.37	13.07	14.33	13.03	8.05	7.39	6.52	6.03	11.50	10.42	19.78	17.75	19.73	17.69	10.66	9.65	8.15	7.46	16.35	14.58
120	20.38	18.32	20.29	18.26	13.90	12.60	11.66	10.56	17.80	16.01	33.69	30.11	33.54	29.97	21.01	18.53	17.25	15.32	28.88	25.79

Table H-403. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
180	0.11	0.11	0.11	0.10	-	-	-	-	0.06	0.06	0.11	0.11	0.11	0.11	-	-	-	-	0.05	0.05
175	0.28	0.27	0.27	0.26	0.02	0.02	-	-	0.10	0.09	0.28	0.27	0.28	0.27	0.02	0.02	-	-	0.10	0.09
170	0.58	0.56	0.57	0.55	0.08	0.08	0.06	0.06	0.20	0.20	0.60	0.58	0.59	0.57	0.09	0.08	0.06	0.06	0.20	0.19
160	1.88	1.79	1.85	1.76	0.37	0.36	0.22	0.21	0.92	0.88	1.95	1.86	1.92	1.84	0.39	0.38	0.21	0.21	0.95	0.92
150	4.26	4.00	4.21	3.97	1.40	1.34	0.94	0.90	2.53	2.40	4.62	4.34	4.57	4.29	1.48	1.42	0.97	0.94	2.66	2.53
140	7.47	6.90	7.42	6.86	3.31	3.11	2.55	2.43	5.18	4.83	8.88	8.15	8.83	8.10	3.62	3.40	2.71	2.57	6.00	5.54
130	12.25	11.16	12.19	11.11	6.36	5.88	5.16	4.80	9.21	8.44	16.26	14.56	16.21	14.50	7.88	7.20	5.92	5.46	12.64	11.44
120	17.93	16.15	17.87	16.10	11.32	10.24	9.21	8.44	15.17	13.72	27.86	24.88	27.76	24.78	16.60	14.78	13.12	11.84	23.38	20.69

Table H-404. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
175	0.11	0.11	0.11	0.10	-	-	-	-	0.06	0.06	0.11	0.11	0.11	0.11	-	-	-	-	0.05	0.05
170	0.28	0.27	0.27	0.26	0.02	0.02	-	-	0.10	0.09	0.28	0.27	0.28	0.27	0.02	0.02	-	-	0.10	0.09
160	1.09	1.04	1.05	1.01	0.18	0.17	0.11	0.10	0.48	0.46	1.15	1.10	1.12	1.07	0.16	0.16	0.11	0.11	0.49	0.48
150	2.88	2.73	2.84	2.70	0.79	0.76	0.49	0.47	1.60	1.54	3.04	2.87	2.99	2.83	0.84	0.80	0.51	0.49	1.69	1.61
140	5.74	5.34	5.70	5.30	2.23	2.11	1.65	1.57	3.74	3.52	6.48	5.99	6.42	5.95	2.40	2.27	1.73	1.66	4.06	3.82
130	9.49	8.73	9.45	8.70	4.71	4.40	3.75	3.53	6.93	6.43	12.25	11.11	12.18	11.05	5.29	4.91	4.07	3.83	8.73	7.99
120	14.93	13.55	14.88	13.51	8.53	7.82	6.89	6.37	12.15	11.04	21.13	18.66	21.01	18.58	11.68	10.56	8.81	8.06	17.37	15.45

Table H-405. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.03	0.03	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
190	0.13	0.12	0.12	0.12	-	-	-	-	0.07	0.07	0.13	0.13	0.13	0.12	-	-	-	-	0.07	0.07
180	0.65	0.63	0.64	0.61	0.11	0.11	0.08	0.07	0.30	0.29	0.69	0.66	0.67	0.64	0.11	0.11	0.08	0.07	0.30	0.29
175	1.24	1.19	1.22	1.16	0.23	0.22	0.12	0.12	0.59	0.56	1.30	1.25	1.28	1.23	0.22	0.22	0.13	0.12	0.63	0.60
170	2.05	1.95	2.02	1.92	0.51	0.49	0.31	0.30	1.14	1.09	2.21	2.09	2.17	2.06	0.54	0.52	0.32	0.31	1.21	1.16
160	4.68	4.38	4.64	4.35	1.72	1.65	1.22	1.17	2.94	2.79	5.22	4.86	5.18	4.82	1.83	1.75	1.29	1.24	3.18	2.98
150	8.36	7.70	8.32	7.66	4.00	3.76	2.98	2.83	6.02	5.58	9.98	9.16	9.94	9.13	4.35	4.08	3.27	3.06	7.11	6.52
140	13.53	12.33	13.49	12.29	7.28	6.70	5.98	5.53	10.40	9.45	18.07	16.13	18.02	16.07	9.12	8.36	6.96	6.38	14.30	12.86
130	19.35	17.48	19.32	17.44	12.64	11.49	10.20	9.30	16.60	14.95	29.54	26.37	29.43	26.27	18.21	16.22	14.69	13.17	25.20	22.47
120	27.58	24.72	27.52	24.66	19.03	17.16	16.79	15.08	24.31	21.82	47.68	43.02	47.34	42.66	31.79	28.37	27.04	24.15	42.16	37.28

Table H-406. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.06	0.07	0.06	-	-	-	-	-	-	0.07	0.06	0.07	0.06	-	-	-	-	-	-
180	0.28	0.27	0.26	0.23	0.06	0.06	-	-	0.11	0.11	0.29	0.28	0.28	0.27	0.05	0.05	-	-	0.11	0.11
175	0.56	0.54	0.54	0.52	0.10	0.09	0.07	0.06	0.23	0.22	0.59	0.57	0.57	0.55	0.10	0.10	0.07	0.06	0.23	0.22
170	1.09	1.04	1.07	1.02	0.21	0.20	0.12	0.11	0.50	0.49	1.15	1.11	1.13	1.08	0.20	0.20	0.12	0.12	0.54	0.52
160	2.92	2.77	2.90	2.74	0.88	0.84	0.56	0.54	1.74	1.67	3.16	2.96	3.12	2.92	0.92	0.88	0.59	0.57	1.85	1.76
150	6.00	5.56	5.95	5.53	2.50	2.37	1.83	1.74	4.11	3.86	6.90	6.36	6.86	6.32	2.66	2.52	1.93	1.83	4.51	4.22
140	9.99	9.19	9.96	9.16	5.18	4.81	4.14	3.89	7.61	7.00	13.14	11.89	13.08	11.84	5.84	5.38	4.52	4.23	9.42	8.64
130	15.82	14.29	15.78	14.25	9.10	8.35	7.48	6.86	12.93	11.78	22.19	19.56	22.08	19.46	12.42	11.21	9.35	8.58	18.04	16.07
120	22.71	20.30	22.65	20.24	15.10	13.64	12.88	11.71	19.09	17.22	35.27	31.64	35.07	31.47	23.21	20.49	18.82	16.79	30.44	27.20

Table H-407. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
180	0.13	0.12	0.12	0.12	-	-	-	-	0.07	0.07	0.13	0.13	0.13	0.12	-	-	-	-	0.07	0.07
175	0.33	0.32	0.32	0.31	0.07	0.06	-	-	0.12	0.12	0.33	0.32	0.33	0.32	0.06	0.06	-	-	0.12	0.12
170	0.65	0.63	0.64	0.61	0.11	0.11	0.08	0.07	0.30	0.29	0.69	0.66	0.67	0.64	0.11	0.11	0.08	0.07	0.30	0.29
160	2.05	1.95	2.02	1.92	0.51	0.49	0.31	0.30	1.14	1.09	2.21	2.09	2.17	2.06	0.54	0.52	0.32	0.31	1.21	1.16
150	4.68	4.38	4.64	4.35	1.72	1.65	1.22	1.17	2.94	2.79	5.22	4.86	5.18	4.82	1.83	1.75	1.29	1.24	3.18	2.98
140	8.36	7.70	8.32	7.66	4.00	3.76	2.98	2.83	6.02	5.58	9.98	9.16	9.94	9.13	4.36	4.08	3.27	3.06	7.11	6.52
130	13.53	12.33	13.49	12.29	7.28	6.70	5.98	5.53	10.40	9.45	18.07	16.13	18.02	16.07	9.12	8.36	6.96	6.38	14.30	12.86
120	19.35	17.48	19.32	17.44	12.64	11.49	10.20	9.30	16.60	14.95	29.54	26.37	29.43	26.27	18.21	16.22	14.69	13.17	25.20	22.47

Table H-408. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.07	0.07	0.07	0.07	-	-	-	-	-	-	0.07	0.07	0.07	0.07	-	-	-	-	-	-
175	0.13	0.12	0.12	0.12	-	-	-	-	0.07	0.07	0.13	0.13	0.13	0.12	-	-	-	-	0.07	0.07
170	0.33	0.32	0.32	0.31	0.07	0.06	-	-	0.12	0.12	0.33	0.32	0.33	0.32	0.06	0.06	-	-	0.12	0.12
160	1.24	1.19	1.22	1.16	0.23	0.22	0.12	0.12	0.59	0.56	1.30	1.25	1.28	1.23	0.22	0.22	0.13	0.12	0.63	0.60
150	3.19	2.99	3.15	2.95	0.98	0.94	0.63	0.60	1.91	1.82	3.51	3.29	3.46	3.24	1.04	1.00	0.67	0.65	2.00	1.91
140	6.35	5.88	6.31	5.85	2.70	2.56	1.97	1.88	4.38	4.12	7.41	6.79	7.35	6.74	2.85	2.71	2.12	2.02	4.86	4.53
130	10.66	9.66	10.60	9.61	5.49	5.10	4.41	4.14	8.06	7.42	13.87	12.53	13.83	12.48	6.29	5.78	4.86	4.52	9.96	9.15
120	16.43	14.81	16.39	14.77	9.53	8.76	7.90	7.26	13.49	12.29	23.49	20.85	23.39	20.75	13.29	11.98	9.96	9.13	18.92	16.91

Table H-409. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.05	0.05	0.05	0.05	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	-	-	-	-	-
190	0.19	0.18	0.18	0.18	0.02	0.02	-	-	0.09	0.08	0.18	0.18	0.18	0.18	0.02	0.02	-	-	0.09	0.09
180	0.81	0.78	0.80	0.76	0.12	0.12	0.09	0.09	0.37	0.36	0.86	0.82	0.84	0.81	0.13	0.13	0.10	0.09	0.38	0.37
175	1.52	1.45	1.50	1.43	0.33	0.32	0.20	0.19	0.77	0.74	1.60	1.53	1.57	1.51	0.33	0.32	0.19	0.19	0.80	0.77
170	2.48	2.35	2.45	2.33	0.67	0.65	0.40	0.39	1.43	1.37	2.64	2.50	2.60	2.47	0.73	0.70	0.43	0.40	1.51	1.44
160	5.27	4.90	5.23	4.87	2.05	1.95	1.51	1.44	3.52	3.30	5.98	5.53	5.94	5.49	2.23	2.11	1.60	1.53	3.84	3.60
150	9.16	8.43	9.13	8.39	4.55	4.26	3.58	3.36	6.73	6.21	11.58	10.46	11.51	10.40	5.03	4.67	3.89	3.66	8.24	7.54
140	14.61	13.23	14.55	13.19	8.16	7.50	6.65	6.12	11.69	10.61	19.68	17.63	19.63	17.58	10.58	9.53	8.17	7.45	16.18	14.42
130	20.72	18.51	20.65	18.46	13.86	12.53	11.62	10.51	17.86	16.04	32.48	29.00	32.32	28.86	20.31	18.06	16.88	14.99	27.90	24.90
120	28.96	25.95	28.91	25.90	20.52	18.33	18.19	16.30	25.94	23.28	57.48	48.48	55.92	47.89	35.41	31.65	30.05	26.81	46.72	41.79

Table H-410. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.08	0.08	0.08	0.08	-	-	-	-	0.02	0.02	0.08	0.08	0.08	0.08	-	-	-	-	0.02	0.02
180	0.35	0.34	0.35	0.34	0.07	0.07	0.02	0.02	0.13	0.12	0.36	0.35	0.35	0.34	0.07	0.07	0.02	0.02	0.13	0.13
175	0.73	0.70	0.72	0.69	0.12	0.11	0.08	0.08	0.33	0.32	0.75	0.72	0.74	0.72	0.12	0.12	0.09	0.08	0.33	0.32
170	1.36	1.30	1.34	1.28	0.29	0.28	0.17	0.17	0.69	0.66	1.43	1.37	1.40	1.34	0.30	0.29	0.16	0.16	0.73	0.70
160	3.47	3.24	3.42	3.21	1.13	1.09	0.74	0.72	2.11	2.00	3.78	3.55	3.75	3.51	1.21	1.16	0.77	0.74	2.26	2.14
150	6.66	6.16	6.62	6.13	2.89	2.74	2.20	2.09	4.68	4.38	7.88	7.22	7.83	7.17	3.08	2.89	2.37	2.23	5.22	4.84
140	11.23	10.19	11.17	10.14	5.78	5.36	4.69	4.39	8.47	7.79	14.62	13.15	14.57	13.09	6.77	6.20	5.19	4.82	10.87	9.80
130	16.98	15.27	16.94	15.23	9.94	9.13	8.34	7.66	14.06	12.75	24.75	22.05	24.66	21.96	14.28	12.80	11.00	9.90	19.85	17.77
120	24.42	21.87	24.35	21.81	16.46	14.77	14.16	12.78	20.42	18.29	39.38	35.53	38.92	35.27	26.08	23.25	21.35	18.75	33.80	30.17

Table H-411. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	0.05	0.05	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	-	-	-	-	-
180	0.19	0.18	0.18	0.18	0.02	0.02	-	-	0.09	0.08	0.18	0.18	0.18	0.18	0.02	0.02	-	-	0.09	0.09
175	0.40	0.38	0.39	0.37	0.08	0.07	0.05	0.05	0.19	0.18	0.41	0.40	0.40	0.39	0.08	0.08	0.03	0.03	0.18	0.17
170	0.81	0.78	0.80	0.76	0.12	0.12	0.09	0.09	0.37	0.36	0.86	0.82	0.84	0.81	0.13	0.13	0.10	0.09	0.38	0.37
160	2.48	2.35	2.45	2.33	0.67	0.65	0.40	0.39	1.43	1.37	2.64	2.50	2.60	2.47	0.73	0.70	0.43	0.40	1.51	1.44
150	5.27	4.90	5.23	4.87	2.05	1.95	1.51	1.44	3.52	3.30	5.98	5.53	5.94	5.49	2.23	2.11	1.60	1.53	3.84	3.60
140	9.16	8.43	9.13	8.39	4.55	4.26	3.58	3.36	6.73	6.21	11.58	10.46	11.51	10.40	5.03	4.67	3.89	3.66	8.24	7.54
130	14.61	13.23	14.55	13.19	8.16	7.50	6.65	6.12	11.69	10.61	19.69	17.63	19.63	17.58	10.58	9.53	8.17	7.45	16.18	14.42
120	20.72	18.51	20.65	18.46	13.86	12.53	11.62	10.51	17.86	16.04	32.48	29.00	32.32	28.86	20.31	18.06	16.88	14.99	27.90	24.90

Table H-412. Monopile foundation (11 m diameter, IHC S-5500, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.09	0.09	0.09	0.09	-	-	-	-	0.04	0.04	0.09	0.09	0.09	0.09	-	-	-	-	0.03	0.03
175	0.19	0.18	0.18	0.18	0.02	0.02	-	-	0.09	0.08	0.18	0.18	0.18	0.18	0.02	0.02	-	-	0.09	0.09
170	0.40	0.38	0.39	0.37	0.08	0.07	0.05	0.05	0.19	0.18	0.41	0.40	0.40	0.39	0.08	0.08	0.03	0.03	0.18	0.17
160	1.52	1.45	1.50	1.43	0.33	0.32	0.20	0.19	0.77	0.74	1.60	1.53	1.57	1.51	0.33	0.32	0.19	0.19	0.80	0.77
150	3.77	3.53	3.73	3.50	1.27	1.22	0.84	0.80	2.35	2.21	4.10	3.85	4.06	3.82	1.34	1.29	0.88	0.84	2.48	2.35
140	7.03	6.49	6.99	6.46	3.12	2.93	2.41	2.29	4.99	4.65	8.40	7.71	8.34	7.66	3.39	3.19	2.57	2.43	5.64	5.21
130	11.85	10.77	11.79	10.72	6.14	5.67	5.01	4.65	8.93	8.20	15.44	13.84	15.39	13.79	7.33	6.67	5.59	5.15	11.79	10.63
120	17.59	15.81	17.55	15.77	10.61	9.61	8.80	8.07	14.68	13.26	25.89	23.15	25.80	23.07	15.24	13.62	11.99	10.79	21.25	18.70

Table H-413. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.07	0.06	0.07	0.06	-	-	-	-	-	-	0.07	0.06	0.07	0.06	-	-	-	-	-	-
190	0.31	0.30	0.31	0.30	0.07	0.06	0.02	0.02	0.12	0.12	0.32	0.31	0.31	0.30	0.06	0.06	0.02	0.02	0.12	0.12
180	1.28	1.23	1.26	1.21	0.24	0.24	0.13	0.13	0.59	0.57	1.34	1.28	1.32	1.26	0.24	0.23	0.13	0.13	0.63	0.60
175	2.11	2.00	2.07	1.97	0.54	0.52	0.33	0.32	1.19	1.14	2.24	2.13	2.21	2.10	0.57	0.55	0.34	0.33	1.26	1.20
170	3.23	3.02	3.18	2.98	1.04	0.99	0.72	0.68	1.93	1.84	3.52	3.30	3.47	3.26	1.15	1.10	0.77	0.74	2.05	1.94
160	6.32	5.86	6.28	5.83	2.77	2.62	2.09	1.98	4.35	4.08	7.20	6.63	7.16	6.59	2.92	2.77	2.26	2.14	4.79	4.47
150	10.26	9.37	10.20	9.32	5.56	5.16	4.50	4.22	7.93	7.30	13.27	12.07	13.21	12.02	6.28	5.79	4.98	4.63	9.64	8.82
140	15.99	14.52	15.95	14.48	9.58	8.80	8.08	7.44	13.25	12.10	23.36	20.95	23.26	20.85	13.07	11.82	9.89	9.04	18.84	16.98
130	23.71	21.29	23.64	21.22	15.92	14.44	13.64	12.44	19.78	17.96	37.93	34.37	37.70	34.11	25.66	23.03	20.70	18.61	33.02	29.56
120	32.33	29.01	32.25	28.94	24.52	22.11	21.14	18.90	29.32	26.33	77.26	60.92	75.07	59.28	47.58	42.22	41.84	36.81	65.68	52.52

Table H-414. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.11	0.11	0.11	0.11	-	-	-	-	0.06	0.06	0.12	0.11	0.11	0.11	-	-	-	-	0.06	0.06
180	0.57	0.55	0.56	0.54	0.10	0.10	0.07	0.07	0.23	0.23	0.59	0.57	0.58	0.56	0.11	0.10	0.07	0.07	0.23	0.22
175	1.14	1.08	1.11	1.06	0.22	0.22	0.12	0.12	0.53	0.51	1.19	1.14	1.17	1.12	0.22	0.21	0.13	0.12	0.56	0.54
170	1.91	1.83	1.89	1.81	0.49	0.47	0.29	0.28	1.01	0.96	2.00	1.91	1.97	1.89	0.51	0.49	0.30	0.29	1.11	1.06
160	4.38	4.12	4.34	4.08	1.64	1.57	1.17	1.13	2.77	2.62	4.84	4.51	4.78	4.47	1.74	1.67	1.25	1.20	2.90	2.76
150	7.81	7.22	7.76	7.17	3.81	3.56	2.90	2.75	5.60	5.21	9.16	8.40	9.12	8.36	4.11	3.86	3.12	2.91	6.41	5.91
140	12.61	11.53	12.56	11.48	6.94	6.43	5.76	5.34	9.65	8.87	16.74	15.04	16.67	14.98	8.36	7.64	6.53	6.02	12.94	11.75
130	18.53	16.78	18.48	16.74	12.06	10.97	9.81	9.02	15.75	14.31	28.70	25.62	28.58	25.52	17.28	15.55	13.77	12.42	24.20	21.71
120	27.20	24.40	27.13	24.34	18.78	17.01	16.43	14.86	23.93	21.56	47.36	42.58	46.94	42.15	32.17	28.81	27.60	24.72	42.10	37.17

Table H-415. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.06	0.07	0.06	-	-	-	-	-	-	0.07	0.06	0.07	0.06	-	-	-	-	-	-
180	0.31	0.30	0.31	0.30	0.07	0.06	0.02	0.02	0.12	0.12	0.32	0.31	0.31	0.30	0.06	0.06	0.02	0.02	0.12	0.12
175	0.65	0.62	0.63	0.61	0.11	0.11	0.08	0.08	0.29	0.28	0.70	0.66	0.66	0.64	0.12	0.12	0.08	0.08	0.30	0.29
170	1.28	1.23	1.26	1.21	0.24	0.24	0.13	0.13	0.59	0.57	1.34	1.28	1.32	1.26	0.24	0.23	0.13	0.13	0.63	0.60
160	3.23	3.02	3.18	2.98	1.04	0.99	0.72	0.68	1.93	1.84	3.52	3.30	3.47	3.26	1.15	1.10	0.77	0.74	2.05	1.94
150	6.32	5.86	6.28	5.83	2.77	2.62	2.09	1.98	4.35	4.08	7.20	6.63	7.16	6.59	2.92	2.77	2.26	2.14	4.79	4.47
140	10.26	9.37	10.20	9.32	5.56	5.16	4.50	4.22	7.93	7.30	13.27	12.07	13.21	12.02	6.28	5.79	4.98	4.63	9.64	8.82
130	15.99	14.52	15.95	14.48	9.58	8.80	8.08	7.44	13.25	12.10	23.36	20.95	23.26	20.85	13.07	11.82	9.89	9.04	18.84	16.98
120	23.71	21.29	23.64	21.22	15.92	14.44	13.64	12.44	19.78	17.96	37.93	34.37	37.70	34.11	25.66	23.03	20.70	18.61	33.02	29.56

Table H-416. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location R3-L07 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
180	0.12	0.12	0.12	0.12	-	-	-	-	0.07	0.06	0.13	0.12	0.12	0.12	-	-	-	-	0.07	0.06
175	0.31	0.30	0.31	0.30	0.07	0.06	0.02	0.02	0.12	0.12	0.32	0.31	0.31	0.30	0.06	0.06	0.02	0.02	0.12	0.12
170	0.65	0.62	0.63	0.61	0.11	0.11	0.08	0.08	0.29	0.28	0.70	0.66	0.66	0.64	0.12	0.12	0.08	0.08	0.30	0.29
160	2.11	2.00	2.07	1.97	0.54	0.52	0.33	0.32	1.19	1.14	2.24	2.13	2.21	2.10	0.57	0.55	0.34	0.33	1.26	1.20
150	4.68	4.38	4.64	4.35	1.80	1.72	1.30	1.25	2.95	2.79	5.19	4.84	5.15	4.80	1.91	1.82	1.36	1.31	3.18	2.98
140	8.22	7.59	8.19	7.55	4.05	3.81	3.12	2.92	5.95	5.53	9.64	8.85	9.59	8.81	4.41	4.13	3.42	3.20	6.84	6.32
130	13.12	12.00	13.07	11.96	7.38	6.80	6.11	5.65	10.09	9.25	17.71	15.89	17.63	15.83	8.97	8.18	6.96	6.41	13.81	12.52
120	19.13	17.35	19.09	17.31	12.68	11.55	10.40	9.44	16.45	14.92	30.03	26.82	29.90	26.70	18.40	16.59	14.79	13.34	25.67	23.00

Table H-417. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.11	0.11	0.11	0.11	-	-	-	-	0.05	0.05	0.11	0.11	0.11	0.11	-	-	-	-	0.05	0.05
180	0.57	0.55	0.56	0.53	0.09	0.09	0.06	0.06	0.22	0.21	0.60	0.57	0.58	0.56	0.09	0.09	0.06	0.06	0.21	0.20
175	1.10	1.04	1.07	1.01	0.18	0.18	0.11	0.11	0.45	0.44	1.16	1.10	1.12	1.06	0.14	0.14	0.11	0.11	0.46	0.44
170	1.91	1.81	1.88	1.78	0.39	0.37	0.23	0.23	0.94	0.90	1.97	1.88	1.95	1.85	0.40	0.38	0.23	0.22	0.97	0.93
160	4.38	4.11	4.34	4.07	1.44	1.38	0.97	0.93	2.62	2.48	4.74	4.45	4.70	4.40	1.53	1.46	1.01	0.97	2.74	2.60
150	7.85	7.28	7.79	7.23	3.51	3.28	2.66	2.53	5.41	5.07	9.18	8.52	9.14	8.47	3.78	3.56	2.81	2.67	6.12	5.74
140	12.97	11.82	12.93	11.78	6.68	6.24	5.41	5.07	9.64	8.94	16.82	15.10	16.75	15.04	8.00	7.41	6.02	5.65	12.94	11.79
130	19.19	17.02	19.13	16.98	12.08	11.02	9.64	8.94	16.12	14.51	28.68	25.47	28.58	25.37	16.48	14.93	13.12	11.97	23.99	21.09
120	27.74	24.63	27.69	24.57	19.12	16.95	16.50	14.81	24.68	21.64	46.14	41.49	45.90	41.18	30.07	26.77	25.32	22.41	40.72	35.81

Table H-418. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.05	0.05	0.05	0.05	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	-	-	-	-	-
180	0.20	0.19	0.20	0.19	-	-	-	-	0.09	0.09	0.20	0.19	0.19	0.18	-	-	-	-	0.09	0.09
175	0.48	0.46	0.46	0.44	0.08	0.08	0.02	0.02	0.18	0.18	0.49	0.47	0.48	0.46	0.08	0.08	0.02	0.02	0.15	0.14
170	0.97	0.93	0.96	0.91	0.13	0.13	0.09	0.09	0.40	0.38	1.00	0.95	0.98	0.94	0.13	0.13	0.10	0.10	0.40	0.39
160	2.74	2.60	2.71	2.56	0.66	0.64	0.41	0.40	1.49	1.42	2.88	2.72	2.84	2.69	0.71	0.68	0.42	0.41	1.56	1.49
150	5.62	5.25	5.58	5.20	2.12	2.01	1.56	1.48	3.59	3.38	6.26	5.84	6.20	5.79	2.26	2.14	1.64	1.57	3.88	3.66
140	9.52	8.81	9.47	8.77	4.63	4.34	3.66	3.44	6.89	6.43	12.02	10.94	11.95	10.88	5.06	4.75	3.95	3.72	8.33	7.74
130	15.20	13.77	15.14	13.72	8.49	7.88	6.85	6.39	12.29	11.21	20.91	18.32	20.80	18.25	10.85	9.90	8.26	7.64	16.53	14.93
120	22.76	19.68	22.69	19.61	14.65	13.29	12.39	11.30	19.03	16.88	34.33	30.80	34.16	30.63	21.35	18.69	17.09	15.41	29.32	26.07

Table H-419. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.11	0.11	0.11	0.11	-	-	-	-	0.05	0.05	0.11	0.11	0.11	0.11	-	-	-	-	0.05	0.05
175	0.23	0.22	0.22	0.21	0.02	0.02	-	-	0.10	0.10	0.26	0.24	0.22	0.21	0.02	0.02	-	-	0.11	0.10
170	0.57	0.55	0.56	0.53	0.09	0.09	0.06	0.06	0.22	0.21	0.60	0.57	0.58	0.56	0.09	0.09	0.06	0.06	0.21	0.20
160	1.91	1.81	1.88	1.78	0.39	0.37	0.23	0.23	0.94	0.90	1.97	1.88	1.95	1.85	0.40	0.38	0.23	0.22	0.97	0.93
150	4.38	4.11	4.34	4.07	1.44	1.38	0.97	0.93	2.62	2.48	4.74	4.45	4.70	4.40	1.53	1.46	1.01	0.97	2.74	2.60
140	7.85	7.28	7.79	7.23	3.51	3.28	2.66	2.53	5.41	5.07	9.18	8.52	9.14	8.47	3.78	3.56	2.81	2.67	6.12	5.74
130	12.97	11.82	12.93	11.78	6.68	6.24	5.41	5.07	9.64	8.94	16.82	15.10	16.75	15.04	8.00	7.41	6.02	5.65	12.94	11.79
120	19.19	17.02	19.13	16.98	12.08	11.02	9.64	8.94	16.12	14.51	28.68	25.47	28.58	25.37	16.48	14.93	13.12	11.97	23.99	21.09

Table H-420. Monopile foundation (11 m diameter, IHC S-5500, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
175	0.11	0.11	0.11	0.11	-	-	-	-	0.05	0.05	0.11	0.11	0.11	0.11	-	-	-	-	0.05	0.05
170	0.23	0.22	0.22	0.21	0.02	0.02	-	-	0.10	0.10	0.26	0.24	0.22	0.21	0.02	0.02	-	-	0.11	0.10
160	1.10	1.04	1.07	1.01	0.18	0.18	0.11	0.11	0.45	0.44	1.16	1.10	1.12	1.06	0.14	0.14	0.11	0.11	0.46	0.44
150	2.93	2.78	2.90	2.75	0.76	0.73	0.46	0.45	1.65	1.57	3.12	2.93	3.07	2.88	0.82	0.78	0.47	0.46	1.72	1.64
140	5.96	5.56	5.90	5.51	2.32	2.20	1.70	1.62	3.90	3.67	6.66	6.22	6.62	6.17	2.48	2.36	1.80	1.72	4.20	3.96
130	9.91	9.17	9.87	9.13	4.94	4.62	3.95	3.72	7.33	6.81	12.78	11.62	12.71	11.57	5.44	5.10	4.25	4.00	8.95	8.30
120	15.84	14.28	15.78	14.24	8.98	8.32	7.28	6.77	12.90	11.77	22.35	19.42	22.24	19.32	11.79	10.79	8.92	8.25	17.65	15.80

Table H-421. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
190	0.13	0.13	0.13	0.13	-	-	-	-	0.07	0.07	0.13	0.13	0.13	0.13	-	-	-	-	0.07	0.07
180	0.70	0.66	0.68	0.65	0.11	0.11	0.08	0.08	0.29	0.28	0.73	0.69	0.72	0.68	0.12	0.11	0.08	0.08	0.31	0.30
175	1.33	1.26	1.30	1.23	0.24	0.23	0.13	0.12	0.62	0.60	1.39	1.33	1.36	1.30	0.24	0.23	0.13	0.13	0.66	0.64
170	2.22	2.10	2.19	2.07	0.52	0.50	0.33	0.31	1.22	1.16	2.35	2.23	2.31	2.19	0.56	0.54	0.33	0.32	1.27	1.21
160	4.94	4.62	4.90	4.58	1.81	1.73	1.28	1.22	3.07	2.89	5.46	5.11	5.40	5.06	1.90	1.81	1.35	1.30	3.34	3.14
150	8.80	8.15	8.75	8.11	4.16	3.91	3.16	2.96	6.26	5.84	10.61	9.65	10.52	9.59	4.48	4.21	3.40	3.20	7.29	6.78
140	14.24	12.94	14.20	12.90	7.62	7.07	6.18	5.77	11.09	10.08	18.84	16.76	18.77	16.70	9.37	8.64	7.08	6.58	14.66	13.35
130	20.85	18.23	20.77	18.18	13.35	12.15	10.92	9.96	17.63	15.72	30.95	27.55	30.83	27.43	18.65	16.71	14.88	13.58	26.24	23.32
120	29.03	25.86	28.97	25.80	20.46	18.03	17.91	15.96	25.96	23.05	50.66	45.61	49.73	45.18	32.86	29.49	27.78	24.78	44.62	39.41

Table H-422. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.06	0.07	0.06	-	-	-	-	-	-	0.07	0.06	0.07	0.06	-	-	-	-	-	-
180	0.28	0.27	0.24	0.24	0.05	0.05	-	-	0.11	0.11	0.29	0.28	0.28	0.27	0.05	0.05	-	-	0.12	0.11
175	0.60	0.57	0.58	0.56	0.11	0.10	0.07	0.07	0.24	0.23	0.63	0.60	0.61	0.59	0.11	0.11	0.07	0.07	0.24	0.23
170	1.18	1.12	1.16	1.10	0.22	0.22	0.12	0.12	0.53	0.51	1.24	1.18	1.22	1.16	0.21	0.21	0.12	0.12	0.57	0.55
160	3.10	2.91	3.05	2.87	0.95	0.91	0.57	0.55	1.84	1.75	3.37	3.16	3.32	3.12	0.99	0.95	0.62	0.60	1.93	1.84
150	6.30	5.88	6.26	5.84	2.61	2.48	1.91	1.82	4.29	4.03	7.20	6.70	7.14	6.65	2.74	2.61	1.99	1.90	4.64	4.36
140	10.76	9.77	10.69	9.71	5.34	5.00	4.30	4.04	7.95	7.38	13.69	12.43	13.63	12.38	5.92	5.55	4.64	4.36	9.68	8.95
130	16.73	14.99	16.68	14.95	9.47	8.78	7.81	7.25	13.60	12.38	23.55	20.60	23.44	20.50	12.73	11.62	9.60	8.85	18.62	16.64
120	24.53	21.54	24.47	21.47	15.98	14.42	13.60	12.39	20.43	18.01	38.66	33.95	38.28	33.72	24.06	21.25	19.22	17.22	31.78	28.37

Table H-423. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
180	0.13	0.13	0.13	0.13	-	-	-	-	0.07	0.07	0.13	0.13	0.13	0.13	-	-	-	-	0.07	0.07
175	0.35	0.33	0.34	0.33	0.07	0.06	-	-	0.12	0.12	0.35	0.33	0.34	0.33	0.07	0.06	-	-	0.13	0.12
170	0.70	0.66	0.68	0.65	0.11	0.11	0.08	0.08	0.29	0.28	0.73	0.69	0.72	0.68	0.12	0.11	0.08	0.08	0.31	0.30
160	2.22	2.10	2.19	2.07	0.52	0.50	0.33	0.31	1.22	1.16	2.35	2.23	2.31	2.19	0.56	0.54	0.33	0.32	1.27	1.21
150	4.94	4.62	4.90	4.58	1.81	1.73	1.28	1.22	3.07	2.89	5.46	5.11	5.40	5.06	1.90	1.81	1.35	1.30	3.34	3.14
140	8.80	8.15	8.75	8.11	4.16	3.91	3.16	2.96	6.26	5.84	10.61	9.65	10.52	9.59	4.48	4.21	3.40	3.20	7.29	6.78
130	14.24	12.94	14.20	12.90	7.62	7.07	6.18	5.77	11.09	10.08	18.84	16.76	18.77	16.70	9.37	8.64	7.08	6.58	14.66	13.35
120	20.85	18.23	20.77	18.18	13.35	12.15	10.92	9.96	17.63	15.72	30.95	27.55	30.83	27.43	18.65	16.71	14.88	13.58	26.24	23.32

Table H-424. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.08	0.07	0.08	0.07	-	-	-	-	-	-	0.08	0.07	0.08	0.07	-	-	-	-	-	-
175	0.13	0.13	0.13	0.13	-	-	-	-	0.07	0.07	0.13	0.13	0.13	0.13	-	-	-	-	0.07	0.07
170	0.35	0.33	0.34	0.33	0.07	0.06	-	-	0.12	0.12	0.35	0.33	0.34	0.33	0.07	0.06	-	-	0.13	0.12
160	1.33	1.26	1.30	1.23	0.24	0.23	0.13	0.12	0.62	0.60	1.39	1.33	1.36	1.30	0.24	0.23	0.13	0.13	0.66	0.64
150	3.43	3.21	3.38	3.17	1.06	1.01	0.66	0.63	2.00	1.91	3.71	3.49	3.66	3.44	1.13	1.08	0.71	0.68	2.12	2.02
140	6.68	6.22	6.62	6.18	2.81	2.67	2.10	1.99	4.58	4.29	7.74	7.19	7.68	7.14	2.94	2.80	2.21	2.10	4.98	4.69
130	11.43	10.38	11.37	10.32	5.68	5.31	4.58	4.30	8.41	7.81	14.40	13.08	14.35	13.03	6.39	5.97	4.96	4.66	10.37	9.51
120	17.40	15.53	17.36	15.49	9.91	9.19	8.26	7.67	14.20	12.90	24.77	21.83	24.68	21.73	13.60	12.39	10.32	9.41	19.57	17.47

Table H-425. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.04	0.04	0.04	0.04	-	-	-	-	-	-	0.04	0.04	0.04	0.04	-	-	-	-	-	-
190	0.16	0.16	0.15	0.14	-	-	-	-	0.08	0.08	0.15	0.14	0.14	0.14	-	-	-	-	0.09	0.08
180	0.81	0.77	0.78	0.74	0.13	0.12	0.09	0.09	0.37	0.36	0.86	0.82	0.81	0.77	0.13	0.13	0.09	0.09	0.38	0.36
175	1.55	1.48	1.53	1.46	0.30	0.29	0.18	0.18	0.74	0.72	1.63	1.55	1.60	1.53	0.31	0.30	0.15	0.14	0.77	0.74
170	2.55	2.41	2.52	2.38	0.65	0.63	0.40	0.39	1.46	1.39	2.66	2.53	2.64	2.51	0.70	0.67	0.41	0.40	1.51	1.44
160	5.40	5.05	5.36	5.01	2.06	1.95	1.50	1.44	3.55	3.33	6.06	5.67	6.02	5.62	2.19	2.08	1.59	1.51	3.82	3.60
150	9.43	8.72	9.39	8.69	4.56	4.29	3.60	3.37	6.84	6.38	11.86	10.79	11.79	10.72	4.96	4.67	3.87	3.65	8.22	7.65
140	15.15	13.72	15.09	13.67	8.42	7.80	6.75	6.30	12.22	11.11	20.52	18.04	20.41	17.98	10.50	9.59	8.05	7.46	16.30	14.69
130	22.58	19.50	22.50	19.44	14.45	13.14	12.22	11.11	18.90	16.77	33.56	29.98	33.43	29.85	20.52	18.10	16.59	14.97	28.51	25.30
120	30.68	27.24	30.62	27.17	22.59	19.54	19.27	17.11	27.55	24.46	58.19	49.16	56.96	48.72	35.40	31.96	29.98	26.66	46.72	42.16

Table H-426. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.08	0.07	0.08	0.07	-	-	-	-	-	-	0.08	0.08	0.08	0.08	-	-	-	-	-	-
180	0.36	0.34	0.35	0.34	0.07	0.06	-	-	0.13	0.12	0.36	0.34	0.35	0.34	0.07	0.06	-	-	0.13	0.13
175	0.72	0.69	0.71	0.68	0.12	0.11	0.08	0.08	0.31	0.30	0.74	0.71	0.74	0.70	0.12	0.12	0.08	0.08	0.32	0.31
170	1.41	1.33	1.38	1.31	0.25	0.24	0.13	0.13	0.67	0.64	1.46	1.39	1.44	1.37	0.25	0.24	0.14	0.13	0.71	0.68
160	3.56	3.33	3.52	3.29	1.13	1.08	0.69	0.67	2.12	2.00	3.85	3.62	3.80	3.57	1.19	1.14	0.74	0.70	2.24	2.12
150	6.84	6.38	6.80	6.34	2.90	2.74	2.19	2.07	4.72	4.42	7.99	7.42	7.95	7.38	3.06	2.89	2.32	2.20	5.18	4.87
140	11.75	10.67	11.70	10.62	5.86	5.47	4.72	4.42	8.70	8.06	14.85	13.49	14.79	13.44	6.69	6.24	5.13	4.82	10.95	1-
130	17.85	15.88	17.80	15.83	10.44	9.53	8.60	7.97	14.63	13.28	25.68	22.64	25.59	22.55	14.17	12.89	10.86	9.90	20.47	18.04
120	25.89	22.92	25.83	22.86	17.44	15.55	14.79	13.41	22.43	19.39	42.04	37.04	41.84	36.85	26.23	23.25	21.35	18.66	34.42	30.90

Table H-427. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.04	0.04	0.04	0.04	-	-	-	-	-	-	0.04	0.04	0.04	0.04	-	-	-	-	-	-
180	0.16	0.16	0.15	0.14	-	-	-	-	0.08	0.08	0.15	0.14	0.14	0.14	-	-	-	-	0.09	0.08
175	0.40	0.38	0.40	0.38	0.08	0.07	0.02	0.02	0.13	0.13	0.41	0.39	0.40	0.38	0.08	0.07	0.02	0.02	0.14	0.14
170	0.81	0.77	0.78	0.74	0.13	0.12	0.09	0.09	0.37	0.36	0.86	0.82	0.81	0.77	0.13	0.13	0.09	0.09	0.38	0.36
160	2.55	2.41	2.52	2.38	0.65	0.63	0.40	0.39	1.46	1.39	2.66	2.53	2.64	2.51	0.70	0.67	0.41	0.40	1.51	1.44
150	5.40	5.05	5.36	5.01	2.06	1.95	1.50	1.44	3.55	3.33	6.06	5.67	6.02	5.62	2.19	2.08	1.59	1.51	3.82	3.60
140	9.43	8.72	9.39	8.69	4.56	4.29	3.60	3.37	6.84	6.38	11.86	10.79	11.79	10.72	4.96	4.67	3.87	3.65	8.22	7.65
130	15.15	13.72	15.09	13.67	8.42	7.80	6.75	6.30	12.22	11.11	20.52	18.04	20.41	17.98	10.50	9.59	8.05	7.46	16.30	14.69
120	22.58	19.50	22.50	19.44	14.45	13.14	12.22	11.11	18.90	16.77	33.56	29.98	33.43	29.85	20.52	18.10	16.59	14.97	28.51	25.30

Table H-428. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.09	0.09	0.09	0.08	-	-	-	-	0.02	0.02	0.09	0.09	0.09	0.09	-	-	-	-	0.02	0.02
175	0.16	0.16	0.15	0.14	-	-	-	-	0.08	0.08	0.15	0.14	0.14	0.14	-	-	-	-	0.09	0.08
170	0.40	0.38	0.40	0.38	0.08	0.07	0.02	0.02	0.13	0.13	0.41	0.39	0.40	0.38	0.08	0.07	0.02	0.02	0.14	0.14
160	1.55	1.48	1.53	1.46	0.30	0.29	0.18	0.18	0.74	0.72	1.63	1.55	1.60	1.53	0.31	0.30	0.15	0.14	0.77	0.74
150	3.86	3.62	3.82	3.58	1.24	1.19	0.80	0.77	2.35	2.22	4.16	3.92	4.13	3.88	1.32	1.26	0.86	0.80	2.49	2.36
140	7.26	6.74	7.21	6.70	3.13	2.93	2.40	2.28	5.04	4.71	8.53	7.91	8.47	7.87	3.38	3.18	2.55	2.43	5.59	5.25
130	12.36	11.23	12.30	11.18	6.23	5.81	5.02	4.69	9.15	8.49	15.74	14.20	15.65	14.15	7.22	6.71	5.50	5.17	11.88	10.83
120	18.51	16.42	18.45	16.38	11.20	10.19	9.07	8.41	15.30	13.84	26.84	23.76	26.75	23.68	15.05	13.71	11.81	10.80	21.95	19.07

Table H-429. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.07	0.06	0.06	0.06	-	-	-	-	-	-	0.07	0.06	0.06	0.06	-	-	-	-	-	-
190	0.24	0.23	0.24	0.23	0.05	0.05	-	-	0.11	0.11	0.28	0.27	0.24	0.23	0.05	0.05	-	-	0.12	0.11
180	1.15	1.09	1.13	1.07	0.23	0.22	0.12	0.11	0.56	0.54	1.21	1.16	1.19	1.14	0.22	0.21	0.12	0.12	0.59	0.57
175	1.96	1.87	1.94	1.85	0.46	0.44	0.26	0.25	1.05	1.00	2.05	1.94	2.02	1.92	0.46	0.45	0.26	0.25	1.12	1.06
170	3.01	2.85	2.99	2.83	0.96	0.92	0.59	0.57	1.85	1.76	3.27	3.07	3.23	3.03	0.98	0.94	0.63	0.60	1.93	1.84
160	6.22	5.81	6.18	5.77	2.62	2.49	1.92	1.83	4.28	4.02	6.96	6.51	6.90	6.46	2.74	2.61	1.99	1.90	4.62	4.35
150	10.49	9.57	10.44	9.52	5.48	5.12	4.36	4.10	7.99	7.42	13.51	12.29	13.45	12.23	6.04	5.67	4.72	4.44	9.57	8.89
140	16.75	15.04	16.69	15.00	9.60	8.90	8.02	7.45	13.75	12.49	24.23	21.18	24.12	21.08	12.81	11.70	9.55	8.84	19.10	16.98
130	25.02	22.08	24.96	22.02	16.33	14.70	13.80	12.56	21.18	18.48	39.80	34.82	39.56	34.64	24.63	21.64	19.53	17.40	32.58	29.00
120	33.45	29.94	33.36	29.87	25.18	22.18	21.76	18.86	30.11	26.78	68.24	55.92	67.56	55.38	42.74	37.35	34.55	31.02	53.89	47.46

Table H-430. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.11	0.10	0.11	0.10	-	-	-	-	0.06	0.06	0.11	0.11	0.11	0.10	-	-	-	-	0.05	0.05
180	0.51	0.49	0.50	0.48	0.09	0.09	0.06	0.06	0.23	0.22	0.54	0.52	0.52	0.50	0.09	0.09	0.06	0.06	0.22	0.21
175	1.02	0.96	1.00	0.95	0.20	0.19	0.11	0.11	0.44	0.43	1.06	1.01	1.04	0.99	0.18	0.17	0.11	0.11	0.46	0.44
170	1.81	1.73	1.79	1.70	0.40	0.38	0.24	0.23	0.96	0.92	1.89	1.80	1.87	1.78	0.40	0.38	0.23	0.23	0.99	0.95
160	4.25	4.00	4.21	3.97	1.49	1.43	1.00	0.95	2.64	2.51	4.59	4.32	4.55	4.28	1.58	1.50	1.04	0.99	2.77	2.63
150	7.81	7.24	7.75	7.20	3.63	3.41	2.74	2.60	5.56	5.21	9.04	8.41	8.99	8.36	3.91	3.68	2.86	2.72	6.21	5.82
140	13.02	11.86	12.98	11.82	6.92	6.47	5.64	5.29	9.77	9.06	17.13	15.31	17.05	15.25	8.06	7.49	6.24	5.85	13.08	11.93
130	19.47	17.33	19.43	17.29	12.27	11.18	9.76	9.06	16.45	14.81	29.16	25.82	29.04	25.72	16.78	15.11	13.15	12.02	24.47	21.45
120	28.16	25.08	28.09	25.02	19.35	17.20	16.69	14.97	25.09	22.12	46.46	41.58	46.28	41.36	30.14	26.74	25.39	22.39	41.18	35.99

Table H-431. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.06	0.06	0.06	-	-	-	-	-	-	0.07	0.06	0.06	0.06	-	-	-	-	-	-
180	0.24	0.23	0.24	0.23	0.05	0.05	-	-	0.11	0.11	0.28	0.27	0.24	0.23	0.05	0.05	-	-	0.12	0.11
175	0.60	0.57	0.58	0.56	0.10	0.09	0.07	0.07	0.24	0.24	0.62	0.59	0.61	0.58	0.11	0.10	0.07	0.06	0.24	0.24
170	1.15	1.09	1.13	1.07	0.23	0.22	0.12	0.11	0.56	0.54	1.21	1.16	1.19	1.14	0.22	0.21	0.12	0.12	0.59	0.57
160	3.01	2.85	2.99	2.83	0.96	0.92	0.59	0.57	1.85	1.76	3.27	3.07	3.23	3.03	0.98	0.94	0.63	0.60	1.93	1.84
150	6.22	5.81	6.18	5.77	2.62	2.49	1.92	1.83	4.28	4.02	6.96	6.51	6.90	6.46	2.74	2.61	1.99	1.90	4.62	4.35
140	10.49	9.57	10.44	9.52	5.48	5.12	4.36	4.10	7.99	7.42	13.51	12.29	13.45	12.23	6.04	5.67	4.72	4.44	9.57	8.89
130	16.75	15.04	16.69	15.00	9.60	8.90	8.02	7.45	13.75	12.49	24.23	21.18	24.12	21.08	12.81	11.70	9.55	8.84	19.10	16.98
120	25.02	22.08	24.96	22.02	16.33	14.70	13.80	12.56	21.18	18.48	39.80	34.82	39.56	34.64	24.63	21.64	19.53	17.40	32.58	29.00

Table H-432. Monopile foundation (11 m diameter, IHC S-5500, 1500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180	0.12	0.11	0.11	0.11	-	-	-	-	0.07	0.06	0.12	0.12	0.12	0.11	-	-	-	-	0.06	0.06
175	0.24	0.23	0.24	0.23	0.05	0.05	-	-	0.11	0.11	0.28	0.27	0.24	0.23	0.05	0.05	-	-	0.12	0.11
170	0.60	0.57	0.58	0.56	0.10	0.09	0.07	0.07	0.24	0.24	0.62	0.59	0.61	0.58	0.11	0.10	0.07	0.06	0.24	0.24
160	1.96	1.87	1.94	1.85	0.46	0.44	0.26	0.25	1.05	1.00	2.05	1.94	2.02	1.92	0.46	0.45	0.26	0.25	1.12	1.06
150	4.54	4.27	4.50	4.24	1.66	1.58	1.12	1.08	2.85	2.70	4.94	4.65	4.90	4.61	1.73	1.65	1.18	1.13	2.98	2.83
140	8.23	7.63	8.19	7.59	3.91	3.68	2.92	2.77	5.92	5.54	9.57	8.89	9.53	8.85	4.21	3.97	3.12	2.93	6.66	6.24
130	13.59	12.36	13.55	12.31	7.36	6.85	6.00	5.61	10.38	9.49	18.15	16.14	18.08	16.08	8.68	8.06	6.68	6.25	13.94	12.70
120	20.17	17.89	20.09	17.85	12.91	11.77	10.35	9.49	17.23	15.42	30.52	27.01	30.40	26.92	17.95	16.04	14.07	12.84	25.73	22.70

Table H-433. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.08	0.07	0.07	0.07	-	-	-	-	-	-	0.08	0.07	0.07	0.07	-	-	-	-	-	-
190	0.36	0.35	0.36	0.34	0.07	0.07	0.02	0.02	0.13	0.12	0.37	0.35	0.36	0.34	0.07	0.07	0.02	0.02	0.13	0.13
180	1.42	1.35	1.40	1.33	0.26	0.25	0.13	0.13	0.66	0.64	1.48	1.41	1.46	1.39	0.31	0.30	0.14	0.13	0.69	0.67
175	2.32	2.21	2.29	2.18	0.59	0.57	0.37	0.35	1.31	1.25	2.42	2.30	2.38	2.27	0.63	0.60	0.37	0.36	1.37	1.31
170	3.49	3.29	3.45	3.25	1.14	1.09	0.75	0.72	2.10	2.00	3.75	3.54	3.70	3.50	1.20	1.15	0.74	0.72	2.19	2.09
160	6.70	6.25	6.64	6.21	2.92	2.77	2.23	2.13	4.70	4.41	7.61	7.09	7.55	7.04	3.06	2.90	2.34	2.24	5.10	4.79
150	11.31	10.29	11.26	10.24	5.94	5.56	4.78	4.50	8.54	7.93	14.54	13.23	14.47	13.18	6.61	6.18	5.20	4.88	10.55	9.69
140	17.57	15.75	17.51	15.71	10.20	9.38	8.57	7.96	14.45	13.16	26.07	23.05	25.98	22.96	14.17	12.94	10.73	9.80	20.97	18.38
130	25.94	23.12	25.89	23.07	17.21	15.47	14.57	13.26	22.44	19.58	43.66	38.16	43.46	37.97	27.04	24.03	22.17	19.33	35.98	32.16
120	34.50	31.16	34.42	31.08	26.13	23.28	22.99	20.13	31.17	27.85	77.28	63.43	76.40	62.70	47.14	41.83	41.28	35.74	66.31	54.31

Table H-434. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.12	0.12	0.12	0.12	-	-	-	-	0.07	0.06	0.13	0.12	0.12	0.12	-	-	-	-	0.07	0.06
180	0.63	0.60	0.62	0.60	0.11	0.11	0.08	0.07	0.26	0.25	0.65	0.63	0.65	0.62	0.11	0.11	0.08	0.07	0.31	0.29
175	1.24	1.18	1.22	1.16	0.24	0.23	0.12	0.12	0.59	0.57	1.30	1.25	1.28	1.23	0.24	0.23	0.13	0.13	0.63	0.60
170	2.06	1.95	2.03	1.93	0.52	0.49	0.33	0.32	1.12	1.07	2.16	2.05	2.13	2.02	0.55	0.54	0.34	0.33	1.21	1.16
160	4.68	4.40	4.64	4.36	1.76	1.69	1.21	1.16	2.93	2.78	5.08	4.78	5.04	4.73	1.84	1.76	1.30	1.25	3.11	2.93
150	8.33	7.73	8.29	7.69	4.04	3.81	3.03	2.86	6.04	5.65	9.70	9.01	9.64	8.96	4.32	4.08	3.25	3.06	6.80	6.36
140	13.70	12.46	13.66	12.41	7.48	6.96	6.12	5.73	10.49	9.60	18.55	16.51	18.47	16.45	8.92	8.28	6.82	6.38	14.28	13.03
130	20.37	18.05	20.29	18.01	13.04	11.88	10.49	9.61	17.32	15.57	31.39	27.86	31.27	27.75	18.68	16.69	14.59	13.36	26.59	23.55
120	29.16	26.06	29.09	26.00	20.18	17.96	17.57	15.77	26.01	23.20	50.38	45.73	49.79	45.43	33.25	29.79	28.02	24.92	45.26	39.75

Table H-435. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.08	0.07	0.07	0.07	-	-	-	-	-	-	0.08	0.07	0.07	0.07	-	-	-	-	-	-
180	0.36	0.35	0.36	0.34	0.07	0.07	0.02	0.02	0.13	0.12	0.37	0.35	0.36	0.34	0.07	0.07	0.02	0.02	0.13	0.13
175	0.74	0.70	0.72	0.68	0.12	0.11	0.08	0.08	0.35	0.34	0.76	0.73	0.74	0.72	0.12	0.12	0.09	0.08	0.35	0.34
170	1.42	1.35	1.40	1.33	0.26	0.25	0.13	0.13	0.66	0.64	1.48	1.41	1.46	1.39	0.31	0.30	0.14	0.13	0.69	0.67
160	3.49	3.29	3.45	3.25	1.14	1.09	0.75	0.72	2.10	2.00	3.75	3.54	3.70	3.50	1.20	1.15	0.74	0.72	2.19	2.09
150	6.70	6.25	6.64	6.21	2.92	2.77	2.23	2.13	4.70	4.41	7.61	7.09	7.55	7.04	3.06	2.90	2.34	2.24	5.10	4.79
140	11.31	10.29	11.26	10.24	5.94	5.56	4.78	4.50	8.54	7.93	14.54	13.23	14.47	13.18	6.61	6.18	5.20	4.88	10.55	9.69
130	17.57	15.75	17.51	15.71	10.20	9.38	8.57	7.96	14.45	13.16	26.07	23.05	25.98	22.96	14.17	12.94	10.73	9.80	20.97	18.38
120	25.94	23.12	25.89	23.07	17.21	15.47	14.57	13.26	22.44	19.58	43.66	38.16	43.46	37.97	27.04	24.03	22.17	19.33	35.98	32.16

Table H-436. Monopile foundation (11 m diameter, IHC S-5500, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
180	0.13	0.13	0.13	0.13	-	-	-	-	0.08	0.07	0.14	0.13	0.13	0.13	-	-	-	-	0.08	0.07
175	0.36	0.35	0.36	0.34	0.07	0.07	0.02	0.02	0.13	0.12	0.37	0.35	0.36	0.34	0.07	0.07	0.02	0.02	0.13	0.13
170	0.74	0.70	0.72	0.68	0.12	0.11	0.08	0.08	0.35	0.34	0.76	0.73	0.74	0.72	0.12	0.12	0.09	0.08	0.35	0.34
160	2.32	2.21	2.29	2.18	0.59	0.57	0.37	0.35	1.31	1.25	2.42	2.30	2.38	2.27	0.63	0.60	0.37	0.36	1.37	1.31
150	4.98	4.68	4.96	4.65	1.91	1.83	1.40	1.34	3.19	3.00	5.46	5.12	5.40	5.08	1.98	1.90	1.46	1.40	3.42	3.22
140	8.74	8.11	8.70	8.07	4.32	4.07	3.34	3.13	6.40	5.99	10.38	9.53	10.31	9.47	4.64	4.38	3.56	3.35	7.34	6.83
130	14.27	12.97	14.23	12.92	7.93	7.38	6.48	6.05	11.26	10.25	19.50	17.34	19.44	17.29	9.57	8.86	7.33	6.82	15.19	13.87
120	21.46	18.75	21.39	18.69	13.68	12.44	11.24	10.27	18.08	16.19	32.85	29.32	32.73	29.19	19.73	17.62	15.61	14.28	27.89	24.75

Table H-437. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.09	0.09	0.09	0.08	-	-	-	-	0.02	0.02	0.09	0.09	0.09	0.09	-	-	-	-	0.02	0.02
190	0.45	0.44	0.43	0.42	0.08	0.08	0.02	0.02	0.17	0.16	0.47	0.45	0.46	0.44	0.08	0.08	0.02	0.02	0.15	0.15
180	1.61	1.54	1.59	1.51	0.34	0.33	0.21	0.21	0.83	0.80	1.69	1.61	1.67	1.59	0.35	0.34	0.20	0.19	0.86	0.82
175	2.57	2.45	2.55	2.43	0.73	0.70	0.43	0.42	1.48	1.42	2.71	2.57	2.68	2.55	0.77	0.74	0.46	0.44	1.56	1.49
170	3.86	3.64	3.82	3.61	1.33	1.28	0.86	0.83	2.41	2.28	4.14	3.92	4.11	3.88	1.41	1.35	0.90	0.87	2.53	2.41
160	7.08	6.59	7.02	6.55	3.19	3.00	2.49	2.37	5.00	4.69	8.08	7.51	8.02	7.46	3.43	3.24	2.64	2.51	5.44	5.11
150	11.92	10.86	11.86	10.81	6.26	5.84	5.08	4.76	8.91	8.28	15.06	13.72	14.99	13.66	6.95	6.48	5.51	5.16	11.15	10.20
140	18.28	16.36	18.23	16.31	10.97	10.02	8.96	8.33	15.10	13.76	26.59	23.64	26.50	23.55	14.78	13.50	11.41	10.41	21.74	19.02
130	26.86	23.99	26.81	23.94	18.23	16.35	15.43	14.05	23.71	20.87	45.36	39.72	45.14	39.47	28.10	25.12	23.47	20.72	39.26	33.90
120	36.38	32.56	36.22	32.47	27.55	24.60	24.61	21.78	32.58	29.23	83.38	69.97	82.24	68.52	50.12	45.44	45.16	39.18	73.33	59.66

Table H-438. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
190	0.14	0.13	0.13	0.13	-	-	-	-	0.08	0.07	0.14	0.14	0.14	0.14	-	-	-	-	0.08	0.07
180	0.80	0.77	0.79	0.75	0.12	0.12	0.09	0.09	0.34	0.33	0.82	0.79	0.81	0.78	0.13	0.13	0.09	0.09	0.34	0.33
175	1.46	1.39	1.44	1.37	0.26	0.26	0.14	0.13	0.74	0.72	1.53	1.46	1.50	1.44	0.27	0.26	0.14	0.14	0.78	0.74
170	2.39	2.27	2.37	2.24	0.58	0.57	0.37	0.36	1.34	1.28	2.50	2.38	2.47	2.35	0.63	0.60	0.38	0.37	1.41	1.35
160	5.04	4.74	5.00	4.70	1.95	1.86	1.42	1.36	3.23	3.04	5.50	5.16	5.44	5.11	2.04	1.94	1.52	1.45	3.49	3.29
150	8.71	8.10	8.68	8.06	4.34	4.08	3.38	3.18	6.36	5.95	10.16	9.37	10.09	9.32	4.66	4.38	3.62	3.41	7.20	6.69
140	14.23	12.95	14.18	12.91	7.86	7.30	6.40	6.00	11.20	10.21	19.05	17.00	18.98	16.95	9.33	8.61	7.18	6.67	14.79	13.50
130	21.55	18.82	21.47	18.77	13.77	12.52	11.34	10.35	18.17	16.28	32.00	28.64	31.88	28.51	19.36	17.38	15.34	14.03	27.23	24.27
120	30.23	26.99	30.15	26.94	21.87	19.10	18.67	16.73	27.15	24.25	56.79	48.63	55.62	48.11	35.34	31.74	29.55	26.43	47.32	41.94

Table H-439. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.09	0.09	0.09	0.08	-	-	-	-	0.02	0.02	0.09	0.09	0.09	0.09	-	-	-	-	0.02	0.02
180	0.45	0.44	0.43	0.42	0.08	0.08	0.02	0.02	0.17	0.16	0.47	0.45	0.46	0.44	0.08	0.08	0.02	0.02	0.15	0.15
175	0.88	0.84	0.87	0.83	0.13	0.13	0.09	0.09	0.40	0.38	0.91	0.87	0.89	0.85	0.14	0.13	0.10	0.09	0.40	0.39
170	1.61	1.54	1.59	1.51	0.34	0.33	0.21	0.21	0.83	0.80	1.69	1.61	1.67	1.59	0.35	0.34	0.20	0.19	0.86	0.82
160	3.86	3.64	3.82	3.61	1.33	1.28	0.86	0.83	2.41	2.28	4.14	3.92	4.11	3.88	1.41	1.35	0.90	0.87	2.53	2.41
150	7.08	6.59	7.02	6.55	3.19	3.00	2.49	2.37	5.00	4.69	8.08	7.51	8.02	7.46	3.43	3.24	2.64	2.51	5.44	5.11
140	11.92	10.86	11.86	10.81	6.26	5.84	5.08	4.76	8.91	8.28	15.06	13.72	14.99	13.66	6.95	6.48	5.51	5.16	11.15	10.20
130	18.28	16.36	18.23	16.31	10.97	10.02	8.96	8.33	15.10	13.76	26.59	23.64	26.50	23.55	14.78	13.50	11.41	10.41	21.74	19.02
120	26.86	23.99	26.81	23.94	18.23	16.35	15.43	14.05	23.71	20.87	45.36	39.72	45.14	39.47	28.10	25.12	23.47	20.72	39.26	33.90

Table H-440. Monopile foundation (11 m diameter, IHC S-5500, 2500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location T1-L08 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	0.03	0.03	-	-	-	-	-	-	0.03	0.03	0.03	0.03	-	-	-	-	-	-
180	0.15	0.15	0.15	0.14	-	-	-	-	0.09	0.09	0.16	0.15	0.16	0.15	-	-	-	-	0.09	0.09
175	0.45	0.44	0.43	0.42	0.08	0.08	0.02	0.02	0.17	0.16	0.47	0.45	0.46	0.44	0.08	0.08	0.02	0.02	0.15	0.15
170	0.88	0.84	0.87	0.83	0.13	0.13	0.09	0.09	0.40	0.38	0.91	0.87	0.89	0.85	0.14	0.13	0.10	0.09	0.40	0.39
160	2.57	2.45	2.55	2.43	0.73	0.70	0.43	0.42	1.48	1.42	2.71	2.57	2.68	2.55	0.77	0.74	0.46	0.44	1.56	1.49
150	5.36	5.03	5.32	4.99	2.18	2.07	1.57	1.50	3.55	3.34	5.86	5.50	5.82	5.46	2.29	2.18	1.66	1.59	3.80	3.59
140	9.14	8.47	9.08	8.43	4.60	4.33	3.69	3.46	6.74	6.29	11.04	10.10	10.96	10.03	4.98	4.68	3.92	3.70	7.77	7.20
130	14.81	13.48	14.76	13.44	8.29	7.71	6.78	6.34	11.92	10.86	19.94	17.80	19.88	17.75	9.94	9.18	7.75	7.17	15.75	14.38
120	22.59	19.71	22.51	19.64	14.41	13.12	12.09	11.02	18.90	16.91	33.55	30.20	33.41	30.05	20.65	18.30	16.45	15.04	28.60	25.52

Table H-441. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	0.01	0.01	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-
190	0.11	0.10	0.11	0.10	-	-	-	-	0.05	0.05	0.11	0.11	0.11	0.10	-	-	-	-	0.05	0.05
180	0.51	0.49	0.50	0.48	0.09	0.08	0.06	0.06	0.20	0.20	0.54	0.52	0.52	0.50	0.09	0.08	0.05	0.05	0.20	0.19
175	1.01	0.96	0.99	0.95	0.17	0.17	0.10	0.10	0.42	0.40	1.06	1.01	1.04	0.99	0.14	0.13	0.11	0.10	0.44	0.42
170	1.82	1.73	1.79	1.70	0.36	0.34	0.22	0.21	0.90	0.85	1.89	1.80	1.87	1.78	0.36	0.35	0.21	0.20	0.93	0.89
160	4.24	3.99	4.19	3.95	1.40	1.32	0.93	0.89	2.54	2.40	4.58	4.31	4.53	4.26	1.47	1.39	0.97	0.92	2.67	2.53
150	7.55	7.03	7.49	6.98	3.37	3.16	2.59	2.45	5.25	4.92	8.85	8.20	8.79	8.16	3.64	3.43	2.71	2.57	5.85	5.51
140	12.49	11.37	12.44	11.32	6.35	5.96	5.21	4.88	9.18	8.55	16.03	14.38	15.96	14.33	7.44	6.98	5.78	5.41	12.11	11.05
130	18.18	16.37	18.14	16.32	11.04	10.09	9.06	8.43	15.19	13.70	26.85	23.98	26.76	23.89	15.59	14.00	12.20	11.16	21.93	19.39
120	26.07	23.42	26.00	23.36	17.67	15.87	15.31	13.79	22.45	19.92	43.60	38.82	43.34	38.59	28.30	25.17	23.53	20.86	36.72	32.87

Table H-442. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
190	0.05	0.05	0.05	0.05	-	-	-	-	-	-	0.05	0.05	0.05	0.04	-	-	-	-	-	-
180	0.19	0.18	0.18	0.18	0.01	0.01	-	-	0.09	0.08	0.18	0.18	0.18	0.17	0.01	0.01	-	-	0.09	0.08
175	0.43	0.41	0.41	0.40	0.08	0.08	0.02	0.02	0.18	0.17	0.45	0.43	0.43	0.42	0.08	0.08	0.02	0.02	0.16	0.15
170	0.92	0.87	0.90	0.86	0.12	0.12	0.09	0.09	0.37	0.35	0.94	0.91	0.93	0.89	0.13	0.12	0.10	0.09	0.37	0.36
160	2.64	2.50	2.61	2.47	0.64	0.61	0.38	0.37	1.43	1.36	2.77	2.63	2.73	2.60	0.68	0.65	0.39	0.37	1.49	1.43
150	5.42	5.08	5.38	5.04	2.05	1.93	1.48	1.41	3.49	3.28	6.02	5.64	5.97	5.60	2.17	2.06	1.57	1.49	3.77	3.55
140	9.21	8.54	9.17	8.50	4.49	4.21	3.53	3.31	6.60	6.19	11.38	10.36	11.29	10.30	4.87	4.58	3.81	3.58	7.86	7.34
130	14.68	13.26	14.63	13.21	7.96	7.44	6.51	6.11	11.47	10.47	19.35	17.44	19.30	17.38	9.86	9.22	7.66	7.19	15.65	14.05
120	20.79	18.56	20.72	18.50	13.67	12.42	11.33	10.36	17.75	15.96	32.20	28.68	32.06	28.56	19.52	17.61	16.13	14.47	27.44	24.47

Table H-443. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	0.01	0.01	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-
180	0.11	0.10	0.11	0.10	-	-	-	-	0.05	0.05	0.11	0.11	0.11	0.10	-	-	-	-	0.05	0.05
175	0.21	0.21	0.21	0.20	0.01	0.01	-	-	0.10	0.09	0.21	0.21	0.21	0.20	0.01	0.01	-	-	0.10	0.09
170	0.51	0.49	0.50	0.48	0.09	0.08	0.06	0.06	0.20	0.20	0.54	0.52	0.52	0.50	0.09	0.08	0.05	0.05	0.20	0.19
160	1.82	1.73	1.79	1.70	0.36	0.34	0.22	0.21	0.90	0.85	1.89	1.80	1.87	1.78	0.36	0.35	0.21	0.20	0.93	0.89
150	4.24	3.99	4.19	3.95	1.40	1.32	0.93	0.89	2.54	2.40	4.58	4.31	4.53	4.26	1.47	1.39	0.97	0.92	2.67	2.53
140	7.55	7.03	7.49	6.98	3.37	3.16	2.59	2.45	5.25	4.92	8.85	8.20	8.79	8.16	3.64	3.43	2.71	2.57	5.85	5.51
130	12.49	11.37	12.44	11.32	6.36	5.96	5.21	4.88	9.18	8.55	16.03	14.38	15.96	14.33	7.44	6.98	5.78	5.41	12.11	11.05
120	18.18	16.37	18.14	16.32	11.04	10.09	9.06	8.43	15.19	13.70	26.85	23.98	26.76	23.89	15.59	14.00	12.20	11.16	21.93	19.39

Table H-444. Monopile foundation (11 m diameter, IHC S-5500, 450 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
180	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.05	0.05	-	-	-	-	-	-
175	0.11	0.10	0.11	0.10	-	-	-	-	0.05	0.05	0.11	0.11	0.11	0.10	-	-	-	-	0.05	0.05
170	0.21	0.21	0.21	0.20	0.01	0.01	-	-	0.10	0.09	0.21	0.21	0.21	0.20	0.01	0.01	-	-	0.10	0.09
160	1.01	0.96	0.99	0.95	0.17	0.17	0.10	0.10	0.42	0.40	1.06	1.01	1.04	0.99	0.14	0.13	0.11	0.10	0.44	0.42
150	2.83	2.69	2.81	2.66	0.74	0.70	0.47	0.44	1.59	1.51	2.98	2.82	2.94	2.79	0.78	0.74	0.48	0.45	1.66	1.58
140	5.75	5.38	5.70	5.34	2.27	2.13	1.64	1.56	3.80	3.57	6.43	6.02	6.37	5.97	2.41	2.28	1.74	1.65	4.08	3.85
130	9.59	8.89	9.55	8.86	4.77	4.48	3.81	3.58	6.96	6.52	12.17	11.06	12.10	11.00	5.24	4.91	4.11	3.86	8.44	7.88
120	15.25	13.75	15.21	13.70	8.42	7.85	6.86	6.43	12.14	11.07	20.28	18.20	20.17	18.13	10.80	9.93	8.28	7.76	16.59	14.87

Table H-445. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (Rmax and R95% in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.03	0.03	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
190	0.13	0.12	0.13	0.12	0.01	0.01	-	-	0.07	0.07	0.13	0.13	0.13	0.13	0.01	0.01	-	-	0.07	0.07
180	0.67	0.64	0.66	0.63	0.11	0.11	0.08	0.08	0.29	0.28	0.69	0.66	0.68	0.65	0.11	0.11	0.08	0.08	0.30	0.29
175	1.31	1.25	1.29	1.23	0.24	0.23	0.13	0.12	0.61	0.58	1.38	1.31	1.36	1.29	0.24	0.23	0.13	0.13	0.64	0.61
170	2.18	2.06	2.14	2.02	0.53	0.51	0.33	0.32	1.15	1.10	2.32	2.20	2.29	2.17	0.57	0.54	0.34	0.33	1.24	1.18
160	4.84	4.55	4.80	4.51	1.78	1.69	1.24	1.18	2.99	2.84	5.36	5.03	5.31	4.98	1.87	1.79	1.33	1.27	3.27	3.08
150	8.57	7.96	8.53	7.92	4.11	3.87	3.12	2.92	6.13	5.75	10.20	9.38	10.12	9.33	4.45	4.19	3.38	3.18	7.06	6.62
140	14.02	12.70	13.96	12.65	7.52	7.01	6.14	5.75	10.80	9.83	18.36	16.51	18.29	16.45	9.16	8.54	6.95	6.53	14.54	13.13
130	19.92	17.97	19.87	17.93	13.24	12.03	10.78	9.82	17.29	15.51	30.76	27.44	30.64	27.32	18.30	16.46	14.83	13.37	25.86	23.13
120	28.76	25.79	28.69	25.73	19.83	17.88	17.60	15.79	25.55	22.92	48.54	44.02	48.24	43.66	32.55	29.00	27.37	24.47	43.24	38.42

Table H-446. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
190	0.07	0.07	0.07	0.07	-	-	-	-	0.01	0.01	0.07	0.07	0.07	0.07	-	-	-	-	0.01	0.01
180	0.29	0.28	0.27	0.25	0.06	0.06	0.01	0.01	0.11	0.11	0.30	0.29	0.29	0.28	0.05	0.05	0.01	0.01	0.11	0.11
175	0.60	0.57	0.59	0.56	0.10	0.10	0.07	0.07	0.24	0.23	0.62	0.60	0.61	0.59	0.11	0.10	0.07	0.07	0.24	0.23
170	1.14	1.09	1.11	1.06	0.22	0.21	0.12	0.11	0.54	0.52	1.21	1.16	1.18	1.13	0.21	0.21	0.12	0.12	0.57	0.55
160	3.03	2.87	2.99	2.84	0.93	0.89	0.58	0.56	1.81	1.72	3.31	3.12	3.26	3.07	0.96	0.92	0.62	0.59	1.90	1.81
150	6.17	5.78	6.13	5.74	2.58	2.44	1.89	1.79	4.19	3.96	6.98	6.54	6.93	6.49	2.72	2.58	1.97	1.88	4.57	4.31
140	10.39	9.50	10.31	9.45	5.29	4.96	4.25	4.00	7.76	7.24	13.41	12.17	13.36	12.12	5.92	5.54	4.63	4.35	9.44	8.81
130	16.38	14.72	16.34	14.68	9.38	8.71	7.72	7.20	13.43	12.20	22.88	20.30	22.76	20.20	12.54	11.45	9.38	8.76	18.26	16.42
120	23.82	21.25	23.75	21.18	15.89	14.27	13.53	12.28	19.79	17.84	36.92	33.13	36.72	32.93	23.52	20.89	18.81	16.95	31.57	28.14

Table H-447. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
180	0.13	0.12	0.13	0.12	0.01	0.01	-	-	0.07	0.07	0.13	0.13	0.13	0.12	0.01	0.01	-	-	0.07	0.07
175	0.34	0.33	0.33	0.32	0.07	0.07	0.01	0.01	0.12	0.12	0.35	0.33	0.34	0.33	0.07	0.07	0.01	0.01	0.12	0.12
170	0.67	0.64	0.66	0.63	0.11	0.11	0.08	0.08	0.29	0.28	0.69	0.66	0.68	0.65	0.11	0.11	0.08	0.08	0.30	0.29
160	2.18	2.06	2.14	2.02	0.53	0.51	0.33	0.32	1.15	1.10	2.32	2.20	2.29	2.17	0.57	0.54	0.34	0.33	1.24	1.18
150	4.84	4.55	4.80	4.51	1.78	1.69	1.24	1.18	2.99	2.84	5.37	5.03	5.31	4.98	1.87	1.79	1.33	1.27	3.27	3.08
140	8.57	7.96	8.53	7.92	4.11	3.87	3.12	2.92	6.13	5.75	10.20	9.38	10.12	9.33	4.45	4.19	3.38	3.18	7.06	6.62
130	14.02	12.70	13.96	12.65	7.52	7.01	6.14	5.75	10.80	9.83	18.36	16.51	18.29	16.45	9.16	8.54	6.95	6.53	14.54	13.13
120	19.92	17.97	19.87	17.93	13.24	12.03	10.78	9.82	17.29	15.51	30.76	27.44	30.64	27.32	18.31	16.46	14.83	13.37	25.86	23.13

Table H-448. Monopile foundation (11 m diameter, IHC S-5500, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
180	0.08	0.07	0.07	0.07	-	-	-	-	0.01	0.01	0.08	0.07	0.08	0.07	-	-	-	-	0.01	0.01
175	0.13	0.12	0.13	0.12	0.01	0.01	-	-	0.07	0.07	0.13	0.13	0.13	0.12	0.01	0.01	-	-	0.07	0.07
170	0.34	0.33	0.33	0.32	0.07	0.07	0.01	0.01	0.12	0.12	0.35	0.33	0.34	0.33	0.07	0.07	0.01	0.01	0.12	0.12
160	1.31	1.25	1.29	1.23	0.24	0.23	0.13	0.12	0.61	0.58	1.38	1.31	1.36	1.29	0.24	0.23	0.13	0.13	0.64	0.61
150	3.36	3.16	3.31	3.12	1.00	0.95	0.64	0.61	1.96	1.86	3.64	3.44	3.60	3.40	1.05	1.00	0.68	0.64	2.09	1.97
140	6.53	6.10	6.48	6.06	2.77	2.62	2.04	1.93	4.49	4.22	7.49	6.99	7.44	6.94	2.91	2.77	2.20	2.08	4.93	4.64
130	11.08	10.07	11.01	10.01	5.63	5.27	4.53	4.26	8.22	7.66	14.19	12.82	14.13	12.76	6.33	5.94	4.96	4.66	10.02	9.32
120	16.98	15.26	16.93	15.22	9.80	9.12	8.18	7.62	14.05	12.72	24.26	21.59	24.14	21.48	13.43	12.22	9.96	9.31	19.15	17.26

Table H-449. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.05	0.04	0.04	0.04	-	-	-	-	-	-	0.04	0.04	0.04	0.04	-	-	-	-	-	-
190	0.18	0.17	0.18	0.17	0.01	0.01	-	-	0.09	0.08	0.17	0.17	0.17	0.16	0.01	0.01	-	-	0.09	0.08
180	0.86	0.82	0.85	0.81	0.13	0.12	0.10	0.09	0.37	0.35	0.90	0.86	0.88	0.85	0.13	0.13	0.10	0.09	0.37	0.36
175	1.58	1.50	1.56	1.48	0.33	0.31	0.20	0.19	0.79	0.75	1.67	1.58	1.64	1.56	0.33	0.31	0.19	0.18	0.81	0.78
170	2.55	2.41	2.51	2.38	0.66	0.63	0.39	0.38	1.41	1.34	2.67	2.54	2.64	2.51	0.71	0.68	0.41	0.39	1.49	1.41
160	5.33	5.00	5.29	4.96	2.07	1.95	1.50	1.43	3.51	3.30	5.93	5.56	5.87	5.51	2.21	2.09	1.57	1.50	3.78	3.58
150	9.23	8.54	9.19	8.50	4.58	4.30	3.59	3.37	6.71	6.29	11.59	10.60	11.52	10.54	4.97	4.68	3.88	3.65	8.07	7.54
140	15.00	13.57	14.94	13.53	8.26	7.67	6.67	6.24	11.94	10.94	20.10	18.05	19.98	17.99	10.31	9.56	7.92	7.43	16.31	14.67
130	21.98	19.43	21.90	19.36	14.30	12.97	11.90	10.91	18.43	16.66	33.42	29.75	33.28	29.62	20.24	18.19	16.71	15.02	28.56	25.38
120	30.39	27.24	30.31	27.18	21.65	19.24	18.70	16.90	27.12	24.36	51.69	47.34	51.34	47.00	35.54	31.76	30.28	26.94	46.40	41.52

Table H-450. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
190	0.08	0.08	0.08	0.08	-	-	-	-	0.01	0.01	0.08	0.08	0.08	0.08	-	-	-	-	0.01	0.01
180	0.36	0.35	0.35	0.34	0.07	0.07	0.01	0.01	0.13	0.12	0.36	0.35	0.36	0.35	0.07	0.07	0.01	0.01	0.13	0.13
175	0.77	0.74	0.76	0.73	0.12	0.11	0.08	0.08	0.33	0.31	0.80	0.76	0.79	0.75	0.12	0.12	0.09	0.08	0.33	0.32
170	1.40	1.34	1.38	1.31	0.27	0.25	0.13	0.13	0.67	0.64	1.48	1.40	1.45	1.38	0.29	0.28	0.13	0.13	0.73	0.69
160	3.54	3.33	3.49	3.29	1.14	1.08	0.74	0.70	2.10	1.97	3.82	3.61	3.78	3.57	1.20	1.14	0.77	0.73	2.24	2.11
150	6.71	6.25	6.67	6.21	2.88	2.73	2.19	2.06	4.68	4.40	7.77	7.23	7.73	7.19	3.03	2.87	2.33	2.22	5.13	4.84
140	11.38	10.42	11.33	10.37	5.83	5.46	4.72	4.44	8.51	7.92	14.84	13.40	14.78	13.35	6.57	6.20	5.15	4.84	10.75	9.89
130	17.46	15.76	17.41	15.71	10.10	9.36	8.42	7.84	14.50	13.16	25.64	22.76	25.55	22.67	14.22	12.88	10.71	9.89	20.06	18.06
120	25.62	22.90	25.56	22.85	17.03	15.35	14.59	13.22	21.70	19.23	40.38	36.10	40.06	35.89	26.38	23.47	21.22	18.83	34.36	30.62

Table H-451. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
190	0.05	0.04	0.04	0.04	-	-	-	-	-	-	0.04	0.04	0.04	0.04	-	-	-	-	-	-
180	0.18	0.17	0.18	0.17	0.01	0.01	-	-	0.09	0.08	0.17	0.17	0.17	0.16	0.01	0.01	-	-	0.09	0.08
175	0.43	0.42	0.42	0.40	0.08	0.08	0.02	0.02	0.18	0.17	0.46	0.44	0.45	0.43	0.08	0.08	0.02	0.02	0.16	0.15
170	0.86	0.82	0.85	0.81	0.13	0.12	0.10	0.09	0.37	0.35	0.90	0.86	0.88	0.85	0.13	0.13	0.10	0.09	0.37	0.36
160	2.55	2.41	2.51	2.38	0.66	0.63	0.39	0.38	1.41	1.34	2.67	2.54	2.64	2.51	0.71	0.68	0.41	0.39	1.49	1.41
150	5.33	5.00	5.29	4.96	2.07	1.95	1.50	1.43	3.51	3.30	5.93	5.56	5.87	5.51	2.21	2.09	1.58	1.50	3.78	3.58
140	9.23	8.54	9.19	8.50	4.58	4.30	3.59	3.37	6.71	6.29	11.59	10.60	11.52	10.54	4.97	4.68	3.88	3.65	8.07	7.54
130	15.00	13.57	14.94	13.53	8.26	7.67	6.67	6.24	11.94	10.94	20.10	18.05	19.98	17.99	10.31	9.56	7.92	7.43	16.31	14.67
120	21.98	19.43	21.91	19.36	14.30	12.97	11.90	10.91	18.43	16.66	33.42	29.75	33.28	29.62	20.24	18.19	16.71	15.02	28.56	25.38

Table H-452. Monopile foundation (11 m diameter, IHC S-5500, 1000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
180	0.09	0.08	0.09	0.08	-	-	-	-	0.02	0.02	0.09	0.09	0.09	0.08	-	-	-	-	0.02	0.02
175	0.18	0.17	0.18	0.17	0.01	0.01	-	-	0.09	0.08	0.17	0.17	0.17	0.16	0.01	0.01	-	-	0.09	0.08
170	0.43	0.42	0.42	0.40	0.08	0.08	0.02	0.02	0.18	0.17	0.46	0.44	0.45	0.43	0.08	0.08	0.02	0.02	0.16	0.15
160	1.58	1.50	1.56	1.48	0.33	0.31	0.20	0.19	0.79	0.75	1.67	1.58	1.64	1.56	0.33	0.31	0.19	0.18	0.81	0.78
150	3.83	3.62	3.79	3.58	1.27	1.21	0.83	0.78	2.30	2.18	4.14	3.91	4.10	3.87	1.34	1.27	0.86	0.82	2.45	2.32
140	7.07	6.58	7.01	6.54	3.12	2.92	2.41	2.28	4.99	4.69	8.33	7.73	8.27	7.68	3.38	3.18	2.54	2.41	5.53	5.20
130	12.03	11.00	11.97	10.95	6.19	5.78	5.02	4.71	8.98	8.35	15.70	14.13	15.65	14.08	7.07	6.66	5.51	5.17	11.71	10.75
120	18.08	16.32	18.02	16.28	10.86	9.98	8.90	8.27	15.17	13.72	26.83	23.86	26.74	23.77	15.21	13.71	11.74	10.79	21.70	19.13

Table H-453. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.06	0.06	0.05	0.05	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	-	-	-	-	-
190	0.22	0.21	0.22	0.21	0.02	0.02	0.01	0.01	0.11	0.10	0.21	0.21	0.21	0.20	0.02	0.02	0.01	0.01	0.11	0.11
180	1.03	0.98	1.01	0.96	0.21	0.20	0.11	0.11	0.46	0.44	1.09	1.05	1.07	1.02	0.19	0.19	0.12	0.11	0.47	0.45
175	1.83	1.75	1.81	1.72	0.42	0.40	0.25	0.24	0.95	0.91	1.92	1.83	1.89	1.80	0.43	0.41	0.24	0.23	0.98	0.94
170	2.85	2.71	2.82	2.68	0.88	0.85	0.53	0.50	1.67	1.59	2.99	2.84	2.96	2.81	0.92	0.88	0.56	0.54	1.77	1.69
160	5.70	5.35	5.66	5.31	2.47	2.34	1.81	1.72	3.94	3.70	6.37	5.96	6.31	5.92	2.59	2.47	1.90	1.80	4.22	3.98
150	9.57	8.88	9.52	8.84	4.98	4.68	4.08	3.82	7.10	6.64	12.39	11.24	12.34	11.18	5.46	5.12	4.36	4.10	8.52	7.97
140	15.65	14.08	15.59	14.03	8.76	8.14	7.20	6.71	12.58	11.48	21.29	18.77	21.18	18.69	11.43	10.43	8.53	8.01	17.30	15.41
130	22.78	20.26	22.71	20.19	15.12	13.67	12.73	11.65	19.07	17.25	36.03	31.87	35.84	31.68	22.66	19.84	18.33	16.37	30.75	27.13
120	31.21	28.02	31.14	27.95	23.06	20.50	19.54	17.72	28.03	25.17	59.30	53.36	58.16	52.41	41.82	37.35	35.74	31.51	51.62	46.42

Table H-454. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
190	0.10	0.09	0.10	0.09	-	-	-	-	0.02	0.02	0.10	0.09	0.10	0.09	-	-	-	-	0.02	0.02
180	0.45	0.43	0.45	0.42	0.09	0.08	0.05	0.05	0.20	0.19	0.46	0.44	0.46	0.44	0.09	0.08	0.03	0.03	0.18	0.17
175	0.94	0.90	0.93	0.89	0.13	0.13	0.10	0.10	0.42	0.40	0.97	0.93	0.96	0.92	0.14	0.14	0.11	0.11	0.43	0.42
170	1.66	1.58	1.63	1.56	0.37	0.36	0.22	0.22	0.87	0.83	1.75	1.67	1.72	1.64	0.38	0.37	0.22	0.21	0.91	0.87
160	3.96	3.73	3.92	3.69	1.38	1.31	0.93	0.89	2.45	2.33	4.26	4.01	4.21	3.97	1.48	1.40	0.96	0.92	2.59	2.46
150	7.06	6.59	7.01	6.55	3.33	3.13	2.60	2.46	5.05	4.73	8.24	7.68	8.18	7.63	3.60	3.38	2.72	2.58	5.56	5.23
140	12.03	10.95	11.97	10.89	6.26	5.87	5.15	4.83	8.92	8.29	15.65	13.99	15.58	13.93	7.10	6.64	5.68	5.31	11.66	10.62
130	18.06	16.28	18.02	16.23	10.92	10.01	9.00	8.35	15.21	13.72	26.72	23.78	26.62	23.69	15.45	13.80	12.00	10.94	21.74	19.06
120	26.22	23.55	26.15	23.49	17.85	16.11	15.50	14.00	22.74	20.23	44.42	39.69	44.06	39.36	29.08	25.68	24.26	21.38	37.96	33.62

Table H-455. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	-	-	-	-	-	-	-	-	0.01	0.01	-	-	-	-	-	-	-	-
190	0.06	0.06	0.05	0.05	-	-	-	-	-	-	0.05	0.05	0.05	0.05	-	-	-	-	-	-
180	0.22	0.21	0.22	0.21	0.02	0.02	0.01	0.01	0.11	0.10	0.21	0.21	0.21	0.20	0.02	0.02	0.01	0.01	0.11	0.11
175	0.51	0.48	0.49	0.47	0.10	0.09	0.07	0.07	0.22	0.22	0.54	0.52	0.52	0.50	0.10	0.09	0.07	0.07	0.22	0.21
170	1.03	0.98	1.01	0.96	0.21	0.20	0.11	0.11	0.46	0.44	1.09	1.05	1.07	1.02	0.19	0.19	0.12	0.11	0.47	0.45
160	2.85	2.71	2.82	2.68	0.88	0.85	0.53	0.50	1.67	1.59	2.99	2.84	2.96	2.81	0.92	0.88	0.56	0.54	1.77	1.69
150	5.70	5.35	5.66	5.31	2.47	2.34	1.81	1.72	3.94	3.70	6.37	5.96	6.31	5.92	2.59	2.47	1.90	1.80	4.22	3.98
140	9.57	8.88	9.52	8.84	4.98	4.68	4.08	3.82	7.10	6.64	12.39	11.24	12.34	11.19	5.46	5.12	4.36	4.10	8.52	7.97
130	15.65	14.08	15.59	14.03	8.76	8.14	7.20	6.71	12.58	11.48	21.29	18.77	21.18	18.69	11.43	10.43	8.53	8.01	17.30	15.41
120	22.78	20.26	22.71	20.19	15.12	13.67	12.73	11.65	19.07	17.25	36.03	31.87	35.84	31.68	22.66	19.84	18.33	16.37	30.75	27.13

Table H-456. Monopile foundation (11 m diameter, IHC S-5500, 1300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location U3-L09 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.01	0.01	0.01	0.01	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-
180	0.11	0.11	0.11	0.10	-	-	-	-	0.05	0.05	0.11	0.11	0.11	0.11	-	-	-	-	0.05	0.05
175	0.22	0.21	0.22	0.21	0.02	0.02	0.01	0.01	0.11	0.10	0.21	0.21	0.21	0.20	0.02	0.02	0.01	0.01	0.11	0.11
170	0.51	0.48	0.49	0.47	0.10	0.09	0.07	0.07	0.22	0.22	0.54	0.52	0.52	0.50	0.10	0.09	0.07	0.07	0.22	0.21
160	1.83	1.75	1.81	1.72	0.42	0.40	0.25	0.24	0.95	0.91	1.92	1.83	1.89	1.80	0.43	0.41	0.24	0.23	0.98	0.94
150	4.23	3.98	4.18	3.94	1.54	1.46	1.01	0.97	2.65	2.51	4.56	4.30	4.52	4.25	1.62	1.54	1.12	1.05	2.79	2.65
140	7.47	6.96	7.43	6.92	3.64	3.43	2.77	2.62	5.35	5.02	8.77	8.17	8.73	8.12	3.88	3.66	2.90	2.76	5.97	5.60
130	12.65	11.50	12.59	11.45	6.61	6.20	5.46	5.12	9.38	8.71	16.48	14.73	16.42	14.68	7.64	7.16	6.06	5.66	12.61	11.44
120	18.66	16.83	18.62	16.79	11.67	10.69	9.44	8.77	15.87	14.29	28.08	24.94	27.95	24.84	16.48	14.69	13.02	11.81	23.28	20.46

H.3.2. Monopile Foundation (Difficult-to-Drive)

Table H-457. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.06	0.06	0.06	0.06	-	-	-	-	0.02	0.02	0.06	0.06	0.06	0.06	-	-	-	-	0.02	0.02
190	0.35	0.33	0.34	0.32	0.06	0.06	0.02	0.02	0.12	0.12	0.37	0.35	0.36	0.34	0.06	0.06	0.02	0.02	0.12	0.12
180	1.26	1.20	1.25	1.18	0.25	0.24	0.15	0.15	0.65	0.62	1.33	1.26	1.32	1.25	0.27	0.26	0.14	0.13	0.67	0.65
175	1.99	1.88	1.98	1.86	0.56	0.54	0.37	0.36	1.15	1.09	2.17	2.01	2.14	1.99	0.60	0.58	0.38	0.36	1.26	1.18
170	2.99	2.78	2.97	2.77	1.00	0.95	0.69	0.67	1.93	1.79	3.35	3.06	3.32	3.03	1.10	1.04	0.73	0.69	2.04	1.90
160	5.59	5.18	5.57	5.16	2.73	2.54	2.04	1.90	4.25	3.95	6.51	5.98	6.48	5.95	2.97	2.76	2.25	2.09	4.85	4.51
150	8.88	8.13	8.86	8.11	5.36	4.98	4.44	4.12	7.31	6.72	11.61	10.57	11.57	10.53	6.45	5.93	5.08	4.72	9.28	8.49
140	13.56	12.39	13.54	12.37	8.94	8.21	7.64	7.00	11.78	10.73	19.25	17.35	19.21	17.31	12.46	11.39	9.90	9.06	16.63	15.02
130	18.89	17.11	18.87	17.08	14.08	12.82	12.42	11.34	17.01	15.44	31.23	28.09	31.13	28.00	22.45	19.92	18.81	16.96	28.41	25.31
120	26.76	23.97	26.71	23.93	19.83	17.95	18.07	16.34	24.53	21.88	54.25	46.08	52.91	45.46	41.06	35.03	33.72	30.58	47.92	41.31

Table H-458. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
190	0.11	0.11	0.11	0.11	-	-	-	-	0.06	0.06	0.11	0.11	0.11	0.11	-	-	-	-	0.06	0.06
180	0.60	0.58	0.59	0.57	0.10	0.09	0.06	0.06	0.26	0.25	0.64	0.61	0.63	0.60	0.10	0.09	0.06	0.06	0.27	0.26
175	1.09	1.04	1.07	1.02	0.22	0.21	0.11	0.11	0.55	0.53	1.18	1.13	1.16	1.11	0.22	0.21	0.12	0.12	0.59	0.57
170	1.86	1.74	1.85	1.73	0.48	0.46	0.32	0.30	1.00	0.95	1.96	1.84	1.95	1.82	0.48	0.47	0.33	0.31	1.08	1.02
160	4.06	3.76	4.04	3.74	1.61	1.51	1.12	1.06	2.73	2.53	4.49	4.17	4.47	4.15	1.74	1.61	1.23	1.16	2.95	2.74
150	6.76	6.23	6.73	6.22	3.74	3.44	2.86	2.67	5.37	4.98	8.20	7.51	8.18	7.49	4.22	3.91	3.20	2.91	6.39	5.88
140	10.46	9.53	10.42	9.50	6.65	6.13	5.56	5.16	8.84	8.12	14.30	13.02	14.26	12.98	8.44	7.72	6.73	6.18	11.96	10.93
130	15.54	14.16	15.52	14.13	10.82	9.83	9.22	8.46	13.80	12.57	24.27	21.46	24.18	21.39	15.67	14.24	13.10	11.98	20.15	18.18
120	21.91	19.45	21.85	19.40	16.28	14.79	14.50	13.21	19.30	17.49	40.18	34.17	39.96	34.00	28.26	25.22	24.61	21.88	33.68	30.41

Table H-459. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	0.02	0.02	0.06	0.06	0.06	0.06	-	-	-	-	0.02	0.02
180	0.35	0.33	0.34	0.32	0.06	0.06	0.02	0.02	0.12	0.12	0.37	0.35	0.36	0.34	0.06	0.06	0.02	0.02	0.12	0.12
175	0.69	0.66	0.68	0.65	0.11	0.10	0.07	0.07	0.32	0.31	0.72	0.69	0.71	0.68	0.11	0.11	0.07	0.07	0.34	0.32
170	1.26	1.20	1.25	1.18	0.25	0.24	0.15	0.14	0.65	0.62	1.33	1.26	1.32	1.25	0.27	0.26	0.14	0.13	0.67	0.65
160	2.99	2.78	2.97	2.77	1.00	0.95	0.69	0.67	1.93	1.79	3.35	3.06	3.32	3.03	1.10	1.04	0.73	0.69	2.04	1.90
150	5.59	5.18	5.57	5.16	2.73	2.54	2.04	1.90	4.25	3.95	6.51	5.98	6.48	5.95	2.97	2.76	2.25	2.09	4.85	4.51
140	8.88	8.13	8.86	8.11	5.36	4.98	4.44	4.12	7.31	6.72	11.61	10.57	11.57	10.53	6.45	5.93	5.08	4.72	9.28	8.49
130	13.56	12.39	13.54	12.37	8.94	8.21	7.64	7.00	11.78	10.73	19.25	17.35	19.21	17.31	12.46	11.39	9.90	9.06	16.63	15.02
120	18.89	17.11	18.87	17.08	14.08	12.82	12.42	11.34	17.01	15.44	31.23	28.09	31.13	28.00	22.45	19.92	18.81	16.96	28.41	25.31

Table H-460. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.03	0.03	0.03	0.03	-	-	-	-	-	-	0.03	0.03	0.03	0.03	-	-	-	-	-	-
180	0.13	0.12	0.12	0.12	-	-	-	-	0.06	0.06	0.13	0.13	0.13	0.13	-	-	-	-	0.06	0.06
175	0.35	0.33	0.34	0.32	0.06	0.06	0.02	0.02	0.12	0.12	0.37	0.35	0.36	0.34	0.06	0.06	0.02	0.02	0.12	0.12
170	0.69	0.66	0.68	0.65	0.11	0.10	0.07	0.07	0.32	0.31	0.72	0.69	0.71	0.68	0.11	0.11	0.07	0.07	0.34	0.32
160	1.99	1.88	1.98	1.86	0.56	0.54	0.37	0.36	1.15	1.09	2.17	2.01	2.14	1.99	0.60	0.58	0.38	0.36	1.26	1.18
150	4.29	3.99	4.27	3.97	1.78	1.66	1.29	1.22	2.90	2.71	4.78	4.44	4.76	4.42	1.90	1.78	1.37	1.30	3.26	2.97
140	7.07	6.51	7.04	6.49	4.01	3.71	3.08	2.84	5.68	5.25	8.68	7.94	8.66	7.91	4.54	4.20	3.52	3.22	6.82	6.26
130	11.06	10.06	11.02	10.03	6.99	6.43	5.86	5.44	9.22	8.47	15.02	13.67	14.98	13.64	9.00	8.21	7.20	6.59	12.70	11.59
120	16.07	14.62	16.04	14.60	11.44	10.41	9.62	8.81	14.30	13.01	25.54	22.62	25.46	22.55	16.67	15.07	13.90	12.68	21.74	19.25

Table H-461. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.18	0.17	0.17	0.17	-	-	-	-	0.06	0.06	0.19	0.18	0.18	0.17	-	-	-	-	0.06	0.06
190	0.80	0.76	0.78	0.75	0.12	0.12	0.07	0.06	0.37	0.35	0.85	0.80	0.82	0.79	0.12	0.12	0.07	0.07	0.38	0.36
180	2.19	2.02	2.15	1.99	0.60	0.58	0.38	0.36	1.25	1.18	2.33	2.16	2.30	2.13	0.63	0.61	0.39	0.37	1.32	1.24
175	3.16	2.90	3.13	2.88	1.08	1.02	0.76	0.72	1.95	1.83	3.47	3.20	3.44	3.17	1.15	1.09	0.81	0.77	2.06	1.93
170	4.40	4.11	4.37	4.09	1.80	1.70	1.33	1.26	2.95	2.76	4.86	4.53	4.82	4.50	1.91	1.78	1.40	1.32	3.25	3.01
160	7.28	6.66	7.24	6.64	4.05	3.77	3.11	2.87	5.76	5.36	9.00	8.14	8.98	8.12	4.51	4.22	3.47	3.19	6.96	6.39
150	11.52	10.47	11.48	10.44	7.14	6.56	5.92	5.51	9.56	8.69	15.56	14.16	15.51	14.12	9.32	8.42	7.40	6.73	13.08	11.97
140	16.62	15.11	16.59	15.08	11.80	10.73	9.84	8.97	14.68	13.40	26.11	23.13	26.06	23.08	17.06	15.44	14.24	13.02	22.45	19.81
130	23.71	21.09	23.66	21.05	17.23	15.64	15.30	13.98	20.56	18.45	41.86	35.69	41.72	35.59	29.90	26.65	26.78	23.67	36.34	32.00
120	30.64	27.63	30.59	27.58	24.94	22.29	22.21	19.71	28.58	25.67	71.07	60.30	69.73	59.22	57.37	48.21	49.22	42.29	65.85	55.81

Table H-462. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.06	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
190	0.35	0.34	0.35	0.34	0.05	0.05	-	-	0.13	0.13	0.37	0.36	0.36	0.35	0.05	0.05	-	-	0.12	0.12
180	1.26	1.20	1.25	1.18	0.25	0.24	0.14	0.13	0.61	0.59	1.33	1.26	1.31	1.24	0.26	0.25	0.14	0.13	0.64	0.61
175	1.96	1.85	1.95	1.84	0.52	0.50	0.32	0.31	1.09	1.03	2.08	1.94	2.05	1.92	0.57	0.55	0.34	0.33	1.16	1.10
170	2.92	2.73	2.90	2.71	0.94	0.90	0.65	0.62	1.82	1.71	3.16	2.91	3.13	2.89	0.99	0.94	0.67	0.64	1.90	1.78
160	5.42	5.04	5.40	5.02	2.57	2.40	1.92	1.79	4.07	3.79	6.22	5.74	6.19	5.72	2.74	2.56	2.01	1.88	4.55	4.25
150	8.80	8.00	8.78	7.98	5.12	4.79	4.21	3.92	7.14	6.55	11.38	10.29	11.34	10.25	6.10	5.64	4.72	4.40	9.14	8.26
140	13.44	12.33	13.42	12.31	8.84	8.03	7.40	6.76	11.64	10.59	18.95	17.10	18.91	17.06	12.14	11.01	9.70	8.77	16.22	14.71
130	18.89	17.11	18.87	17.08	13.84	12.66	12.14	11.09	16.91	15.38	30.46	27.24	30.40	27.19	21.41	18.95	18.19	16.42	27.61	24.49
120	26.69	23.90	26.66	23.87	19.51	17.72	17.69	16.06	24.31	21.68	49.30	42.93	49.06	42.67	38.12	32.92	32.46	29.23	45.70	39.04

Table H-463. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.03	0.03	0.03	0.03	-	-	-	-	-	-	0.03	0.03	0.03	0.03	-	-	-	-	-	-
190	0.18	0.17	0.17	0.17	-	-	-	-	0.06	0.06	0.19	0.18	0.18	0.17	-	-	-	-	0.06	0.06
180	0.80	0.76	0.78	0.75	0.12	0.12	0.07	0.06	0.37	0.35	0.85	0.80	0.83	0.79	0.12	0.12	0.07	0.07	0.38	0.36
175	1.39	1.31	1.37	1.30	0.29	0.28	0.16	0.16	0.67	0.65	1.46	1.37	1.44	1.36	0.30	0.29	0.16	0.16	0.73	0.69
170	2.19	2.02	2.15	1.99	0.60	0.58	0.38	0.36	1.25	1.18	2.33	2.16	2.30	2.13	0.63	0.61	0.39	0.37	1.32	1.24
160	4.40	4.11	4.37	4.09	1.80	1.70	1.33	1.26	2.95	2.76	4.86	4.53	4.82	4.50	1.91	1.78	1.40	1.32	3.25	3.01
150	7.28	6.66	7.24	6.64	4.05	3.77	3.11	2.87	5.76	5.36	9.00	8.14	8.98	8.12	4.51	4.22	3.47	3.19	6.96	6.39
140	11.52	10.47	11.48	10.44	7.14	6.56	5.92	5.51	9.56	8.69	15.56	14.16	15.51	14.12	9.32	8.42	7.40	6.73	13.08	11.97
130	16.62	15.11	16.59	15.08	11.80	10.73	9.84	8.97	14.68	13.40	26.11	23.13	26.06	23.08	17.06	15.44	14.24	13.02	22.45	19.81
120	23.71	21.09	23.66	21.05	17.23	15.64	15.30	13.98	20.56	18.45	41.86	35.69	41.72	35.59	29.90	26.65	26.78	23.67	36.34	32.00

Table H-464. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L01 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.06	0.06	0.06	0.06	-	-	-	-	0.02	0.02	0.07	0.07	0.07	0.07	-	-	-	-	0.02	0.02
180	0.40	0.38	0.40	0.38	0.06	0.06	0.02	0.02	0.15	0.15	0.41	0.39	0.40	0.39	0.06	0.06	0.02	0.02	0.15	0.15
175	0.80	0.76	0.78	0.75	0.12	0.12	0.07	0.06	0.37	0.35	0.85	0.80	0.83	0.79	0.12	0.12	0.07	0.07	0.38	0.36
170	1.39	1.31	1.37	1.30	0.29	0.28	0.16	0.16	0.67	0.65	1.46	1.37	1.44	1.36	0.30	0.29	0.16	0.16	0.73	0.69
160	3.16	2.90	3.13	2.88	1.08	1.02	0.76	0.72	1.95	1.83	3.47	3.20	3.44	3.17	1.15	1.09	0.81	0.77	2.06	1.93
150	5.70	5.29	5.68	5.27	2.75	2.58	2.08	1.94	4.31	4.03	6.62	6.08	6.59	6.06	2.94	2.75	2.25	2.08	4.89	4.57
140	9.18	8.34	9.16	8.32	5.42	5.06	4.46	4.16	7.56	6.89	12.06	10.98	12.02	10.95	6.56	6.04	5.08	4.74	9.64	8.73
130	13.94	12.76	13.90	12.74	9.24	8.39	7.82	7.13	12.18	11.11	19.69	17.80	19.64	17.77	12.84	11.71	10.36	9.28	17.14	15.48
120	19.40	17.59	19.37	17.57	14.36	13.12	12.66	11.59	17.52	15.88	31.59	28.40	31.53	28.34	23.01	20.33	19.13	17.30	28.76	25.59

Table H-465. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.07	0.07	0.07	0.07	-	-	-	-	0.01	0.01	0.07	0.07	0.07	0.07	-	-	-	-	0.01	0.01
190	0.35	0.34	0.35	0.34	0.07	0.07	0.01	0.01	0.13	0.12	0.36	0.35	0.35	0.34	0.07	0.07	0.01	0.01	0.13	0.13
180	1.39	1.33	1.37	1.32	0.31	0.30	0.18	0.18	0.72	0.67	1.45	1.39	1.44	1.37	0.32	0.31	0.16	0.14	0.76	0.73
175	2.24	2.15	2.22	2.12	0.59	0.56	0.38	0.36	1.31	1.25	2.39	2.28	2.36	2.26	0.64	0.60	0.38	0.37	1.37	1.31
170	3.39	3.23	3.35	3.19	1.20	1.14	0.82	0.78	2.08	1.98	3.70	3.52	3.66	3.48	1.26	1.21	0.85	0.81	2.22	2.12
160	6.56	6.15	6.52	6.12	2.90	2.77	2.27	2.16	4.66	4.40	7.63	7.08	7.58	7.03	3.09	2.93	2.43	2.32	5.20	4.90
150	11.10	10.10	11.05	10.05	6.04	5.66	4.85	4.59	8.64	8.03	14.73	13.39	14.67	13.34	7.04	6.53	5.43	5.10	11.19	10.23
140	17.12	15.58	17.07	15.54	10.73	9.79	8.89	8.25	14.62	13.31	26.03	23.28	25.94	23.19	15.08	13.73	11.85	10.82	21.39	18.91
130	25.35	22.74	25.29	22.69	17.44	15.88	15.19	13.80	22.11	19.61	41.60	37.09	41.38	36.88	28.29	25.17	23.71	20.96	36.47	32.30
120	34.13	30.21	34.04	30.14	26.26	23.55	23.40	20.80	31.10	27.57	75.51	61.49	74.30	60.62	48.08	43.29	42.00	37.34	64.73	53.38

Table H-466. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	0.01	0.01	-	-	-	-	-	-	0.01	0.01	0.01	0.01	-	-	-	-	-	-
190	0.12	0.12	0.12	0.11	0.01	0.01	-	-	0.07	0.07	0.13	0.12	0.12	0.12	0.01	0.01	-	-	0.06	0.06
180	0.64	0.62	0.63	0.61	0.11	0.11	0.08	0.08	0.31	0.29	0.68	0.65	0.66	0.64	0.11	0.11	0.08	0.08	0.31	0.30
175	1.27	1.21	1.25	1.20	0.24	0.23	0.13	0.13	0.58	0.56	1.32	1.26	1.30	1.24	0.24	0.23	0.14	0.13	0.62	0.59
170	2.03	1.94	2.00	1.91	0.54	0.51	0.35	0.33	1.16	1.10	2.16	2.07	2.13	2.04	0.56	0.53	0.35	0.34	1.22	1.17
160	4.57	4.34	4.54	4.30	1.76	1.68	1.30	1.24	2.89	2.76	5.04	4.77	5.01	4.73	1.86	1.78	1.36	1.30	3.05	2.90
150	8.18	7.60	8.14	7.57	4.04	3.84	3.05	2.90	6.06	5.68	9.76	9.04	9.72	9.01	4.41	4.18	3.37	3.19	7.12	6.60
140	13.49	12.32	13.45	12.29	7.68	7.15	6.26	5.87	10.72	9.78	18.42	16.68	18.36	16.62	9.53	8.82	7.34	6.80	14.84	13.51
130	19.74	17.87	19.69	17.83	13.43	12.27	11.16	10.18	17.22	15.68	31.69	28.07	31.56	27.96	19.35	17.45	15.75	14.32	26.98	24.10
120	28.71	25.59	28.65	25.54	20.43	18.33	17.97	16.32	25.75	23.13	49.31	44.74	49.00	44.46	35.18	31.16	29.96	26.58	43.89	39.55

Table H-467. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.07	0.07	0.07	0.07	-	-	-	-	0.01	0.01	0.07	0.07	0.07	0.07	-	-	-	-	0.01	0.01
180	0.35	0.34	0.35	0.34	0.07	0.07	0.01	0.01	0.13	0.12	0.36	0.35	0.35	0.34	0.07	0.07	0.01	0.01	0.13	0.13
175	0.79	0.75	0.77	0.74	0.12	0.12	0.09	0.09	0.34	0.33	0.81	0.78	0.80	0.77	0.13	0.12	0.09	0.09	0.35	0.33
170	1.39	1.33	1.37	1.32	0.31	0.30	0.18	0.18	0.72	0.67	1.45	1.39	1.44	1.37	0.32	0.31	0.16	0.14	0.76	0.73
160	3.39	3.23	3.35	3.19	1.20	1.14	0.82	0.78	2.08	1.98	3.70	3.52	3.66	3.48	1.26	1.21	0.85	0.81	2.22	2.12
150	6.56	6.15	6.52	6.12	2.90	2.77	2.27	2.16	4.66	4.40	7.63	7.08	7.58	7.03	3.09	2.93	2.43	2.32	5.20	4.90
140	11.10	10.10	11.05	10.05	6.04	5.66	4.85	4.59	8.64	8.03	14.73	13.39	14.67	13.34	7.04	6.53	5.43	5.10	11.19	10.23
130	17.12	15.58	17.07	15.54	10.73	9.79	8.89	8.25	14.62	13.31	26.03	23.28	25.94	23.19	15.08	13.73	11.85	10.82	21.39	18.91
120	25.35	22.74	25.29	22.69	17.44	15.88	15.19	13.80	22.11	19.61	41.60	37.09	41.38	36.88	28.29	25.17	23.71	20.96	36.47	32.30

Table H-468. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.01	0.01	-	-	-	-	-	-
180	0.13	0.13	0.13	0.13	0.01	0.01	-	-	0.07	0.07	0.14	0.14	0.14	0.13	0.01	0.01	-	-	0.07	0.07
175	0.35	0.34	0.35	0.34	0.07	0.07	0.01	0.01	0.13	0.12	0.36	0.35	0.35	0.34	0.07	0.07	0.01	0.01	0.13	0.13
170	0.79	0.75	0.77	0.74	0.12	0.12	0.09	0.09	0.34	0.33	0.81	0.78	0.80	0.77	0.13	0.12	0.09	0.09	0.35	0.33
160	2.24	2.15	2.22	2.12	0.59	0.56	0.38	0.36	1.31	1.25	2.39	2.28	2.36	2.26	0.64	0.60	0.38	0.37	1.37	1.31
150	4.87	4.62	4.83	4.58	1.92	1.83	1.40	1.34	3.11	2.96	5.42	5.11	5.39	5.07	2.01	1.92	1.52	1.45	3.41	3.23
140	8.61	7.99	8.57	7.95	4.34	4.11	3.36	3.19	6.44	6.03	10.51	9.60	10.45	9.55	4.77	4.51	3.70	3.49	7.70	7.13
130	14.08	12.82	14.03	12.79	8.14	7.58	6.64	6.22	11.45	10.45	19.38	17.49	19.33	17.44	10.25	9.40	7.96	7.37	15.77	14.36
120	20.64	18.47	20.57	18.42	14.09	12.83	11.88	10.85	17.91	16.30	33.22	29.39	33.07	29.27	20.67	18.39	16.82	15.27	28.39	25.32

Table H-469. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.17	0.16	0.16	0.16	0.01	0.01	-	-	0.08	0.08	0.18	0.17	0.18	0.17	0.01	0.01	-	-	0.08	0.08
190	0.87	0.83	0.85	0.82	0.13	0.13	0.09	0.09	0.38	0.37	0.91	0.87	0.89	0.86	0.14	0.14	0.09	0.09	0.44	0.40
180	2.43	2.32	2.39	2.29	0.71	0.69	0.44	0.42	1.38	1.32	2.55	2.44	2.53	2.42	0.77	0.74	0.48	0.46	1.46	1.40
175	3.61	3.42	3.57	3.38	1.28	1.22	0.87	0.83	2.17	2.07	3.86	3.66	3.82	3.62	1.35	1.29	0.88	0.85	2.33	2.21
170	4.98	4.71	4.94	4.67	2.00	1.91	1.52	1.44	3.18	3.01	5.40	5.07	5.36	5.04	2.15	2.04	1.61	1.52	3.42	3.24
160	8.47	7.86	8.44	7.82	4.31	4.09	3.43	3.24	6.24	5.86	9.86	9.12	9.82	9.08	4.63	4.38	3.71	3.50	7.14	6.56
150	13.96	12.69	13.93	12.66	7.83	7.28	6.45	6.04	11.12	10.09	18.70	17.00	18.63	16.95	9.59	8.83	7.44	6.82	15.16	13.74
140	20.54	18.45	20.47	18.40	13.98	12.67	11.64	10.55	17.90	16.23	32.80	28.86	32.66	28.73	20.27	18.28	16.66	15.11	28.17	24.99
130	29.89	26.43	29.84	26.38	21.58	19.16	18.71	16.92	26.87	23.94	55.38	49.00	54.08	48.44	39.02	34.22	33.44	29.38	48.20	43.40
120	39.56	34.96	39.46	34.86	31.38	27.58	28.38	25.09	36.36	31.94	>90.0	84.17	>90.0	83.96	86.36	71.04	71.63	59.79	>90.0	83.33

Table H-470. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.07	0.07	0.07	0.07	-	-	-	-	0.01	0.01	0.07	0.07	0.07	0.07	-	-	-	-	0.01	0.01
190	0.37	0.36	0.36	0.35	0.06	0.06	0.01	0.01	0.13	0.13	0.38	0.37	0.38	0.36	0.05	0.05	0.01	0.01	0.14	0.13
180	1.40	1.34	1.38	1.32	0.31	0.29	0.16	0.14	0.72	0.69	1.46	1.40	1.44	1.38	0.31	0.29	0.15	0.14	0.77	0.74
175	2.21	2.12	2.19	2.09	0.58	0.56	0.37	0.36	1.28	1.22	2.35	2.25	2.33	2.22	0.63	0.59	0.38	0.37	1.34	1.29
170	3.30	3.12	3.26	3.08	1.16	1.11	0.79	0.75	1.99	1.90	3.54	3.37	3.50	3.32	1.20	1.15	0.82	0.79	2.13	2.02
160	6.22	5.83	6.18	5.80	2.76	2.63	2.14	2.04	4.31	4.10	6.90	6.40	6.86	6.36	2.91	2.76	2.31	2.20	4.62	4.38
150	10.17	9.34	10.10	9.30	5.52	5.20	4.51	4.28	7.87	7.32	13.27	12.09	13.22	12.04	6.12	5.68	4.92	4.62	9.49	8.78
140	16.46	14.92	16.42	14.88	9.76	9.02	8.13	7.54	13.84	12.57	23.99	21.42	23.89	21.34	13.57	12.33	10.07	9.25	19.24	17.48
130	24.63	21.97	24.57	21.91	16.78	15.18	14.45	13.06	20.96	18.74	40.03	35.21	39.80	35.00	27.05	24.07	22.27	19.76	34.94	30.75
120	33.60	29.55	33.53	29.49	25.69	22.88	22.45	19.89	30.58	26.95	79.56	64.80	77.54	63.30	49.57	44.68	43.41	38.50	67.91	55.83

Table H-471. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.03	0.03	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
190	0.17	0.16	0.16	0.16	0.01	0.01	-	-	0.08	0.08	0.18	0.17	0.18	0.17	0.01	0.01	-	-	0.08	0.08
180	0.87	0.83	0.85	0.82	0.13	0.13	0.09	0.09	0.38	0.37	0.91	0.87	0.89	0.86	0.14	0.14	0.09	0.09	0.44	0.40
175	1.57	1.50	1.55	1.48	0.35	0.33	0.21	0.20	0.80	0.77	1.64	1.56	1.60	1.54	0.35	0.34	0.20	0.19	0.83	0.80
170	2.43	2.32	2.39	2.29	0.71	0.69	0.44	0.42	1.38	1.32	2.55	2.44	2.53	2.42	0.77	0.74	0.47	0.46	1.46	1.40
160	4.98	4.71	4.94	4.67	2.00	1.91	1.52	1.44	3.18	3.01	5.40	5.07	5.36	5.04	2.15	2.04	1.61	1.52	3.42	3.24
150	8.47	7.86	8.44	7.82	4.31	4.09	3.43	3.24	6.24	5.86	9.86	9.12	9.82	9.08	4.63	4.38	3.71	3.50	7.14	6.56
140	13.96	12.69	13.93	12.66	7.83	7.28	6.45	6.04	11.12	10.09	18.70	17.00	18.63	16.95	9.59	8.83	7.44	6.82	15.16	13.74
130	20.54	18.45	20.47	18.40	13.98	12.67	11.64	10.55	17.90	16.23	32.80	28.86	32.66	28.73	20.27	18.28	16.66	15.11	28.17	24.99
120	29.89	26.43	29.84	26.38	21.58	19.16	18.71	16.92	26.87	23.94	55.37	49.00	54.07	48.44	39.02	34.22	33.44	29.38	48.20	43.40

Table H-472. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L02 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.08	0.08	0.08	0.08	-	-	-	-	0.01	0.01	0.08	0.08	0.08	0.08	-	-	-	-	0.01	0.01
180	0.46	0.44	0.45	0.44	0.07	0.07	0.02	0.02	0.16	0.15	0.48	0.46	0.47	0.46	0.07	0.07	0.02	0.02	0.15	0.15
175	0.87	0.83	0.85	0.82	0.13	0.13	0.09	0.09	0.38	0.37	0.91	0.87	0.89	0.86	0.14	0.14	0.09	0.09	0.44	0.40
170	1.57	1.50	1.55	1.48	0.35	0.33	0.21	0.20	0.80	0.77	1.64	1.56	1.60	1.54	0.35	0.34	0.20	0.19	0.83	0.80
160	3.61	3.42	3.57	3.38	1.28	1.22	0.87	0.83	2.17	2.07	3.86	3.66	3.82	3.62	1.35	1.29	0.88	0.85	2.33	2.21
150	6.54	6.13	6.50	6.09	2.95	2.81	2.34	2.23	4.59	4.36	7.34	6.78	7.30	6.74	3.15	2.98	2.49	2.37	4.97	4.68
140	10.88	9.86	10.81	9.81	5.87	5.52	4.78	4.55	8.35	7.75	14.11	12.82	14.05	12.77	6.56	6.07	5.24	4.92	10.20	9.37
130	17.10	15.50	17.05	15.46	10.38	9.46	8.60	7.97	14.52	13.16	25.38	22.68	25.28	22.59	14.62	13.25	11.20	10.16	20.47	18.40
120	25.50	22.79	25.45	22.74	17.47	15.82	15.17	13.69	22.09	19.62	42.12	37.21	41.86	36.95	28.83	25.51	23.99	21.40	36.87	32.39

Table H-473. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.08	0.08	0.08	0.07	-	-	-	-	-	-	0.08	0.08	0.08	0.07	-	-	-	-	-	-
190	0.39	0.38	0.38	0.37	0.08	0.07	0.02	0.02	0.14	0.13	0.39	0.38	0.39	0.38	0.07	0.07	0.02	0.02	0.14	0.14
180	1.50	1.44	1.48	1.42	0.29	0.28	0.15	0.15	0.72	0.70	1.57	1.50	1.55	1.48	0.33	0.29	0.16	0.16	0.74	0.72
175	2.45	2.32	2.41	2.30	0.64	0.62	0.42	0.41	1.40	1.34	2.56	2.44	2.53	2.41	0.67	0.65	0.43	0.41	1.47	1.40
170	3.64	3.46	3.60	3.42	1.24	1.19	0.91	0.88	2.23	2.12	3.89	3.71	3.84	3.66	1.36	1.30	0.95	0.92	2.38	2.26
160	6.90	6.43	6.86	6.39	3.10	2.93	2.49	2.37	4.76	4.51	7.76	7.22	7.70	7.17	3.36	3.19	2.64	2.52	5.16	4.89
150	11.62	10.63	11.56	10.57	6.12	5.75	5.03	4.75	8.82	8.11	14.77	13.27	14.71	13.21	6.82	6.41	5.56	5.25	10.61	9.66
140	17.89	16.21	17.85	16.17	10.90	9.89	9.00	8.31	14.89	13.59	26.39	23.58	26.29	23.50	15.02	13.45	11.54	10.49	21.41	18.97
130	26.70	23.99	26.63	23.94	17.98	16.35	15.47	14.11	23.37	20.84	44.34	39.83	44.06	39.58	30.31	26.88	25.42	22.63	38.72	34.56
120	35.86	32.51	35.80	32.44	27.61	24.85	24.72	22.14	32.64	29.33	89.99	81.83	88.82	78.17	58.24	52.01	50.19	45.21	77.35	68.68

Table H-474. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.13	0.13	0.13	0.13	-	-	-	-	0.07	0.07	0.13	0.13	0.13	0.13	-	-	-	-	0.07	0.06
180	0.67	0.65	0.66	0.64	0.12	0.12	0.09	0.09	0.27	0.27	0.69	0.67	0.68	0.66	0.12	0.12	0.08	0.08	0.28	0.27
175	1.34	1.28	1.31	1.26	0.26	0.26	0.14	0.14	0.63	0.61	1.40	1.34	1.37	1.32	0.26	0.26	0.15	0.15	0.66	0.64
170	2.20	2.09	2.16	2.06	0.58	0.55	0.39	0.37	1.21	1.16	2.33	2.22	2.29	2.19	0.62	0.60	0.39	0.38	1.30	1.25
160	4.80	4.55	4.76	4.51	1.89	1.81	1.41	1.36	3.04	2.88	5.21	4.93	5.17	4.89	2.00	1.92	1.50	1.43	3.28	3.10
150	8.58	7.94	8.54	7.90	4.21	4.00	3.34	3.16	6.14	5.75	9.79	9.05	9.73	9.01	4.56	4.33	3.64	3.46	6.84	6.42
140	13.96	12.76	13.92	12.71	7.80	7.21	6.40	6.00	10.96	9.95	18.50	16.65	18.44	16.60	9.12	8.48	7.20	6.74	14.58	13.09
130	21.03	18.71	20.96	18.65	13.62	12.44	11.36	10.32	17.78	16.16	32.44	28.81	32.32	28.69	19.67	17.72	16.10	14.40	27.62	24.62
120	30.18	27.10	30.11	27.04	21.60	19.21	18.57	16.86	27.01	24.31	54.38	49.07	53.72	48.56	39.20	34.95	33.58	29.70	48.44	43.61

Table H-475. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.08	0.08	0.08	0.07	-	-	-	-	-	-	0.08	0.08	0.08	0.07	-	-	-	-	-	-
180	0.39	0.38	0.38	0.37	0.08	0.07	0.02	0.02	0.14	0.13	0.39	0.38	0.39	0.38	0.07	0.07	0.02	0.02	0.14	0.14
175	0.81	0.78	0.78	0.75	0.13	0.13	0.09	0.09	0.38	0.37	0.86	0.82	0.84	0.80	0.14	0.13	0.10	0.09	0.38	0.37
170	1.50	1.44	1.48	1.42	0.29	0.28	0.15	0.15	0.72	0.70	1.57	1.50	1.55	1.48	0.33	0.29	0.16	0.16	0.74	0.72
160	3.64	3.46	3.60	3.42	1.24	1.19	0.91	0.88	2.23	2.12	3.89	3.71	3.84	3.66	1.36	1.30	0.95	0.92	2.38	2.26
150	6.90	6.43	6.86	6.39	3.10	2.93	2.49	2.37	4.76	4.51	7.76	7.22	7.70	7.17	3.36	3.19	2.64	2.52	5.16	4.89
140	11.62	10.63	11.56	10.57	6.12	5.75	5.03	4.75	8.82	8.11	14.77	13.27	14.71	13.21	6.82	6.41	5.56	5.25	10.61	9.66
130	17.89	16.21	17.85	16.17	10.90	9.89	9.00	8.31	14.89	13.59	26.39	23.58	26.29	23.50	15.02	13.45	11.54	10.49	21.41	18.97
120	26.70	23.99	26.63	23.94	17.98	16.35	15.47	14.11	23.37	20.84	44.34	39.83	44.06	39.58	30.31	26.88	25.42	22.63	38.72	34.56

Table H-476. Monopile foundation (9.6 m diameter, IHC S-5500, 2300 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
180	0.14	0.14	0.14	0.14	-	-	-	-	0.08	0.08	0.15	0.14	0.15	0.14	-	-	-	-	0.08	0.07
175	0.39	0.38	0.38	0.37	0.08	0.07	0.02	0.02	0.14	0.13	0.39	0.38	0.39	0.38	0.07	0.07	0.02	0.02	0.14	0.14
170	0.81	0.78	0.78	0.75	0.13	0.13	0.09	0.09	0.38	0.37	0.86	0.82	0.84	0.80	0.14	0.13	0.10	0.09	0.38	0.37
160	2.45	2.32	2.41	2.30	0.64	0.62	0.42	0.41	1.40	1.34	2.56	2.44	2.53	2.41	0.67	0.65	0.43	0.41	1.47	1.40
150	5.12	4.84	5.08	4.80	2.04	1.94	1.53	1.47	3.32	3.15	5.59	5.27	5.54	5.23	2.23	2.12	1.65	1.58	3.58	3.40
140	9.00	8.31	8.96	8.28	4.49	4.25	3.63	3.44	6.54	6.10	10.52	9.57	10.44	9.51	4.89	4.63	3.94	3.74	7.40	6.89
130	14.58	13.28	14.53	13.24	8.26	7.62	6.76	6.33	11.68	10.63	19.45	17.52	19.39	17.47	9.79	9.04	7.76	7.23	15.60	13.98
120	22.14	19.60	22.06	19.54	14.28	13.04	12.06	11.00	18.56	16.81	34.11	30.31	33.96	30.18	21.34	18.90	17.37	15.55	29.23	26.00

Table H-477. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.17	0.17	0.17	0.16	-	-	-	-	0.07	0.07	0.18	0.18	0.18	0.17	-	-	-	-	0.07	0.06
190	0.91	0.87	0.90	0.86	0.12	0.12	0.08	0.08	0.37	0.36	0.94	0.90	0.92	0.88	0.13	0.13	0.08	0.08	0.36	0.34
180	2.66	2.53	2.63	2.50	0.65	0.63	0.40	0.38	1.44	1.38	2.79	2.66	2.76	2.63	0.65	0.63	0.40	0.38	1.53	1.46
175	3.93	3.73	3.91	3.69	1.30	1.24	0.86	0.83	2.36	2.25	4.25	4.01	4.20	3.97	1.35	1.29	0.89	0.85	2.49	2.38
170	5.38	5.05	5.33	5.01	2.05	1.95	1.52	1.46	3.48	3.29	5.89	5.49	5.83	5.45	2.21	2.11	1.61	1.54	3.78	3.56
160	8.91	8.23	8.86	8.18	4.47	4.22	3.58	3.40	6.44	6.02	10.30	9.28	10.21	9.23	4.87	4.57	3.89	3.67	7.19	6.64
150	14.26	12.85	14.20	12.80	7.78	7.23	6.49	6.08	10.74	9.73	18.02	16.11	17.95	16.05	8.91	8.17	7.27	6.73	14.02	12.48
140	21.07	18.66	20.98	18.60	13.17	12.01	10.81	9.83	17.59	15.88	29.97	26.72	29.86	26.62	17.96	16.14	14.61	13.04	25.12	22.48
130	30.08	26.90	30.01	26.84	21.20	18.71	18.29	16.45	26.80	23.94	54.86	49.85	53.97	48.99	35.92	31.94	29.80	26.64	48.36	42.80
120	40.88	36.63	40.78	36.53	31.34	27.91	28.28	25.26	36.56	32.89	89.99	84.49	89.99	84.41	89.99	81.75	78.00	68.04	89.99	84.23

Table H-478. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.07	0.06	0.06	0.06	-	-	-	-	-	-	0.06	0.06	0.06	0.06	-	-	-	-	-	-
190	0.36	0.35	0.35	0.34	0.03	0.03	-	-	0.13	0.12	0.34	0.33	0.33	0.32	0.03	0.03	-	-	0.13	0.13
180	1.50	1.44	1.48	1.41	0.26	0.25	0.13	0.13	0.67	0.64	1.57	1.50	1.54	1.47	0.24	0.23	0.14	0.14	0.66	0.64
175	2.47	2.35	2.44	2.32	0.57	0.54	0.33	0.30	1.32	1.27	2.60	2.47	2.56	2.44	0.58	0.57	0.32	0.31	1.37	1.31
170	3.65	3.47	3.62	3.43	1.11	1.06	0.76	0.70	2.10	2.00	3.95	3.73	3.91	3.69	1.18	1.13	0.82	0.78	2.26	2.14
160	6.65	6.21	6.61	6.17	2.89	2.75	2.21	2.10	4.56	4.31	7.40	6.84	7.34	6.79	3.07	2.91	2.37	2.26	4.97	4.66
150	10.75	9.68	10.67	9.62	5.66	5.31	4.64	4.38	7.96	7.38	13.34	11.91	13.27	11.85	6.24	5.81	5.07	4.75	9.17	8.40
140	16.69	15.05	16.65	15.00	9.42	8.71	8.02	7.44	13.38	12.16	22.16	19.57	22.05	19.47	11.91	10.65	9.22	8.45	17.65	15.78
130	24.98	22.26	24.92	22.20	16.01	14.55	13.59	12.37	20.82	18.47	37.27	33.20	37.01	32.98	23.62	21.12	19.04	17.20	31.54	28.05
120	33.82	30.29	33.75	30.22	25.51	22.70	22.21	19.50	30.49	27.19	82.05	71.68	79.64	69.16	50.90	45.38	43.42	37.75	68.88	60.46

Table H-479. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-
190	0.17	0.17	0.17	0.16	-	-	-	-	0.07	0.07	0.18	0.18	0.18	0.17	-	-	-	-	0.07	0.06
180	0.91	0.87	0.90	0.86	0.12	0.12	0.08	0.08	0.37	0.36	0.94	0.90	0.92	0.88	0.13	0.13	0.08	0.08	0.36	0.34
175	1.67	1.59	1.64	1.57	0.29	0.28	0.15	0.14	0.84	0.81	1.75	1.67	1.73	1.65	0.29	0.28	0.16	0.16	0.86	0.82
170	2.66	2.53	2.63	2.50	0.65	0.63	0.40	0.38	1.44	1.38	2.79	2.66	2.76	2.63	0.65	0.63	0.40	0.38	1.53	1.46
160	5.38	5.05	5.33	5.01	2.05	1.95	1.52	1.46	3.48	3.29	5.89	5.49	5.83	5.45	2.21	2.11	1.61	1.54	3.78	3.56
150	8.91	8.23	8.86	8.18	4.47	4.22	3.58	3.40	6.44	6.02	10.30	9.28	10.21	9.23	4.87	4.57	3.89	3.67	7.19	6.64
140	14.26	12.85	14.20	12.80	7.78	7.23	6.49	6.08	10.74	9.73	18.02	16.11	17.95	16.05	8.91	8.17	7.27	6.73	14.02	12.48
130	21.07	18.66	20.98	18.60	13.17	12.01	10.81	9.83	17.59	15.88	29.97	26.72	29.86	26.62	17.96	16.14	14.61	13.04	25.12	22.48
120	30.08	26.90	30.01	26.84	21.20	18.71	18.29	16.45	26.80	23.94	54.86	49.85	53.97	48.99	35.92	31.94	29.80	26.64	48.36	42.80

Table H-480. Monopile foundation (9.6 m diameter, IHC S-5500, 5500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location L03 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	0.08	0.07	0.07	0.07	-	-	-	-	-	-	0.07	0.07	0.07	0.07	-	-	-	-	-	-
180	0.46	0.44	0.44	0.42	0.06	0.06	0.02	0.02	0.14	0.14	0.48	0.46	0.46	0.43	0.06	0.06	0.02	0.02	0.15	0.15
175	0.91	0.87	0.90	0.86	0.12	0.12	0.08	0.08	0.37	0.36	0.94	0.90	0.92	0.88	0.13	0.13	0.08	0.08	0.36	0.34
170	1.67	1.59	1.64	1.57	0.29	0.28	0.15	0.14	0.84	0.81	1.75	1.67	1.73	1.65	0.29	0.28	0.16	0.16	0.86	0.82
160	3.93	3.73	3.91	3.69	1.30	1.24	0.86	0.83	2.36	2.25	4.25	4.01	4.20	3.97	1.35	1.29	0.89	0.85	2.49	2.38
150	6.97	6.51	6.93	6.47	3.11	2.93	2.46	2.34	4.85	4.57	7.85	7.24	7.79	7.19	3.37	3.19	2.60	2.48	5.31	4.97
140	11.37	10.26	11.32	10.19	5.97	5.60	4.92	4.64	8.38	7.76	14.09	12.55	14.02	12.49	6.61	6.15	5.40	5.06	9.70	8.87
130	17.34	15.64	17.28	15.59	9.82	9.07	8.44	7.82	14.05	12.72	23.49	20.87	23.39	20.78	12.87	11.52	9.75	8.92	18.57	16.66
120	25.81	23.08	25.75	23.02	16.81	15.23	14.29	12.98	21.98	19.33	40.18	35.53	39.64	35.22	25.26	22.66	20.25	18.28	33.56	29.80

H.3.3. Jacket Foundation

Table H-481. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
180	0.09	0.09	0.09	0.08	0.01	0.01	0.00	0.00	0.06	0.06	0.09	0.09	0.09	0.09	0.01	0.01	0.00	0.00	0.06	0.06
175	0.19	0.18	0.18	0.18	0.06	0.06	0.03	0.03	0.10	0.09	0.20	0.19	0.19	0.19	0.06	0.06	0.03	0.03	0.10	0.09
170	0.48	0.46	0.48	0.46	0.10	0.09	0.07	0.07	0.25	0.24	0.49	0.47	0.49	0.47	0.11	0.10	0.07	0.07	0.24	0.24
160	1.59	1.51	1.58	1.50	0.54	0.52	0.35	0.34	0.99	0.95	1.67	1.59	1.66	1.58	0.56	0.53	0.36	0.35	1.04	0.99
150	3.63	3.41	3.61	3.39	1.69	1.61	1.30	1.24	2.57	2.44	4.05	3.79	4.02	3.77	1.78	1.69	1.37	1.31	2.76	2.62
140	6.44	5.89	6.42	5.88	3.74	3.50	2.93	2.78	5.16	4.78	7.74	6.94	7.71	6.91	4.16	3.87	3.23	3.03	6.03	5.53
130	9.92	9.04	9.91	9.02	6.63	6.07	5.64	5.20	8.68	7.87	13.61	12.22	13.57	12.19	8.37	7.50	6.68	6.06	11.47	10.23
120	15.12	13.63	15.10	13.60	10.78	9.68	9.34	8.49	13.53	12.25	23.38	20.76	23.26	20.64	15.62	14.00	13.16	11.86	19.88	17.75

Table H-482. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00
175	0.07	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.05	0.04	0.08	0.08	0.07	0.07	0.00	0.00	0.00	0.00	0.05	0.05
170	0.16	0.15	0.16	0.15	0.05	0.05	0.02	0.02	0.08	0.08	0.16	0.15	0.15	0.15	0.05	0.05	0.01	0.01	0.09	0.08
160	0.81	0.77	0.80	0.77	0.20	0.19	0.12	0.12	0.47	0.45	0.85	0.81	0.84	0.80	0.19	0.19	0.12	0.11	0.48	0.46
150	2.27	2.15	2.25	2.14	0.91	0.87	0.65	0.62	1.54	1.46	2.44	2.32	2.42	2.30	0.95	0.91	0.69	0.66	1.61	1.53
140	4.71	4.37	4.69	4.35	2.38	2.25	1.86	1.77	3.50	3.29	5.31	4.90	5.29	4.88	2.54	2.42	1.96	1.86	3.93	3.67
130	7.83	7.08	7.81	7.06	4.79	4.45	4.03	3.75	6.41	5.88	9.60	8.66	9.57	8.64	5.47	5.04	4.45	4.12	7.95	7.12
120	12.14	10.95	12.11	10.92	8.19	7.43	6.94	6.34	10.20	9.24	16.71	14.94	16.65	14.88	10.75	9.55	8.87	7.95	14.43	12.96

Table H-483. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
175	0.04	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.01	0.01	0.05	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.01	0.01
170	0.09	0.08	0.09	0.08	0.01	0.01	0.00	0.00	0.06	0.06	0.09	0.09	0.09	0.09	0.01	0.01	0.00	0.00	0.06	0.06
160	0.48	0.46	0.48	0.46	0.10	0.09	0.07	0.07	0.25	0.24	0.49	0.47	0.49	0.47	0.11	0.10	0.07	0.07	0.24	0.24
150	1.59	1.51	1.58	1.50	0.54	0.52	0.35	0.34	0.99	0.95	1.67	1.59	1.66	1.58	0.55	0.53	0.36	0.35	1.04	0.99
140	3.63	3.41	3.61	3.39	1.69	1.61	1.30	1.24	2.57	2.44	4.05	3.79	4.02	3.77	1.78	1.69	1.37	1.31	2.76	2.62
130	6.44	5.89	6.42	5.88	3.74	3.50	2.93	2.78	5.16	4.78	7.74	6.94	7.71	6.91	4.16	3.87	3.23	3.03	6.03	5.53
120	9.92	9.04	9.91	9.02	6.63	6.07	5.64	5.20	8.68	7.87	13.61	12.22	13.57	12.19	8.37	7.50	6.68	6.06	11.47	10.23

Table H-484. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
175	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
170	0.04	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.01	0.01	0.05	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.01	0.01
160	0.19	0.18	0.18	0.18	0.06	0.06	0.03	0.03	0.10	0.09	0.20	0.19	0.19	0.19	0.06	0.06	0.03	0.03	0.10	0.09
150	0.93	0.89	0.92	0.88	0.26	0.25	0.16	0.16	0.53	0.51	0.96	0.92	0.95	0.91	0.26	0.25	0.16	0.16	0.54	0.52
140	2.48	2.35	2.47	2.34	1.01	0.96	0.73	0.70	1.67	1.59	2.65	2.52	2.64	2.50	1.08	1.02	0.76	0.72	1.77	1.68
130	4.97	4.61	4.95	4.59	2.57	2.43	1.99	1.89	3.78	3.56	5.66	5.20	5.64	5.18	2.75	2.60	2.14	2.03	4.25	3.95
120	8.20	7.42	8.17	7.40	5.07	4.69	4.29	3.98	6.74	6.17	10.06	9.07	10.01	9.05	5.87	5.39	4.76	4.39	8.47	7.60

Table H-485. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
180	0.12	0.11	0.11	0.11	0.02	0.02	0.01	0.01	0.04	0.04	0.12	0.12	0.12	0.11	0.02	0.02	0.01	0.01	0.04	0.04
175	0.26	0.25	0.25	0.25	0.04	0.04	0.03	0.03	0.11	0.11	0.26	0.25	0.25	0.25	0.05	0.04	0.03	0.03	0.12	0.12
170	0.57	0.55	0.56	0.54	0.11	0.10	0.06	0.06	0.27	0.26	0.55	0.53	0.54	0.52	0.11	0.10	0.06	0.06	0.27	0.26
160	2.01	1.92	1.99	1.91	0.58	0.56	0.36	0.35	1.25	1.20	2.13	2.02	2.10	2.00	0.58	0.55	0.36	0.35	1.27	1.22
150	4.81	4.48	4.79	4.46	2.18	2.08	1.55	1.48	3.67	3.45	5.50	5.10	5.49	5.08	2.41	2.28	1.63	1.56	4.19	3.94
140	8.54	7.74	8.52	7.72	5.37	5.00	4.34	4.07	7.23	6.59	11.33	10.12	11.29	10.07	6.76	6.19	5.21	4.88	9.52	8.62
130	13.51	12.25	13.48	12.22	9.65	8.80	8.42	7.65	12.20	11.02	22.19	19.50	22.01	19.35	14.91	13.39	12.44	11.19	19.28	17.16
120	19.47	17.46	19.44	17.43	15.45	13.95	13.86	12.56	18.12	16.23	44.48	38.57	43.78	37.98	31.40	28.01	27.28	24.22	39.36	34.50

Table H-486. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.02	0.02
175	0.11	0.10	0.11	0.10	0.02	0.02	0.01	0.01	0.04	0.04	0.11	0.10	0.11	0.10	0.02	0.02	0.01	0.01	0.04	0.04
170	0.23	0.22	0.22	0.22	0.04	0.04	0.03	0.03	0.11	0.10	0.22	0.22	0.22	0.21	0.04	0.04	0.03	0.03	0.11	0.10
160	1.01	0.95	0.99	0.94	0.23	0.23	0.13	0.13	0.51	0.49	0.99	0.95	0.99	0.95	0.23	0.22	0.13	0.13	0.51	0.49
150	2.95	2.80	2.93	2.79	1.05	1.00	0.68	0.65	1.96	1.88	3.24	3.05	3.22	3.02	1.10	1.05	0.69	0.66	2.10	2.00
140	6.11	5.64	6.09	5.62	3.30	3.10	2.45	2.33	4.98	4.64	7.48	6.74	7.45	6.72	3.85	3.62	2.72	2.57	5.93	5.50
130	10.10	9.18	10.08	9.16	6.93	6.36	5.76	5.36	9.04	8.21	14.69	13.17	14.61	13.12	9.45	8.56	7.61	6.88	12.83	11.54
120	15.73	14.17	15.70	14.14	12.00	10.86	10.18	9.25	14.39	13.00	29.00	25.77	28.79	25.56	19.99	17.79	16.81	15.02	26.02	23.16

Table H-487. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
175	0.04	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.02	0.02	0.04	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.02	0.02
170	0.12	0.11	0.12	0.11	0.02	0.02	0.01	0.01	0.04	0.04	0.12	0.12	0.12	0.11	0.02	0.02	0.01	0.01	0.04	0.04
160	0.57	0.55	0.56	0.54	0.11	0.10	0.06	0.06	0.27	0.26	0.55	0.53	0.54	0.52	0.11	0.10	0.06	0.06	0.27	0.26
150	2.01	1.92	1.99	1.91	0.58	0.56	0.36	0.35	1.25	1.20	2.13	2.02	2.10	2.00	0.58	0.55	0.36	0.35	1.27	1.22
140	4.81	4.48	4.79	4.46	2.18	2.08	1.55	1.48	3.67	3.45	5.50	5.10	5.49	5.08	2.41	2.28	1.63	1.56	4.19	3.94
130	8.54	7.74	8.52	7.72	5.37	5.00	4.34	4.07	7.23	6.59	11.33	10.12	11.29	10.07	6.76	6.19	5.21	4.88	9.52	8.62
120	13.51	12.25	13.48	12.22	9.65	8.80	8.42	7.65	12.20	11.02	22.19	19.50	22.01	19.35	14.91	13.39	12.44	11.19	19.28	17.16

Table H-488. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
175	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
170	0.04	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.02	0.02	0.04	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.02	0.02
160	0.26	0.25	0.25	0.25	0.04	0.04	0.03	0.03	0.12	0.11	0.26	0.25	0.25	0.25	0.05	0.04	0.03	0.03	0.12	0.12
150	1.19	1.13	1.17	1.12	0.26	0.25	0.15	0.15	0.60	0.58	1.19	1.13	1.17	1.11	0.26	0.26	0.16	0.15	0.59	0.56
140	3.24	3.06	3.22	3.04	1.21	1.16	0.79	0.76	2.24	2.13	3.63	3.41	3.60	3.39	1.25	1.19	0.81	0.77	2.42	2.30
130	6.48	5.94	6.46	5.93	3.65	3.43	2.71	2.57	5.31	4.95	8.09	7.28	8.06	7.25	4.26	4.01	3.00	2.84	6.46	5.93
120	10.75	9.64	10.71	9.62	7.40	6.74	6.15	5.70	9.43	8.59	15.65	14.00	15.56	13.94	10.06	9.12	8.35	7.53	13.70	12.32

Table H-489. Jacket foundation (2.5 m diameter, IHC S-4000, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.04	0.04	0.03	0.03	0.01	0.01	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.01	0.01	0.00	0.00	0.02	0.02
180	0.24	0.23	0.24	0.23	0.04	0.04	0.03	0.03	0.12	0.12	0.24	0.23	0.23	0.23	0.04	0.04	0.03	0.03	0.13	0.12
175	0.46	0.45	0.46	0.45	0.12	0.11	0.06	0.06	0.26	0.26	0.46	0.45	0.46	0.45	0.12	0.12	0.06	0.06	0.26	0.25
170	1.03	0.94	1.02	0.93	0.26	0.26	0.16	0.16	0.55	0.54	0.95	0.91	0.94	0.91	0.26	0.25	0.17	0.17	0.55	0.53
160	2.92	2.78	2.91	2.77	1.19	1.14	0.79	0.76	2.04	1.93	3.05	2.87	3.03	2.86	1.15	1.10	0.76	0.73	1.99	1.91
150	6.23	5.74	6.21	5.72	3.61	3.41	2.72	2.59	5.19	4.83	7.54	6.78	7.50	6.75	3.98	3.72	2.81	2.65	6.04	5.58
140	10.64	9.56	10.60	9.53	7.62	6.93	6.37	5.89	9.47	8.63	15.46	13.87	15.38	13.80	10.12	9.15	8.39	7.55	13.61	12.26
130	16.52	14.87	16.48	14.83	13.04	11.85	11.52	10.42	15.25	13.78	31.81	28.39	31.50	28.07	23.35	20.66	19.25	17.16	29.01	25.75
120	24.79	22.06	24.71	21.99	19.55	17.55	17.97	16.12	23.01	20.39	73.61	62.47	70.74	60.04	51.32	45.41	45.62	39.47	66.38	56.18

Table H-490. Jacket foundation (2.5 m diameter, IHC S-4000, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
180	0.11	0.10	0.11	0.10	0.02	0.02	0.01	0.01	0.03	0.03	0.11	0.10	0.11	0.10	0.02	0.02	0.01	0.01	0.03	0.03
175	0.21	0.20	0.20	0.19	0.03	0.03	0.03	0.03	0.11	0.10	0.21	0.20	0.20	0.20	0.03	0.03	0.03	0.03	0.11	0.10
170	0.43	0.41	0.42	0.41	0.10	0.10	0.05	0.05	0.23	0.22	0.43	0.42	0.43	0.41	0.10	0.10	0.05	0.05	0.23	0.22
160	1.63	1.56	1.62	1.55	0.47	0.46	0.32	0.31	1.04	0.93	1.62	1.54	1.60	1.53	0.48	0.47	0.31	0.30	1.00	0.95
150	4.22	3.95	4.20	3.93	1.89	1.80	1.35	1.29	3.07	2.91	4.60	4.28	4.58	4.26	1.88	1.79	1.33	1.27	3.33	3.11
140	7.93	7.18	7.91	7.16	5.06	4.72	4.08	3.84	6.74	6.19	9.93	9.00	9.91	8.98	5.95	5.51	4.55	4.26	8.67	7.78
130	12.99	11.77	12.96	11.75	9.49	8.66	8.32	7.56	11.77	10.62	20.64	18.24	20.43	18.10	14.18	12.79	11.77	10.57	18.33	16.36
120	19.17	17.18	19.13	17.14	15.46	13.98	13.95	12.65	17.93	16.07	44.40	38.46	43.56	37.78	31.43	28.01	27.31	24.20	39.22	34.44

Table H-491. Jacket foundation (2.5 m diameter, IHC S-4000, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.04	0.04	0.03	0.03	0.01	0.01	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.01	0.01	0.00	0.00	0.02	0.02
175	0.12	0.12	0.12	0.11	0.02	0.02	0.01	0.01	0.04	0.04	0.12	0.12	0.12	0.12	0.02	0.02	0.01	0.01	0.04	0.04
170	0.24	0.23	0.24	0.23	0.04	0.04	0.03	0.03	0.13	0.12	0.24	0.23	0.23	0.23	0.04	0.04	0.03	0.03	0.13	0.12
160	1.04	0.94	1.02	0.93	0.26	0.26	0.16	0.16	0.55	0.54	0.95	0.91	0.94	0.91	0.26	0.25	0.17	0.17	0.55	0.53
150	2.92	2.78	2.91	2.77	1.19	1.14	0.79	0.76	2.04	1.93	3.05	2.87	3.03	2.86	1.15	1.10	0.76	0.73	1.99	1.91
140	6.23	5.74	6.21	5.72	3.61	3.41	2.72	2.59	5.19	4.83	7.54	6.78	7.50	6.75	3.98	3.72	2.81	2.65	6.04	5.58
130	10.64	9.56	10.60	9.53	7.62	6.93	6.37	5.89	9.47	8.63	15.46	13.87	15.38	13.80	10.12	9.15	8.39	7.55	13.61	12.26
120	16.52	14.87	16.48	14.83	13.04	11.85	11.52	10.42	15.25	13.78	31.81	28.39	31.50	28.07	23.35	20.66	19.25	17.16	29.01	25.75

Table H-492. Jacket foundation (2.5 m diameter, IHC S-4000, 2000 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01
175	0.04	0.04	0.03	0.03	0.01	0.01	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.01	0.01	0.00	0.00	0.02	0.02
170	0.12	0.12	0.12	0.11	0.02	0.02	0.01	0.01	0.04	0.04	0.12	0.12	0.12	0.12	0.02	0.02	0.01	0.01	0.04	0.04
160	0.46	0.45	0.46	0.45	0.12	0.11	0.06	0.06	0.26	0.26	0.46	0.45	0.46	0.45	0.12	0.12	0.06	0.06	0.26	0.25
150	1.83	1.75	1.82	1.74	0.55	0.53	0.37	0.36	1.18	1.13	1.82	1.73	1.80	1.71	0.56	0.54	0.37	0.35	1.15	1.08
140	4.53	4.22	4.52	4.21	2.14	2.04	1.53	1.46	3.46	3.25	5.00	4.64	4.98	4.62	2.09	1.99	1.51	1.44	3.75	3.52
130	8.38	7.59	8.36	7.57	5.43	5.06	4.43	4.15	7.18	6.55	10.83	9.66	10.77	9.62	6.58	6.02	5.05	4.71	9.30	8.38
120	13.54	12.27	13.51	12.24	9.89	9.05	8.80	8.00	12.37	11.19	22.53	19.89	22.34	19.69	15.34	13.78	12.78	11.54	19.62	17.50

Table H-493. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
190	0.10	0.09	0.09	0.09	0.01	0.01	0.00	0.00	0.03	0.03	0.09	0.09	0.09	0.09	0.01	0.01	0.00	0.00	0.03	0.03
180	0.31	0.30	0.30	0.29	0.07	0.07	0.03	0.03	0.15	0.15	0.31	0.30	0.30	0.29	0.07	0.07	0.03	0.03	0.16	0.15
175	0.66	0.63	0.65	0.62	0.16	0.15	0.10	0.10	0.34	0.33	0.64	0.59	0.60	0.58	0.16	0.16	0.10	0.10	0.33	0.32
170	1.24	1.19	1.23	1.18	0.36	0.35	0.21	0.20	0.72	0.69	1.21	1.17	1.21	1.16	0.35	0.34	0.21	0.21	0.71	0.68
160	3.33	3.13	3.31	3.11	1.45	1.38	1.02	0.93	2.39	2.27	3.46	3.25	3.43	3.23	1.39	1.33	0.99	0.95	2.38	2.26
150	6.73	6.17	6.71	6.16	4.17	3.92	3.20	3.03	5.69	5.29	8.28	7.42	8.25	7.39	4.52	4.21	3.27	3.07	6.71	6.12
140	11.59	10.43	11.56	10.40	8.48	7.73	7.22	6.61	10.15	9.24	17.16	15.39	17.05	15.29	11.73	10.51	9.52	8.60	15.11	13.60
130	17.67	15.85	17.61	15.80	14.23	12.89	12.83	11.65	16.42	14.78	36.28	32.69	35.67	32.10	27.40	24.25	23.13	20.47	32.89	29.47
120	26.39	23.50	26.30	23.43	21.74	19.16	19.53	17.53	24.95	22.19	88.54	79.74	84.33	73.79	69.51	59.27	61.05	51.72	80.66	69.29

Table H-494. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.01	0.01
180	0.14	0.13	0.14	0.13	0.03	0.03	0.01	0.01	0.05	0.04	0.14	0.13	0.14	0.13	0.03	0.03	0.01	0.01	0.07	0.07
175	0.27	0.26	0.26	0.25	0.05	0.04	0.03	0.03	0.14	0.14	0.27	0.26	0.27	0.26	0.05	0.05	0.03	0.03	0.14	0.14
170	0.53	0.52	0.53	0.51	0.14	0.13	0.09	0.09	0.29	0.28	0.53	0.51	0.52	0.50	0.14	0.14	0.09	0.09	0.29	0.28
160	1.88	1.79	1.87	1.78	0.67	0.64	0.42	0.40	1.23	1.18	1.87	1.78	1.86	1.77	0.65	0.61	0.43	0.41	1.21	1.17
150	4.61	4.29	4.59	4.28	2.28	2.16	1.65	1.57	3.56	3.35	5.01	4.64	4.99	4.62	2.23	2.10	1.60	1.53	3.76	3.52
140	8.54	7.75	8.52	7.73	5.66	5.28	4.69	4.38	7.41	6.74	11.05	9.85	11.00	9.80	6.79	6.18	5.23	4.86	9.47	8.54
130	13.88	12.55	13.84	12.52	10.41	9.43	9.21	8.43	12.73	11.54	23.55	20.91	23.33	20.69	16.23	14.59	13.52	12.24	20.64	18.27
120	20.47	18.22	20.37	18.16	16.91	15.21	15.32	13.86	19.15	17.18	51.46	45.50	50.10	43.97	37.21	33.62	32.31	28.84	46.98	40.80

Table H-495. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
180	0.10	0.09	0.09	0.09	0.01	0.01	0.00	0.00	0.03	0.03	0.09	0.09	0.09	0.09	0.01	0.01	0.00	0.00	0.03	0.03
175	0.15	0.15	0.15	0.14	0.03	0.03	0.02	0.02	0.08	0.08	0.17	0.16	0.16	0.15	0.03	0.03	0.02	0.02	0.08	0.08
170	0.31	0.30	0.30	0.29	0.07	0.07	0.03	0.03	0.15	0.15	0.31	0.30	0.30	0.29	0.07	0.07	0.03	0.03	0.16	0.15
160	1.24	1.19	1.23	1.18	0.36	0.35	0.21	0.20	0.72	0.70	1.21	1.17	1.21	1.16	0.35	0.34	0.21	0.21	0.71	0.68
150	3.33	3.13	3.31	3.11	1.45	1.38	1.02	0.93	2.39	2.27	3.46	3.25	3.43	3.23	1.39	1.33	0.99	0.95	2.38	2.26
140	6.73	6.17	6.71	6.16	4.17	3.92	3.20	3.03	5.69	5.29	8.28	7.42	8.25	7.39	4.52	4.21	3.27	3.07	6.71	6.12
130	11.59	10.43	11.56	10.40	8.48	7.73	7.22	6.61	10.15	9.24	17.16	15.39	17.05	15.29	11.73	10.51	9.52	8.60	15.11	13.60
120	17.67	15.85	17.61	15.80	14.23	12.89	12.83	11.65	16.42	14.78	36.28	32.69	35.67	32.10	27.40	24.25	23.13	20.47	32.89	29.47

Table H-496. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS1 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.01	0.01
175	0.10	0.09	0.09	0.09	0.01	0.01	0.00	0.00	0.03	0.03	0.09	0.09	0.09	0.09	0.01	0.01	0.00	0.00	0.03	0.03
170	0.15	0.15	0.15	0.14	0.03	0.03	0.02	0.02	0.08	0.08	0.17	0.16	0.16	0.15	0.03	0.03	0.02	0.02	0.08	0.08
160	0.66	0.63	0.65	0.62	0.16	0.15	0.10	0.10	0.34	0.33	0.64	0.59	0.60	0.58	0.16	0.16	0.10	0.10	0.33	0.32
150	2.08	1.97	2.04	1.94	0.75	0.72	0.47	0.46	1.37	1.31	2.01	1.92	1.99	1.90	0.73	0.69	0.48	0.46	1.32	1.27
140	4.93	4.58	4.92	4.57	2.52	2.40	1.86	1.77	3.93	3.70	5.44	5.03	5.42	5.00	2.51	2.39	1.82	1.73	4.19	3.91
130	8.97	8.15	8.95	8.13	6.09	5.65	5.06	4.73	7.91	7.19	11.96	10.74	11.91	10.69	7.55	6.78	5.78	5.37	10.13	9.13
120	14.44	13.05	14.42	13.02	11.12	10.04	9.66	8.85	13.31	12.07	25.49	22.67	25.22	22.43	17.71	15.87	14.73	13.29	22.66	20.03

Table H-497. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.06	0.06	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.06	0.06
175	0.16	0.16	0.16	0.16	0.06	0.06	0.02	0.02	0.09	0.09	0.16	0.15	0.16	0.15	0.06	0.06	0.02	0.02	0.09	0.09
170	0.46	0.44	0.45	0.44	0.09	0.09	0.07	0.07	0.22	0.21	0.46	0.44	0.46	0.44	0.10	0.09	0.07	0.07	0.20	0.19
160	1.67	1.60	1.64	1.58	0.49	0.47	0.31	0.30	1.02	0.98	1.74	1.67	1.72	1.65	0.51	0.50	0.33	0.32	1.05	1.00
150	4.09	3.88	4.06	3.86	1.78	1.70	1.33	1.26	2.80	2.67	4.53	4.30	4.50	4.28	1.86	1.79	1.39	1.34	2.97	2.83
140	7.51	7.02	7.48	6.99	4.19	3.96	3.35	3.14	5.82	5.47	9.23	8.59	9.20	8.55	4.61	4.37	3.68	3.47	6.85	6.43
130	12.61	11.62	12.56	11.58	7.59	7.10	6.41	6.02	9.99	9.28	17.76	16.11	17.69	16.05	9.62	8.94	7.68	7.17	14.51	13.27
120	18.72	17.03	18.68	16.99	12.98	11.93	10.97	10.07	16.40	14.95	31.58	28.06	31.34	27.85	20.22	18.33	17.04	15.46	27.46	24.48

Table H-498. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00
175	0.07	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.05	0.05	0.07	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.05	0.05
170	0.13	0.13	0.13	0.13	0.05	0.05	0.00	0.00	0.08	0.08	0.14	0.13	0.14	0.13	0.05	0.05	0.00	0.00	0.08	0.08
160	0.78	0.75	0.77	0.75	0.20	0.19	0.11	0.11	0.45	0.44	0.80	0.77	0.78	0.76	0.18	0.17	0.12	0.11	0.45	0.44
150	2.48	2.37	2.45	2.35	0.93	0.88	0.58	0.56	1.59	1.53	2.65	2.53	2.62	2.51	0.96	0.92	0.63	0.61	1.66	1.60
140	5.30	5.01	5.28	4.99	2.59	2.47	1.96	1.88	3.93	3.72	6.12	5.76	6.09	5.73	2.75	2.62	2.08	1.99	4.34	4.12
130	9.25	8.60	9.23	8.58	5.38	5.08	4.48	4.24	7.33	6.85	12.29	11.30	12.24	11.25	6.19	5.82	4.99	4.72	9.25	8.61
120	14.89	13.65	14.86	13.61	9.37	8.71	8.00	7.48	12.65	11.64	22.54	20.05	22.41	19.93	13.44	12.33	10.32	9.50	18.69	16.95

Table H-499. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
175	0.04	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00
170	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.06	0.06	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.06	0.06
160	0.46	0.44	0.45	0.44	0.09	0.09	0.07	0.07	0.22	0.21	0.46	0.44	0.46	0.44	0.10	0.09	0.07	0.07	0.20	0.19
150	1.67	1.60	1.64	1.58	0.49	0.47	0.31	0.30	1.02	0.98	1.74	1.67	1.72	1.65	0.51	0.50	0.33	0.32	1.05	1.00
140	4.09	3.88	4.06	3.86	1.78	1.70	1.33	1.26	2.80	2.67	4.53	4.30	4.50	4.28	1.86	1.79	1.39	1.34	2.97	2.83
130	7.51	7.02	7.48	6.99	4.19	3.96	3.35	3.14	5.82	5.47	9.23	8.59	9.20	8.55	4.61	4.37	3.68	3.47	6.85	6.43
120	12.61	11.62	12.56	11.58	7.59	7.10	6.41	6.02	9.99	9.28	17.76	16.11	17.69	16.05	9.62	8.94	7.68	7.17	14.51	13.27

Table H-500. Jacket foundation (2.5 m diameter, IHC S-4000, 500 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
175	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.04	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00
160	0.16	0.16	0.16	0.16	0.06	0.06	0.02	0.02	0.09	0.09	0.16	0.15	0.16	0.15	0.06	0.06	0.02	0.02	0.09	0.09
150	0.93	0.90	0.92	0.89	0.22	0.22	0.12	0.12	0.48	0.46	0.96	0.93	0.95	0.91	0.21	0.20	0.12	0.12	0.49	0.48
140	2.70	2.58	2.68	2.56	1.03	0.98	0.68	0.66	1.76	1.69	2.87	2.74	2.85	2.72	1.07	1.02	0.72	0.70	1.85	1.77
130	5.64	5.32	5.61	5.30	2.80	2.66	2.17	2.07	4.22	3.99	6.55	6.16	6.52	6.13	2.96	2.82	2.32	2.22	4.69	4.45
120	9.66	8.98	9.64	8.95	5.72	5.39	4.76	4.51	7.79	7.27	13.11	12.04	13.05	12.00	6.65	6.24	5.37	5.06	9.85	9.15

Table H-501. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00
180	0.12	0.12	0.12	0.12	0.03	0.03	0.00	0.00	0.06	0.06	0.13	0.13	0.13	0.12	0.03	0.03	0.00	0.00	0.06	0.06
175	0.30	0.29	0.29	0.28	0.06	0.06	0.04	0.04	0.12	0.12	0.29	0.28	0.29	0.28	0.06	0.06	0.04	0.04	0.12	0.11
170	0.67	0.65	0.66	0.64	0.13	0.13	0.07	0.07	0.31	0.30	0.67	0.65	0.66	0.64	0.13	0.13	0.07	0.07	0.32	0.31
160	2.49	2.38	2.47	2.36	0.68	0.65	0.40	0.38	1.40	1.34	2.66	2.54	2.63	2.51	0.68	0.65	0.41	0.39	1.48	1.42
150	5.80	5.46	5.77	5.44	2.38	2.28	1.70	1.60	4.17	3.98	6.85	6.43	6.81	6.40	2.66	2.53	1.80	1.72	4.90	4.65
140	10.42	9.58	10.38	9.55	5.94	5.60	4.61	4.39	8.55	7.97	14.98	13.72	14.92	13.66	7.68	7.21	5.70	5.40	12.12	11.16
130	17.05	15.53	17.00	15.49	11.41	10.48	9.30	8.68	14.88	13.62	29.47	26.22	29.27	26.06	18.27	16.66	14.65	13.47	25.43	22.72
120	25.94	23.17	25.86	23.11	18.50	16.83	16.20	14.81	23.21	20.66	55.94	50.22	54.98	49.41	39.14	34.69	32.65	29.02	49.61	44.51

Table H-502. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.02	0.02	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.02	0.02
175	0.11	0.10	0.11	0.10	0.02	0.02	0.00	0.00	0.06	0.06	0.11	0.10	0.11	0.10	0.02	0.02	0.00	0.00	0.05	0.05
170	0.25	0.24	0.24	0.24	0.06	0.06	0.04	0.04	0.10	0.10	0.24	0.24	0.24	0.24	0.06	0.06	0.04	0.04	0.10	0.10
160	1.22	1.17	1.20	1.16	0.27	0.26	0.16	0.16	0.59	0.56	1.26	1.20	1.24	1.19	0.27	0.26	0.16	0.15	0.60	0.57
150	3.67	3.49	3.64	3.46	1.17	1.12	0.77	0.74	2.27	2.16	4.10	3.90	4.07	3.87	1.23	1.18	0.79	0.76	2.49	2.38
140	7.45	6.96	7.42	6.93	3.58	3.41	2.58	2.47	5.75	5.41	9.45	8.78	9.41	8.75	4.26	4.05	2.91	2.77	7.06	6.64
130	13.12	12.05	13.08	12.02	7.84	7.32	6.29	5.92	10.82	9.92	19.31	17.58	19.23	17.51	11.20	10.34	8.40	7.89	16.39	14.94
120	19.80	17.96	19.74	17.93	14.15	12.97	12.02	11.06	17.72	16.13	38.10	33.74	37.76	33.43	25.28	22.62	19.77	18.08	33.19	29.46

Table H-503. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00
175	0.06	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.03	0.03	0.06	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.03	0.03
170	0.12	0.12	0.12	0.12	0.03	0.03	0.00	0.00	0.06	0.06	0.13	0.13	0.13	0.12	0.03	0.03	0.00	0.00	0.06	0.06
160	0.67	0.65	0.66	0.64	0.13	0.13	0.07	0.07	0.31	0.30	0.67	0.65	0.66	0.64	0.13	0.13	0.07	0.07	0.32	0.31
150	2.49	2.38	2.47	2.36	0.68	0.65	0.40	0.38	1.40	1.34	2.66	2.54	2.63	2.51	0.68	0.65	0.41	0.39	1.48	1.42
140	5.80	5.46	5.77	5.44	2.38	2.28	1.70	1.60	4.17	3.98	6.85	6.43	6.81	6.40	2.66	2.53	1.80	1.72	4.90	4.65
130	10.42	9.58	10.38	9.55	5.94	5.60	4.61	4.39	8.55	7.98	14.98	13.72	14.92	13.66	7.68	7.21	5.70	5.40	12.12	11.16
120	17.05	15.53	17.00	15.49	11.41	10.48	9.30	8.68	14.88	13.62	29.47	26.22	29.27	26.06	18.27	16.66	14.65	13.47	25.43	22.72

Table H-504. Jacket foundation (2.5 m diameter, IHC S-4000, 750 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
175	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00
170	0.06	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.03	0.03	0.06	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.03	0.03
160	0.30	0.29	0.29	0.28	0.06	0.06	0.04	0.04	0.12	0.12	0.29	0.28	0.29	0.28	0.06	0.06	0.04	0.04	0.12	0.11
150	1.41	1.35	1.39	1.33	0.31	0.30	0.19	0.18	0.68	0.65	1.44	1.39	1.43	1.37	0.32	0.31	0.18	0.17	0.68	0.65
140	4.00	3.82	3.97	3.79	1.32	1.27	0.89	0.86	2.54	2.42	4.48	4.27	4.46	4.24	1.40	1.34	0.90	0.87	2.79	2.65
130	7.94	7.41	7.91	7.38	3.94	3.76	2.85	2.72	6.16	5.80	10.12	9.36	10.06	9.32	4.73	4.49	3.31	3.13	7.79	7.28
120	13.73	12.60	13.70	12.56	8.36	7.81	6.73	6.32	11.57	10.62	20.63	18.61	20.49	18.51	12.32	11.38	9.23	8.63	17.58	15.99

Table H-505. Jacket foundation (2.5 m diameter, IHC S-4000, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00
180	0.15	0.14	0.15	0.14	0.03	0.03	0.02	0.02	0.06	0.06	0.15	0.15	0.15	0.14	0.03	0.03	0.02	0.02	0.06	0.06
175	0.35	0.34	0.34	0.33	0.06	0.06	0.04	0.04	0.16	0.15	0.34	0.33	0.33	0.32	0.06	0.06	0.04	0.04	0.16	0.15
170	0.66	0.64	0.65	0.63	0.14	0.14	0.09	0.09	0.35	0.34	0.65	0.63	0.64	0.62	0.15	0.15	0.08	0.08	0.34	0.34
160	2.46	2.35	2.43	2.33	0.70	0.66	0.46	0.45	1.46	1.39	2.46	2.36	2.44	2.33	0.71	0.68	0.46	0.45	1.44	1.38
150	5.97	5.62	5.94	5.60	2.75	2.62	1.91	1.84	4.54	4.33	6.74	6.36	6.71	6.33	2.71	2.57	1.88	1.79	4.92	4.67
140	11.31	10.41	11.27	10.37	6.89	6.48	5.52	5.24	9.40	8.78	15.87	14.54	15.80	14.47	8.60	8.06	6.34	5.99	13.12	12.11
130	18.38	16.75	18.34	16.70	13.43	12.37	11.34	10.48	16.54	15.14	33.77	29.87	33.43	29.60	21.74	19.56	17.43	15.97	29.54	26.27
120	28.16	25.16	28.06	25.10	21.83	19.50	19.08	17.40	26.13	23.41	79.58	66.93	76.23	64.47	49.52	44.49	41.41	36.57	62.78	56.49

Table H-506. Jacket foundation (2.5 m diameter, IHC S-4000, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.03	0.03	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.03	0.03
175	0.13	0.12	0.12	0.12	0.03	0.03	0.02	0.02	0.05	0.05	0.13	0.13	0.13	0.13	0.03	0.03	0.02	0.02	0.05	0.05
170	0.28	0.27	0.27	0.26	0.06	0.05	0.04	0.04	0.12	0.11	0.27	0.26	0.26	0.25	0.06	0.05	0.04	0.04	0.13	0.13
160	1.19	1.12	1.15	1.09	0.27	0.26	0.17	0.16	0.59	0.57	1.11	1.06	1.10	1.05	0.27	0.26	0.17	0.17	0.59	0.57
150	3.66	3.50	3.63	3.48	1.30	1.26	0.85	0.82	2.44	2.32	3.86	3.67	3.83	3.64	1.25	1.20	0.83	0.79	2.42	2.31
140	7.82	7.31	7.79	7.28	4.20	4.02	3.03	2.88	6.28	5.91	9.57	8.93	9.52	8.90	4.48	4.26	3.03	2.87	7.38	6.92
130	14.07	12.90	14.03	12.87	9.14	8.55	7.51	7.05	12.25	11.29	21.34	19.16	21.16	19.02	12.90	11.95	9.64	9.04	18.08	16.52
120	22.17	19.74	22.09	19.67	16.42	15.04	14.37	13.20	19.60	17.84	44.80	39.70	44.16	39.09	30.81	27.37	25.34	22.72	39.55	34.93

Table H-507. Jacket foundation (2.5 m diameter, IHC S-4000, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00
175	0.06	0.06	0.05	0.05	0.00	0.00	0.00	0.00	0.03	0.03	0.06	0.06	0.05	0.05	0.00	0.00	0.00	0.00	0.03	0.03
170	0.15	0.14	0.15	0.14	0.03	0.03	0.02	0.02	0.06	0.06	0.15	0.15	0.15	0.14	0.03	0.03	0.02	0.02	0.06	0.06
160	0.66	0.64	0.65	0.63	0.14	0.14	0.09	0.09	0.35	0.34	0.65	0.63	0.64	0.62	0.15	0.15	0.08	0.08	0.34	0.34
150	2.46	2.35	2.43	2.33	0.70	0.66	0.46	0.45	1.46	1.39	2.46	2.36	2.44	2.33	0.71	0.68	0.46	0.45	1.44	1.38
140	5.97	5.62	5.94	5.60	2.75	2.62	1.91	1.84	4.54	4.33	6.74	6.36	6.71	6.33	2.71	2.57	1.88	1.79	4.92	4.67
130	11.31	10.41	11.27	10.37	6.89	6.48	5.52	5.24	9.40	8.78	15.87	14.54	15.80	14.47	8.60	8.06	6.34	5.99	13.12	12.11
120	18.38	16.75	18.34	16.70	13.43	12.37	11.34	10.48	16.54	15.14	33.77	29.87	33.43	29.60	21.74	19.56	17.43	15.97	29.54	26.27

Table H-508. Jacket foundation (2.5 m diameter, IHC S-4000, 1100 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
175	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00
170	0.06	0.06	0.05	0.05	0.00	0.00	0.00	0.00	0.03	0.03	0.06	0.06	0.05	0.05	0.00	0.00	0.00	0.00	0.03	0.03
160	0.35	0.34	0.34	0.33	0.06	0.06	0.04	0.04	0.16	0.15	0.34	0.33	0.33	0.32	0.06	0.06	0.04	0.04	0.16	0.15
150	1.38	1.33	1.36	1.32	0.34	0.34	0.21	0.20	0.70	0.66	1.37	1.32	1.35	1.30	0.34	0.32	0.22	0.21	0.71	0.68
140	4.04	3.86	4.02	3.84	1.45	1.39	0.96	0.92	2.73	2.61	4.26	4.06	4.24	4.03	1.43	1.37	0.96	0.92	2.69	2.56
130	8.33	7.78	8.29	7.76	4.62	4.40	3.42	3.27	6.73	6.33	10.41	9.63	10.35	9.58	5.02	4.77	3.53	3.34	8.16	7.65
120	14.76	13.52	14.72	13.48	9.67	9.04	8.10	7.59	12.95	11.93	23.42	20.97	23.22	20.81	14.14	13.03	10.74	9.99	19.37	17.71

Table H-509. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 0 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.03	0.03	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.03	0.03
180	0.30	0.29	0.29	0.28	0.05	0.05	0.04	0.04	0.15	0.14	0.29	0.28	0.28	0.27	0.05	0.05	0.04	0.04	0.15	0.15
175	0.56	0.54	0.55	0.53	0.14	0.14	0.07	0.07	0.31	0.30	0.55	0.54	0.54	0.52	0.15	0.15	0.07	0.07	0.30	0.29
170	1.07	1.02	1.04	1.00	0.27	0.26	0.20	0.19	0.59	0.57	1.07	1.02	1.04	1.00	0.30	0.29	0.21	0.20	0.60	0.58
160	3.38	3.23	3.36	3.21	1.34	1.28	0.93	0.89	2.32	2.22	3.36	3.20	3.31	3.16	1.33	1.26	0.87	0.83	2.30	2.18
150	7.47	7.00	7.44	6.98	4.28	4.09	3.24	3.09	6.12	5.79	8.76	8.17	8.70	8.13	4.23	4.03	3.05	2.88	6.65	6.30
140	13.89	12.77	13.84	12.73	9.46	8.82	7.96	7.47	12.27	11.34	20.35	18.48	20.14	18.35	12.59	11.68	9.50	8.90	17.60	16.08
130	22.36	19.95	22.24	19.85	17.22	15.73	15.31	14.05	19.94	18.16	46.31	41.32	45.37	40.31	32.09	28.47	26.68	23.89	40.71	35.93
120	32.81	29.17	32.65	29.04	27.60	24.71	25.33	22.72	30.89	27.52	90.00	84.34	90.00	84.19	88.56	73.31	70.06	60.75	90.00	83.88

Table H-510. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 6 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
180	0.12	0.12	0.12	0.12	0.02	0.02	0.02	0.02	0.05	0.05	0.12	0.12	0.12	0.12	0.02	0.02	0.02	0.02	0.05	0.05
175	0.25	0.24	0.24	0.24	0.05	0.05	0.03	0.03	0.13	0.13	0.25	0.24	0.24	0.24	0.05	0.05	0.03	0.03	0.13	0.13
170	0.47	0.46	0.46	0.45	0.12	0.11	0.06	0.06	0.24	0.23	0.47	0.46	0.46	0.45	0.12	0.12	0.06	0.06	0.24	0.24
160	1.81	1.73	1.78	1.71	0.53	0.51	0.38	0.36	1.02	0.98	1.79	1.72	1.77	1.70	0.52	0.50	0.35	0.34	1.08	1.03
150	4.84	4.61	4.82	4.59	2.22	2.12	1.63	1.56	3.57	3.41	5.00	4.77	4.98	4.74	2.13	2.02	1.54	1.47	3.56	3.39
140	9.62	8.96	9.59	8.94	6.08	5.76	4.90	4.66	8.24	7.71	12.67	11.70	12.60	11.64	6.51	6.16	4.90	4.66	9.90	9.27
130	16.83	15.40	16.79	15.35	12.48	11.54	10.46	9.67	15.24	13.99	29.06	25.84	28.79	25.61	18.39	16.80	14.71	13.56	25.34	22.69
120	26.64	23.86	26.54	23.78	20.73	18.66	18.59	16.99	24.80	22.19	68.87	59.55	63.36	57.24	45.17	40.23	37.79	33.41	57.66	51.63

Table H-511. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 10 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.03	0.03	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.03	0.03
175	0.14	0.14	0.14	0.14	0.03	0.03	0.02	0.02	0.05	0.05	0.14	0.14	0.14	0.14	0.03	0.03	0.02	0.02	0.05	0.05
170	0.30	0.29	0.29	0.28	0.05	0.05	0.04	0.04	0.15	0.14	0.29	0.28	0.28	0.27	0.05	0.05	0.04	0.04	0.15	0.15
160	1.07	1.02	1.04	1.00	0.27	0.26	0.20	0.19	0.59	0.57	1.07	1.02	1.04	1.00	0.30	0.29	0.21	0.20	0.60	0.58
150	3.38	3.23	3.36	3.21	1.34	1.28	0.93	0.89	2.32	2.22	3.36	3.20	3.31	3.16	1.33	1.26	0.87	0.83	2.30	2.18
140	7.47	7.00	7.44	6.98	4.28	4.09	3.24	3.09	6.12	5.79	8.76	8.17	8.70	8.13	4.23	4.03	3.05	2.88	6.65	6.30
130	13.89	12.77	13.84	12.73	9.46	8.82	7.96	7.47	12.27	11.34	20.35	18.48	20.14	18.35	12.59	11.68	9.50	8.90	17.60	16.08
120	22.36	19.95	22.24	19.85	17.22	15.73	15.31	14.05	19.94	18.16	46.31	41.32	45.37	40.31	32.09	28.47	26.68	23.89	40.71	35.93

Table H-512. Jacket foundation (2.5 m diameter, IHC S-4000, 3200 kJ energy level) acoustic ranges (R_{max} and $R_{95\%}$ in km) for each of the flat and frequency weighted SPL categories (Finneran et al. 2017, NMFS 2018) at location OSS2 for 15 dB.

Level (L_p)	Summer										Winter									
	Flat		LF		MF		HF		PW		Flat		LF		MF		HF		PW	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
190	0.003	0.003	0	0	0	0	0	0	0	0	0.003	0.003	0	0	0	0	0	0	0	0
180	0.023	0.023	0.023	0.023	0	0	0	0	0.003	0.003	0.023	0.023	0.023	0.023	0	0	0	0	0.003	0.003
175	0.047	0.047	0.047	0.047	0.003	0.003	0	0	0.027	0.027	0.047	0.047	0.047	0.047	0.003	0.003	0	0	0.027	0.027
170	0.143	0.14	0.14	0.137	0.027	0.027	0.02	0.02	0.047	0.047	0.143	0.14	0.143	0.137	0.027	0.027	0.02	0.02	0.047	0.047
160	0.563	0.541	0.545	0.526	0.144	0.143	0.074	0.071	0.309	0.3	0.554	0.536	0.536	0.517	0.151	0.146	0.071	0.07	0.304	0.294
150	2.035	1.947	2.007	1.921	0.612	0.588	0.449	0.434	1.299	1.245	1.967	1.88	1.949	1.847	0.63	0.608	0.42	0.405	1.22	1.171
140	5.237	4.975	5.217	4.953	2.506	2.386	1.767	1.692	4.02	3.846	5.49	5.211	5.453	5.182	2.424	2.322	1.744	1.653	3.993	3.791
130	10.18	9.417	10.124	9.385	6.58	6.208	5.34	5.078	8.8	8.236	13.787	12.681	13.716	12.615	7.258	6.834	5.453	5.173	11.114	10.313
120	17.633	16.088	17.577	16.039	13.179	12.2	11.36	10.488	15.979	14.677	31.323	27.774	30.969	27.491	19.877	18.182	16.201	14.888	27.547	24.55

H.4. Impact Pile Driving Per Pile SEL Acoustic Ranges with Attenuation

H.4.1. Monopile Foundation

H.4.1.1. 9.6 m Diameter Pile

Table H-513. Monopile (summer, 9.6 m diameter, IHC S-5500) foundation SEL acoustic ranges ($R_{95\%}$ in km) with attenuation (Finneran et al. 2017, NMFS 2018) for locations L0, L02 and L03.

Hearing group	Threshold (dB)	L01				L02				L03			
		Attenuation level (dB)				Attenuation level (dB)				Attenuation level (dB)			
		0	6	10	15	0	6	10	15	0	6	10	15
LF	183	3.97	2.56	1.82	1.15	4.55	2.88	2.09	1.29	4.78	3.05	2.20	1.35
MF	185	-	-	-	-	-	-	-	-	-	-	-	-
HF	155	0.84	0.40	0.14	0.09	0.21	0.09	0.05	0.01	0.48	0.16	0.10	0.06
PW	185	0.67	0.29	0.14	0.06	0.75	0.31	0.13	0.08	0.72	0.32	0.13	0.09
TUW	204	1.12	0.54	0.30	0.12	1.27	0.57	0.33	0.12	1.30	0.62	0.35	0.13

Table H-514. Monopile (winter, 9.6 m diameter, IHC S-5500) foundation SEL acoustic ranges ($R_{95\%}$ in km) with attenuation (Finneran et al. 2017, NMFS 2018) for locations L01, L02 and L03.

Hearing group	Threshold (dB)	L01				L02				L03			
		Attenuation level (dB)				Attenuation level (dB)				Attenuation level (dB)			
		0	6	10	15	0	6	10	15	0	6	10	15
LF	183	4.52	2.77	1.94	1.22	5.09	3.17	2.26	1.37	5.28	3.33	2.34	1.42
MF	185	-	-	-	-	-	-	-	-	-	-	-	-
HF	155	0.95	0.31	0.20	0.10	0.26	0.10	0.05	0.02	0.72	0.24	0.12	0.05
PW	185	0.72	0.30	0.14	0.07	0.79	0.32	0.14	0.08	0.77	0.32	0.14	0.08
TUW	204	1.19	0.57	0.31	0.12	1.33	0.60	0.33	0.13	1.38	0.65	0.35	0.13

H.4.1.2. 11 m Diameter Pile

Table H-515. Monopile (summer, 11 m diameter, IHC S-5500) foundation SEL acoustic ranges ($R_{95\%}$ in km) with attenuation (Finneran et al. 2017, NMFS 2018) for locations R3-L04, T1-L05, and U3-L06.

Hearing group	Threshold (dB)	R3-L04				T1-L05				U3-L06			
		Attenuation level (dB)				Attenuation level (dB)				Attenuation level (dB)			
		0	6	10	15	0	6	10	15	0	6	10	15
LF	183	3.72	2.35	1.65	0.98	3.82	2.45	1.74	1.05	3.94	2.51	1.77	1.09
MF	185	-	-	-	-	-	-	-	-	-	-	-	-
HF	155	0.08	0.03	0.01	-	0.09	0.03	-	-	0.08	0.03	-	-
PW	185	0.54	0.21	0.11	0.06	0.57	0.23	0.11	0.06	0.61	0.25	0.11	0.06
TUW	204	0.96	0.44	0.24	0.10	1.03	0.47	0.26	0.11	1.07	0.47	0.28	0.11

Table H-516. Monopile (winter, 11 m diameter, IHC S-5500) foundation SEL acoustic ranges ($R_{95\%}$ in km) with attenuation (Finneran et al. 2017, NMFS 2018) for locations R3-L04, T1-L05, and U3-L06.

Hearing group	Threshold (dB)	R3-L04				T1-L05				U3-L06			
		Attenuation level (dB)				Attenuation level (dB)				Attenuation level (dB)			
		0	6	10	15	0	6	10	15	0	6	10	15
LF	183	4.14	2.52	1.75	1.04	4.26	2.62	1.83	1.12	4.42	2.68	1.87	1.15
MF	185	-	-	-	-	-	-	-	-	-	-	-	-
HF	155	0.08	0.03	0.01	-	0.10	0.03	-	-	0.08	0.03	-	-
PW	185	0.59	0.22	0.11	0.07	0.62	0.24	0.12	0.06	0.64	0.26	0.12	0.07
TUW	204	1.02	0.46	0.25	0.11	1.10	0.48	0.27	0.11	1.12	0.50	0.28	0.11

Table H-517. Monopile (summer, 11 m diameter, IHC S-5500) foundation SEL acoustic ranges ($R_{95\%}$ in km) with attenuation (Finneran et al. 2017, NMFS 2018) for locations R3-L07, T1-L09, and U3-L09.

Hearing group	Threshold (dB)	R3-L07				T1-L09				U3-L09			
		Attenuation level (dB)				Attenuation level (dB)				Attenuation level (dB)			
		0	6	10	15	0	6	10	15	0	6	10	15
LF	183	4.07	2.58	1.80	1.08	4.39	2.78	1.96	1.20	4.39	2.78	1.96	1.20
MF	185	-	-	-	-	-	-	-	-	-	-	-	-
HF	155	0.12	0.06	0.03	0.02	0.07	0.03	-	-	0.09	0.04	0.01	0.01
PW	185	0.57	0.23	0.12	0.06	0.62	0.24	0.12	0.07	0.64	0.25	0.12	0.08
TUW	204	1.04	0.48	0.23	0.11	1.18	0.53	0.29	0.12	1.18	0.53	0.30	0.12

Table H-518. Monopile (winter, 11 m diameter, IHC S-5500) foundation SEL acoustic ranges ($R_{95\%}$ in km) with attenuation (Finneran et al. 2017, NMFS 2018) for locations R3-L07, T1-L09, and U3-L09.

Hearing group	Threshold (dB)	R3-L07				T1-L09				U3-L09			
		Attenuation level (dB)				Attenuation level (dB)				Attenuation level (dB)			
		0	6	10	15	0	6	10	15	0	6	10	15
LF	183	4.44	2.74	1.90	1.16	4.78	2.96	2.09	1.26	4.81	2.98	2.12	1.27
MF	185	-	-	-	-	-	-	-	-	-	-	-	-
HF	155	0.13	0.06	0.03	0.02	0.09	0.03	-	-	0.09	0.04	0.01	0.01
PW	185	0.60	0.22	0.12	0.06	0.67	0.24	0.13	0.07	0.67	0.27	0.13	0.08
TUW	204	1.12	0.50	0.25	0.11	1.23	0.56	0.30	0.12	1.25	0.56	0.30	0.12

H.4.2. Monopile Foundation (Difficult-to-Drive)

Table H-519. Monopile (summer, 9.6 m diameter, IHC S-5500) foundation SEL acoustic ranges ($R_{95\%}$ in km) with attenuation (Finneran et al. 2017, NMFS 2018) for locations L01, L02 and L03.

Hearing group	Threshold (dB)	L01				L02				L03			
		Attenuation level (dB)				Attenuation level (dB)				Attenuation level (dB)			
		0	6	10	15	0	6	10	15	0	6	10	15
LF	183	5.38	3.82	2.79	1.86	6.11	4.28	3.21	2.15	6.31	4.49	3.44	2.30
MF	185	-	-	-	-	-	-	-	-	-	-	-	-
HF	155	0.86	0.40	0.17	0.09	0.47	0.18	0.09	0.04	0.51	0.20	0.10	0.06
PW	185	1.24	0.61	0.36	0.15	1.38	0.70	0.37	0.15	1.44	0.65	0.38	0.14
TUW	204	1.84	1.01	0.64	0.33	2.11	1.21	0.75	0.35	2.28	1.24	0.78	0.35

Table H-520. Monopile (winter, 9.6 m diameter, IHC S-5500) foundation SEL acoustic ranges ($R_{95\%}$ in km) with attenuation (Finneran et al. 2017, NMFS 2018) for locations L0, L02 and L03.

Hearing group	Threshold (dB)	L01				L02				L03			
		Attenuation level (dB)				Attenuation level (dB)				Attenuation level (dB)			
		0	6	10	15	0	6	10	15	0	6	10	15
LF	183	6.39	4.28	3.08	2.00	7.10	4.66	3.50	2.31	7.21	4.89	3.72	2.43
MF	185	-	-	-	-	-	-	-	-	-	-	-	-
HF	155	0.96	0.32	0.21	0.10	0.35	0.47	0.22	0.10	0.75	0.27	0.12	0.06
PW	185	1.32	0.64	0.37	0.14	1.26	1.48	0.75	0.40	1.52	0.67	0.37	0.15
TUW	204	1.96	1.10	0.68	0.35	1.92	2.27	1.27	0.78	2.41	1.30	0.80	0.34

H.4.3. Jacket Foundation

Table H-521. Jacket (summer, 2.5 m diameter, IHC S-4000) foundation SEL acoustic ranges ($R_{95\%}$ in km) with attenuation for 1 pin pile (Finneran et al. 2017, NMFS 2018) for locations OSS1 and OSS2 .

Hearing group	Threshold (dB)	OSS1				OSS2			
		Attenuation level (dB)				Attenuation level (dB)			
		0	6	10	15	0	6	10	15
LF	183	1.78	0.86	0.48	0.23	1.70	0.79	0.43	0.19
MF	185	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HF	155	0.17	0.09	0.03	0.01	0.15	0.05	0.03	0.00
PW	185	0.12	0.04	0.02	0.00	0.10	0.04	0.02	0.00
TUW	204	0.19	0.09	0.03	0.01	0.17	0.06	0.03	0.00

Table H-522. Jacket (summer, 2.5 m diameter, IHC S-4000) foundation SEL acoustic ranges ($R_{95\%}$ in km) with attenuation for 2 pin piles (Finneran et al. 2017, NMFS 2018) for locations OSS1 and OSS2 .

Hearing group	Threshold (dB)	OSS1				OSS2			
		Attenuation level (dB)				Attenuation level (dB)			
		0	6	10	15	0	6	10	15
LF	183	2.44	1.28	0.76	0.36	2.41	1.19	0.66	0.33
MF	185	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HF	155	0.24	0.12	0.07	0.02	0.23	0.10	0.04	0.02
PW	185	0.19	0.08	0.03	0.01	0.17	0.06	0.04	0.00
TUW	204	0.31	0.13	0.07	0.03	0.28	0.10	0.06	0.02

Table H-523. Jacket (summer, 2.5 m diameter, IHC S-4000) foundation SEL acoustic ranges ($R_{95\%}$ in km) with attenuation for 3 pin piles (Finneran et al. 2017, NMFS 2018) for locations OSS1 and OSS2 .

Hearing group	Threshold (dB)	OSS1				OSS2			
		Attenuation level (dB)				Attenuation level (dB)			
		0	6	10	15	0	6	10	15
LF	183	2.81	1.56	0.94	0.46	2.82	1.48	0.88	0.42
MF	185	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HF	155	0.37	0.15	0.09	0.02	0.33	0.13	0.10	0.03
PW	185	0.26	0.10	0.05	0.02	0.22	0.08	0.05	0.02
TUW	204	0.41	0.15	0.10	0.03	0.37	0.14	0.06	0.03

Table H-524. Jacket (winter, 2.5 m diameter, IHC S-4000) foundation SEL acoustic ranges ($R_{95\%}$ in km) with attenuation for 1 pin pile (Finneran et al. 2017, NMFS 2018) for locations OSS1 and OSS2 .

Hearing group	Threshold (dB)	OSS1				OSS2			
		Attenuation level (dB)				Attenuation level (dB)			
		0	6	10	15	0	6	10	15
LF	183	1.81	0.86	0.48	0.23	1.75	0.79	0.43	0.19
MF	185	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HF	155	0.16	0.09	0.03	0.01	0.14	0.05	0.03	0.00
PW	185	0.13	0.04	0.02	0.00	0.10	0.04	0.02	0.00
TUW	204	0.20	0.09	0.03	0.01	0.16	0.06	0.03	0.00

Table H-525. Jacket (winter, 2.5 m diameter, IHC S-4000) foundation SEL acoustic ranges ($R_{95\%}$ in km) with attenuation for 2 pin piles (Finneran et al. 2017, NMFS 2018) for locations OSS1 and OSS2 .

Hearing group	Threshold (dB)	OSS1				OSS2			
		Attenuation level (dB)				Attenuation level (dB)			
		0	6	10	15	0	6	10	15
LF	183	2.53	1.28	0.77	0.35	2.49	1.20	0.67	0.32
MF	185	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HF	155	0.23	0.11	0.06	0.02	0.23	0.10	0.04	0.02
PW	185	0.19	0.08	0.03	0.01	0.17	0.06	0.04	0.00
TUW	204	0.31	0.13	0.07	0.03	0.28	0.10	0.06	0.02

Table H-526. Jacket (winter, 2.5 m diameter, IHC S-4000) foundation SEL acoustic ranges ($R_{95\%}$ in km) with attenuation for 3 pin piles (Finneran et al. 2017, NMFS 2018) for locations OSS1 and OSS2 .

Hearing group	Threshold (dB)	OSS1				OSS2			
		Attenuation level (dB)				Attenuation level (dB)			
		0	6	10	15	0	6	10	15
LF	183	3.00	1.57	0.96	0.47	2.97	1.51	0.89	0.42
MF	185	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HF	155	0.36	0.13	0.09	0.02	0.33	0.12	0.07	0.03
PW	185	0.27	0.10	0.05	0.02	0.22	0.08	0.05	0.02
TUW	204	0.42	0.16	0.10	0.03	0.37	0.14	0.06	0.03

H.5. Fish and Sea Turtle Acoustic Distances to Threshold

The calculated acoustic distances to injury and behavioral thresholds for fish and sea turtles for monopile and jacket foundations with 0, 6, and 15 dB of broadband attenuation are shown in Tables 527-586. Jacket foundation results assume a 2 dB post-piling shift.

H.5.1. Monopile Foundation

H.5.1.1. 9.6 m Diameter Pile

Table H-527. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L01 for different energy levels with 0 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ									
			Summer					Winter				
			450	800	1400	1700	2300	450	800	1400	1700	2300
Fish equal to or greater than 2 g	L_E [a]	187	4.90					5.60				
	L_{pk} [a]	206	0.06	0.08	0.11	0.12	0.15	0.06	0.08	0.11	0.13	0.19
	L_p [b]	150	5.17	6.16	7.41	7.78	8.07	6.01	7.34	8.98	9.69	10.52
Fish less than 2 g	L_E [a]	183	5.93					7.03				
	L_{pk} [a]	206	0.06	0.08	0.11	0.12	0.15	0.06	0.08	0.11	0.13	0.19
	L_p [b]	150	5.17	6.16	7.41	7.78	8.07	6.01	7.34	8.98	9.69	10.52
Fish without swim bladder	L_E [c]	216	0.31					0.32				
	L_{pk} [c]	213	-	0.03	0.05	0.06	0.07	-	0.03	0.05	0.06	0.07
Fish with swim bladder not involved in hearing	L_E [c]	203	1.58					1.68				
	L_{pk} [c]	207	0.06	0.07	0.10	0.11	0.13	0.06	0.07	0.10	0.12	0.13
Fish with swim bladder involved in hearing	L_E [c]	203	1.58					1.68				
	L_{pk} [c]	207	0.06	0.07	0.10	0.11	0.13	0.06	0.07	0.10	0.12	0.13
Sea turtles	L_E [d]	204	1.44					1.52				
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.67	0.97	1.50	1.71	1.91	0.71	1.05	1.60	1.81	2.05

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-528. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L02 for different energy levels with 0 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ									
			Summer					Winter				
			450	800	1400	1700	2300	450	800	1400	1700	2300
Fish equal to or greater than 2 g	L_E [a]	187	5.85					6.21				
	L_{pk} [a]	206	0.07	0.10	0.13	0.14	0.18	0.07	0.11	0.13	0.14	0.18
	L_p [b]	150	6.36	7.89	9.25	9.72	9.76	7.65	9.59	12.03	12.97	12.82
Fish less than 2 g	L_E [a]	183	7.27					8.69				
	L_{pk} [a]	206	0.07	0.10	0.13	0.14	0.18	0.07	0.11	0.13	0.14	0.18
	L_p [b]	150	6.36	7.89	9.25	9.72	9.76	7.65	9.59	12.03	12.97	12.82
Fish without swim bladder	L_E [c]	216	0.34					0.35				
	L_{pk} [c]	213	0.01	0.04	0.06	0.07	0.09	0.01	0.04	0.06	0.07	0.09
Fish with swim bladder not involved in hearing	L_E [c]	203	1.78					1.87				
	L_{pk} [c]	207	0.07	0.09	0.12	0.13	0.14	0.07	0.09	0.12	0.13	0.15
Fish with swim bladder involved in hearing	L_E [c]	203	1.78					1.87				
	L_{pk} [c]	207	0.07	0.09	0.12	0.13	0.14	0.07	0.09	0.12	0.13	0.15
Sea turtles	L_E [d]	204	1.63					1.72				
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.76	1.12	1.69	1.89	2.20	0.79	1.19	1.78	2.00	2.34

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-529. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L03 for different energy levels with 0 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ									
			Summer					Winter				
			450	800	1400	1700	2300	450	800	1400	1700	2300
Fish equal to or greater than 2 g	L_E [a]	187	6.26					7.22				
	L_{pk} [a]	206	0.08	0.11	0.14	0.15	0.19	0.08	0.12	0.14	0.15	0.18
	L_p [b]	150	6.88	8.46	9.99	10.35	11.22	8.27	10.41	12.82	13.15	14.36
Fish less than 2 g	L_E [a]	183	7.86					9.24				
	L_{pk} [a]	206	0.08	0.11	0.14	0.15	0.19	0.08	0.12	0.14	0.15	0.18
	L_p [b]	150	6.88	8.46	9.99	10.35	11.22	8.27	10.41	12.82	13.15	14.36
Fish without swim bladder	L_E [c]	216	0.36					0.37				
	L_{pk} [c]	213	-	0.02	0.07	0.08	0.09	-	0.02	0.06	0.08	0.09
Fish with swim bladder not involved in hearing	L_E [c]	203	1.86					1.95				
	L_{pk} [c]	207	0.07	0.10	0.13	0.14	0.15	0.07	0.11	0.13	0.14	0.16
Fish with swim bladder involved in hearing	L_E [c]	203	1.86					1.95				
	L_{pk} [c]	207	0.07	0.10	0.13	0.14	0.15	0.07	0.11	0.13	0.14	0.16
Sea turtles	L_E [d]	204	1.71					1.78				
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.81	1.22	1.80	2.02	2.31	0.85	1.28	1.87	2.14	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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-530. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L01 for different energy levels with 6 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ									
			Summer					Winter				
			450	800	1400	1700	2300	450	800	1400	1700	2300
Fish equal to or greater than 2 g	L_E [a]	187	3.48					3.87				
	L_{pk} [a]	206	0.02	0.04	0.06	0.06	0.08	0.02	0.04	0.06	0.06	0.08
	L_p [b]	150	3.74	4.61	5.65	5.96	6.18	4.20	5.27	6.60	7.06	7.43
Fish less than 2 g	L_E [a]	183	4.41					4.98				
	L_{pk} [a]	206	0.02	0.04	0.06	0.06	0.08	0.02	0.04	0.06	0.06	0.08
	L_p [b]	150	3.74	4.61	5.65	5.96	6.18	4.20	5.27	6.60	7.06	7.43
Fish without swim bladder	L_E [c]	216	0.10					0.11				
	L_{pk} [c]	213	-	-	-	-	0.02	-	-	-	-	0.02
Fish with swim bladder not involved in hearing	L_E [c]	203	0.83					0.87				
	L_{pk} [c]	207	-	0.03	0.05	0.06	0.07	-	0.03	0.05	0.06	0.07
Fish with swim bladder involved in hearing	L_E [c]	203	0.83					0.87				
	L_{pk} [c]	207	-	0.03	0.05	0.06	0.07	-	0.03	0.05	0.06	0.07
Sea turtles	L_E [d]	204	0.72					0.76				
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.30	0.47	0.75	0.91	1.10	0.31	0.48	0.78	0.94	1.17

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-531. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L02 for different energy levels with 6 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ									
			Summer					Winter				
			450	800	1400	1700	2300	450	800	1400	1700	2300
Fish equal to or greater than 2 g	L_E [a]	187	4.09					4.48				
	L_{pk} [a]	206	0.01	0.05	0.07	0.08	0.09	0.01	0.05	0.07	0.08	0.10
	L_p [b]	150	4.47	5.66	6.93	7.33	7.45	5.07	6.62	8.35	8.82	8.72
Fish less than 2 g	L_E [a]	183	5.22					5.91				
	L_{pk} [a]	206	0.01	0.05	0.07	0.08	0.09	0.01	0.05	0.07	0.08	0.10
	L_p [b]	150	4.47	5.66	6.93	7.33	7.45	5.07	6.62	8.35	8.82	8.72
Fish without swim bladder	L_E [c]	216	0.12					0.12				
	L_{pk} [c]	213	-	-	0.01	0.01	0.01	-	-	0.01	0.01	0.01
Fish with swim bladder not involved in hearing	L_E [c]	203	0.91					0.94				
	L_{pk} [c]	207	0.01	0.04	0.06	0.07	0.09	0.01	0.04	0.06	0.07	0.09
Fish with swim bladder involved in hearing	L_E [c]	203	0.91					0.94				
	L_{pk} [c]	207	0.01	0.04	0.06	0.07	0.09	0.01	0.04	0.06	0.07	0.09
Sea turtles	L_E [d]	204	0.81					0.85				
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.34	0.46	0.87	0.95	1.25	0.35	0.50	0.90	1.00	1.31

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-532. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L03 for different energy levels with 6 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ									
			Summer					Winter				
			450	800	1400	1700	2300	450	800	1400	1700	2300
Fish equal to or greater than 2 g	L_E [a]	187	4.34					4.74				
	L_{pk} [a]	206	-	0.06	0.07	0.09	0.10	-	0.05	0.08	0.09	0.11
	L_p [b]	150	4.82	6.04	7.40	7.68	8.25	5.45	7.05	8.78	8.90	9.77
Fish less than 2 g	L_E [a]	183	5.57					6.27				
	L_{pk} [a]	206	-	0.06	0.07	0.09	0.10	-	0.05	0.08	0.09	0.11
	L_p [b]	150	4.82	6.04	7.40	7.68	8.25	5.45	7.05	8.78	8.90	9.77
Fish without swim bladder	L_E [c]	216	0.12					0.13				
	L_{pk} [c]	213	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.97					1.00				
	L_{pk} [c]	207	-	0.02	0.07	0.08	0.09	-	0.02	0.06	0.08	0.09
Fish with swim bladder involved in hearing	L_E [c]	203	0.97					1.00				
	L_{pk} [c]	207	-	0.02	0.07	0.08	0.09	-	0.02	0.06	0.08	0.09
Sea turtles	L_E [d]	204	0.82					0.87				
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.37	0.51	0.90	1.10	1.25	0.37	0.54	0.91	1.14	1.31

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-533. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L01 for different energy levels with 15 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ									
			Summer					Winter				
			450	800	1400	1700	2300	450	800	1400	1700	2300
Fish equal to or greater than 2 g	L_E [a]	187	1.73					1.83				
	L_{pk} [a]	206	-	-	-	-	-	-	-	-	-	-
	L_p [b]	150	1.87	2.55	3.43	3.74	3.99	2.04	2.76	3.86	4.17	4.41
Fish less than 2 g	L_E [a]	183	2.42					2.60				
	L_{pk} [a]	206	-	-	-	-	-	-	-	-	-	-
	L_p [b]	150	1.87	2.55	3.43	3.74	3.98	2.04	2.76	3.86	4.17	4.41
Fish without swim bladder	L_E [c]	216	0.03					0.03				
	L_{pk} [c]	213	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.23					0.24				
	L_{pk} [c]	207	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.23					0.24				
	L_{pk} [c]	207	-	-	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.19					0.19				
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.07	0.11	0.19	0.25	0.35	0.07	0.11	0.20	0.26	0.36

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-534. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L02 for different energy levels with 15 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ									
			Summer					Winter				
			450	800	1400	1700	2300	450	800	1400	1700	2300
Fish equal to or greater than 2 g	L_E [a]	187	1.94					2.09				
	L_{pk} [a]	206	-	-	-	-	0.01	-	-	-	-	0.01
	L_p [b]	150	2.23	2.97	4.04	4.34	4.61	2.41	3.32	4.49	4.84	5.05
Fish less than 2 g	L_E [a]	183	2.75					2.93				
	L_{pk} [a]	206	-	-	-	-	0.01	-	-	-	-	0.01
	L_p [b]	150	2.23	2.97	4.04	4.34	4.61	2.41	3.32	4.49	4.84	5.05
Fish without swim bladder	L_E [c]	216	0.02					0.02				
	L_{pk} [c]	213	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.22					0.24				
	L_{pk} [c]	207	-	-	-	-	0.01	-	-	-	-	0.01
Fish with swim bladder involved in hearing	L_E [c]	203	0.22					0.24				
	L_{pk} [c]	207	-	-	-	-	0.01	-	-	-	-	0.01
Sea turtles	L_E [d]	204	0.19					0.19				
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.09	0.12	0.21	0.29	0.36	0.09	0.12	0.21	0.30	0.39

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-535. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L03 for different energy levels with 15 dB attenuation.

Faunal group	Metric	Threshold	Summer 450 kJ	Summer 800 kJ	Summer 1400 kJ	Summer 1700 kJ	Summer 2300 kJ	Winter 450 kJ	Winter 800 kJ	Winter 1400 kJ	Winter 1700 kJ	Winter 2300 kJ
Fish equal to or greater than 2 g	L_E [a]	187	2.05					2.19				
	L_{pk} [a]	206	-	-	-	-	-	-	-	-	-	-
	L_p [b]	150	2.43	3.24	4.26	4.53	4.95	2.58	3.56	4.69	4.95	5.46
Fish less than 2 g	L_E [a]	183	2.89					3.14				
	L_{pk} [a]	206	-	-	-	-	-	-	-	-	-	-
	L_p [b]	150	2.43	3.24	4.26	4.53	4.95	2.58	3.56	4.69	4.95	5.46
Fish without swim bladder	L_E [c]	216	0.02					0.02				
	L_{pk} [c]	213	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.23					0.23				
	L_{pk} [c]	207	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.23					0.23				
	L_{pk} [c]	207	-	-	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.20					0.20				
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.09	0.13	0.23	0.31	0.37	0.09	0.13	0.23	0.32	0.38

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

H.5.1.2. 11 m Diameter Pile

Table H-536. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location R3-L04 for different energy levels with 0 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	2000	500	750	1100	2000
Fish equal to or greater than 2 g	L_E [a]	187	4.76				5.40			
	L_{pk} [a]	206	0.07	0.08	0.10	0.15	0.07	0.09	0.11	0.20
	L_p [b]	150	6.01	6.60	7.26	8.43	7.04	7.99	8.86	11.15
Fish less than 2 g	L_E [a]	183	5.87				6.89			
	L_{pk} [a]	206	0.07	0.08	0.10	0.15	0.07	0.09	0.11	0.20
	L_p [b]	150	6.01	6.60	7.26	8.43	7.04	7.99	8.86	11.15
Fish without swim bladder	L_E [c]	216	0.26				0.26			
	L_{pk} [c]	213	0.02	0.03	0.04	0.07	0.02	0.03	0.04	0.08
Fish with swim bladder not involved in hearing	L_E [c]	203	1.41				1.50			
	L_{pk} [c]	207	0.06	0.08	0.09	0.13	0.06	0.08	0.09	0.13
Fish with swim bladder involved in hearing	L_E [c]	203	1.41				1.50			
	L_{pk} [c]	207	0.06	0.08	0.09	0.13	0.06	0.08	0.09	0.13
Sea turtles	L_E [d]	204	1.28				1.36			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.94	1.04	1.29	1.79	0.97	1.11	1.36	1.89

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-537. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location T1-L05 for different energy levels with 0 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
Fish equal to or greater than 2 g	L_E [a]	187	4.95						5.63					
	L_{pk} [a]	206	0.06	0.08	0.10	0.13	0.15	0.25	0.07	0.09	0.11	0.13	0.15	0.25
	L_p [b]	150	6.09	6.73	7.33	8.16	8.68	9.00	7.19	8.15	8.88	10.29	11.36	12.24
Fish less than 2 g	L_E [a]	183	6.09						7.23					
	L_{pk} [a]	206	0.06	0.08	0.10	0.13	0.15	0.25	0.07	0.09	0.11	0.13	0.15	0.25
	L_p [b]	150	6.09	6.73	7.33	8.16	8.68	9.00	7.19	8.15	8.88	10.29	11.36	12.24
Fish without swim bladder	L_E [c]	216	0.28						0.29					
	L_{pk} [c]	213	0.02	0.03	0.05	0.06	0.07	0.08	0.02	0.03	0.05	0.06	0.07	0.08
Fish with swim bladder not involved in hearing	L_E [c]	203	1.53						1.62					
	L_{pk} [c]	207	0.06	0.08	0.09	0.12	0.13	0.16	0.06	0.08	0.09	0.12	0.13	0.15
Fish with swim bladder involved in hearing	L_E [c]	203	1.53						1.62					
	L_{pk} [c]	207	0.06	0.08	0.09	0.12	0.13	0.16	0.06	0.08	0.09	0.12	0.13	0.15
Sea turtles	L_E [d]	204	1.39						1.46					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.94	1.13	1.32	1.66	1.89	2.13	0.98	1.19	1.39	1.75	2.01	2.28

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-538. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location U3-L06 for different energy levels with 0 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			450	750	1000	1300	450	750	1000	1300
Fish equal to or greater than 2 g	L_E [a]	187	5.12				5.86			
	L_{pk} [a]	206	0.06	0.08	0.10	0.13	0.06	0.08	0.11	0.13
	L_p [b]	150	6.18	6.97	7.51	7.92	7.21	8.44	9.13	9.97
Fish less than 2 g	L_E [a]	183	6.30				7.53			
	L_{pk} [a]	206	0.06	0.08	0.10	0.13	0.06	0.08	0.11	0.13
	L_p [b]	150	6.18	6.97	7.51	7.92	7.21	8.44	9.13	9.97
Fish without swim bladder	L_E [c]	216	0.30				0.31			
	L_{pk} [c]	213	0.02	0.03	0.05	0.06	0.02	0.03	0.05	0.06
Fish with swim bladder not involved in hearing	L_E [c]	203	1.57				1.66			
	L_{pk} [c]	207	0.06	0.07	0.09	0.12	0.06	0.07	0.10	0.12
Fish with swim bladder involved in hearing	L_E [c]	203	1.57				1.66			
	L_{pk} [c]	207	0.06	0.07	0.09	0.12	0.06	0.07	0.10	0.12
Sea turtles	L_E [d]	204	1.43				1.51			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.91	1.14	1.34	1.57	0.94	1.20	1.42	1.67

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-539. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location R3-L07 for different energy levels with 0 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	2000	500	750	1100	2000
Fish equal to or greater than 2 g	L_E [a]	187	5.37				6.04			
	L_{pk} [a]	206	0.08	0.11	0.12	0.18	0.08	0.11	0.13	0.18
	L_p [b]	150	6.90	7.70	8.43	9.37	8.15	9.16	10.46	12.07
Fish less than 2 g	L_E [a]	183	6.63				7.79			
	L_{pk} [a]	206	0.08	0.11	0.12	0.18	0.08	0.11	0.13	0.18
	L_p [b]	150	6.90	7.70	8.43	9.37	8.15	9.16	10.46	12.07
Fish without swim bladder	L_E [c]	216	0.28				0.28			
	L_{pk} [c]	213	0.02	0.03	0.06	0.09	0.02	0.03	0.06	0.09
Fish with swim bladder not involved in hearing	L_E [c]	203	1.57				1.65			
	L_{pk} [c]	207	0.07	0.09	0.11	0.15	0.07	0.09	0.12	0.15
Fish with swim bladder involved in hearing	L_E [c]	203	1.57				1.65			
	L_{pk} [c]	207	0.07	0.09	0.11	0.15	0.07	0.09	0.12	0.15
Sea turtles	L_E [d]	204	1.42				1.49			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	1.04	1.19	1.45	2.00	1.10	1.25	1.53	2.13

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-540. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location T1-L08 for different energy levels with 0 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
Fish equal to or greater than 2 g	L_E [a]	187	5.80						6.51					
	L_{pk} [a]	206	0.08	0.11	0.12	0.14	0.18	0.30	0.08	0.11	0.13	0.15	0.17	0.30
	L_p [b]	150	7.28	8.15	8.72	9.57	10.29	10.86	8.52	9.65	10.79	12.29	13.23	13.72
Fish less than 2 g	L_E [a]	183	7.24						8.45					
	L_{pk} [a]	206	0.08	0.11	0.12	0.14	0.18	0.30	0.08	0.11	0.13	0.15	0.17	0.30
	L_p [b]	150	7.28	8.15	8.72	9.57	10.29	10.86	8.52	9.65	10.79	12.29	13.23	13.72
Fish without swim bladder	L_E [c]	216	0.32						0.32					
	L_{pk} [c]	213	-	0.03	0.05	0.07	0.09	0.11	-	0.02	0.05	0.08	0.09	0.11
Fish with swim bladder not involved in hearing	L_E [c]	203	1.73						1.81					
	L_{pk} [c]	207	0.07	0.09	0.11	0.13	0.14	0.19	0.07	0.10	0.11	0.14	0.15	0.19
Fish with swim bladder involved in hearing	L_E [c]	203	1.73						1.81					
	L_{pk} [c]	207	0.07	0.09	0.11	0.13	0.14	0.19	0.07	0.10	0.11	0.14	0.15	0.19
Sea turtles	L_E [d]	204	1.56						1.64					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	1.04	1.26	1.48	1.87	2.21	2.45	1.10	1.33	1.55	1.94	2.30	2.57

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-541. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location U3-L09 for different energy levels with 0 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			450	750	1000	1300	450	750	1000	1300
Fish equal to or greater than 2 g	L_E [a]	187	5.78				6.53			
	L_{pk} [a]	206	0.07	0.10	0.12	0.14	0.07	0.10	0.12	0.14
	L_p [b]	150	7.03	7.96	8.54	8.88	8.20	9.38	10.60	11.24
Fish less than 2 g	L_E [a]	183	7.19				8.46			
	L_{pk} [a]	206	0.07	0.10	0.12	0.14	0.07	0.10	0.12	0.14
	L_p [b]	150	7.03	7.96	8.54	8.88	8.20	9.38	10.60	11.24
Fish without swim bladder	L_E [c]	216	0.33				0.34			
	L_{pk} [c]	213	0.01	0.03	0.06	0.08	0.01	0.03	0.05	0.08
Fish with swim bladder not involved in hearing	L_E [c]	203	1.74				1.83			
	L_{pk} [c]	207	0.06	0.09	0.11	0.13	0.06	0.09	0.11	0.13
Fish with swim bladder involved in hearing	L_E [c]	203	1.74				1.83			
	L_{pk} [c]	207	0.06	0.09	0.11	0.13	0.06	0.09	0.11	0.13
Sea turtles	L_E [d]	204	1.58				1.67			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.96	1.25	1.50	1.75	1.01	1.31	1.58	1.83

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-542. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location R3-L04 for different energy levels with 6 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	2000	500	750	1100	2000
Fish equal to or greater than 2 g	L_E [a]	187	3.25				3.61			
	L_{pk} [a]	206	0.03	0.04	0.05	0.08	0.03	0.04	0.05	0.08
	L_p [b]	150	4.45	4.88	5.39	6.35	4.98	5.59	6.26	7.60
Fish less than 2 g	L_E [a]	183	4.25				4.75			
	L_{pk} [a]	206	0.03	0.04	0.05	0.08	0.03	0.04	0.05	0.08
	L_p [b]	150	4.45	4.88	5.39	6.35	4.98	5.59	6.26	7.60
Fish without swim bladder	L_E [c]	216	0.09				0.09			
	L_{pk} [c]	213	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fish with swim bladder not involved in hearing	L_E [c]	203	0.70				0.74			
	L_{pk} [c]	207	0.02	0.03	0.04	0.07	0.02	0.03	0.04	0.08
Fish with swim bladder involved in hearing	L_E [c]	203	0.70				0.74			
	L_{pk} [c]	207	0.02	0.03	0.04	0.07	0.02	0.03	0.04	0.08
Sea turtles	L_E [d]	204	0.63				0.66			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.42	0.48	0.63	0.97	0.44	0.51	0.66	1.03

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-543. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location T1-L05 for different energy levels with 6 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
Fish equal to or greater than 2 g	L_E [a]	187	3.45						3.79					
	L_{pk} [a]	206	0.03	0.04	0.05	0.07	0.08	0.09	0.03	0.04	0.05	0.07	0.08	0.10
	L_p [b]	150	4.48	4.98	5.43	6.11	6.54	6.87	5.02	5.69	6.26	7.22	7.89	8.41
Fish less than 2 g	L_E [a]	183	4.43						4.96					
	L_{pk} [a]	206	0.03	0.04	0.05	0.07	0.08	0.09	0.03	0.04	0.05	0.07	0.08	0.10
	L_p [b]	150	4.48	4.98	5.43	6.11	6.54	6.87	5.02	5.69	6.26	7.22	7.89	8.41
Fish without swim bladder	L_E [c]	216	0.10						0.11					
	L_{pk} [c]	213	-	-	-	-	-	0.03	-	-	-	-	-	0.03
Fish with swim bladder not involved in hearing	L_E [c]	203	0.76						0.81					
	L_{pk} [c]	207	0.02	0.03	0.05	0.06	0.07	0.08	0.02	0.03	0.05	0.06	0.07	0.08
Fish with swim bladder involved in hearing	L_E [c]	203	0.76						0.81					
	L_{pk} [c]	207	0.02	0.03	0.05	0.06	0.07	0.08	0.02	0.03	0.05	0.06	0.07	0.08
Sea turtles	L_E [d]	204	0.69						0.72					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.43	0.51	0.64	0.88	1.04	1.24	0.44	0.54	0.68	0.92	1.11	1.30

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-544. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location U3-L06 for different energy levels with 6 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			450	750	1000	1300	450	750	1000	1300
Fish equal to or greater than 2 g	L_E [a]	187	3.58				3.94			
	L_{pk} [a]	206	0.03	0.04	0.06	0.07	0.03	0.04	0.06	0.07
	L_p [b]	150	4.52	5.12	5.55	5.89	5.04	5.87	6.42	6.90
Fish less than 2 g	L_E [a]	183	4.58				5.15			
	L_{pk} [a]	206	0.03	0.04	0.06	0.07	0.03	0.04	0.06	0.07
	L_p [b]	150	4.52	5.12	5.55	5.89	5.04	5.87	6.42	6.90
Fish without swim bladder	L_E [c]	216	0.10				0.11			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.80				0.84			
	L_{pk} [c]	207	0.02	0.03	0.05	0.06	0.02	0.03	0.05	0.06
Fish with swim bladder involved in hearing	L_E [c]	203	0.80				0.84			
	L_{pk} [c]	207	0.02	0.03	0.05	0.06	0.02	0.03	0.05	0.06
Sea turtles	L_E [d]	204	0.72				0.74			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.40	0.51	0.66	0.81	0.41	0.54	0.68	0.85

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-545. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location R3-L07 for different energy levels with 6 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	2000	500	750	1100	2000
Fish equal to or greater than 2 g	L_E [a]	187	3.73				4.04			
	L_{pk} [a]	206	0.03	0.05	0.06	0.10	0.03	0.05	0.06	0.10
	L_p [b]	150	5.06	5.56	6.16	7.22	5.63	6.36	7.22	8.40
Fish less than 2 g	L_E [a]	183	4.79				5.31			
	L_{pk} [a]	206	0.03	0.05	0.06	0.10	0.03	0.05	0.06	0.10
	L_p [b]	150	5.06	5.56	6.16	7.22	5.63	6.36	7.22	8.40
Fish without swim bladder	L_E [c]	216	0.10				0.11			
	L_{pk} [c]	213	-	-	-	0.02	-	-	-	0.02
Fish with swim bladder not involved in hearing	L_E [c]	203	0.78				0.81			
	L_{pk} [c]	207	0.02	0.03	0.06	0.09	0.02	0.03	0.06	0.09
Fish with swim bladder involved in hearing	L_E [c]	203	0.78				0.81			
	L_{pk} [c]	207	0.02	0.03	0.06	0.09	0.02	0.03	0.06	0.09
Sea turtles	L_E [d]	204	0.68				0.72			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.48	0.54	0.70	1.08	0.50	0.57	0.72	1.14

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-546. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location T1-L08 for different energy levels with 6 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
Fish equal to or greater than 2 g	L_E [a]	187	4.03						4.35					
	L_{pk} [a]	206	0.02	0.05	0.06	0.08	0.10	0.11	0.02	0.04	0.06	0.09	0.10	0.12
	L_p [b]	150	5.25	5.88	6.38	7.24	7.73	8.10	5.84	6.70	7.42	8.41	9.01	9.37
Fish less than 2 g	L_E [a]	183	5.17						5.73					
	L_{pk} [a]	206	0.02	0.05	0.06	0.08	0.10	0.11	0.02	0.04	0.06	0.09	0.10	0.12
	L_p [b]	150	5.25	5.88	6.38	7.24	7.73	8.10	5.84	6.70	7.42	8.41	9.01	9.37
Fish without swim bladder	L_E [c]	216	0.11						0.12					
	L_{pk} [c]	213	-	-	-	-	-	0.02	-	-	-	-	-	0.02
Fish with swim bladder not involved in hearing	L_E [c]	203	0.87						0.90					
	L_{pk} [c]	207	-	0.03	0.05	0.07	0.09	0.11	-	0.02	0.05	0.08	0.09	0.11
Fish with swim bladder involved in hearing	L_E [c]	203	0.87						0.90					
	L_{pk} [c]	207	-	0.03	0.05	0.07	0.09	0.11						
Sea turtles	L_E [d]	204	0.75						0.78					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.46	0.57	0.69	0.96	1.18	1.39	0.47	0.60	0.71	1.01	1.25	1.46

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 (dB re 1 μPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-547. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location U3-L09 for different energy levels with 6 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			450	750	1000	1300	450	750	1000	1300
Fish equal to or greater than 2 g	L_E [a]	187	4.04				4.39			
	L_{pk} [a]	206	0.02	0.04	0.07	0.08	0.02	0.04	0.07	0.08
	L_p [b]	150	5.08	5.78	6.25	6.59	5.64	6.54	7.23	7.68
Fish less than 2 g	L_E [a]	183	5.16				5.76			
	L_{pk} [a]	206	0.02	0.04	0.07	0.08	0.02	0.04	0.07	0.08
	L_p [b]	150	5.08	5.78	6.25	6.59	5.64	6.54	7.23	7.68
Fish without swim bladder	L_E [c]	216	0.11				0.12			
	L_{pk} [c]	213	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fish with swim bladder not involved in hearing	L_E [c]	203	0.89				0.92			
	L_{pk} [c]	207	0.01	0.03	0.06	0.08	0.01	0.03	0.05	0.08
Fish with swim bladder involved in hearing	L_E [c]	203	0.89				0.92			
	L_{pk} [c]	207	0.01	0.03	0.06	0.08	0.01	0.03	0.05	0.08
Sea turtles	L_E [d]	204	0.77				0.82			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.41	0.57	0.74	0.90	0.43	0.60	0.76	0.93

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-548. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location R3-L04 for different energy levels with 15 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	2000	500	750	1100	2000
Fish equal to or greater than 2 g	L_E [a]	187	1.56				1.65			
	L_{pk} [a]	206	-	-	0.01	0.01	-	-	0.01	0.01
	L_p [b]	150	2.44	2.65	3.03	3.93	2.60	2.84	3.41	4.35
Fish less than 2 g	L_E [a]	183	2.22				2.39			
	L_{pk} [a]	206	-	-	0.01	0.01	-	-	0.01	0.01
	L_p [b]	150	2.44	2.65	3.03	3.93	2.60	2.84	3.41	4.35
Fish without swim bladder	L_E [c]	216	0.02				0.01			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.17				0.17			
	L_{pk} [c]	207	-	-	0.01	0.01	-	-	0.01	0.01
Fish with swim bladder involved in hearing	L_E [c]	203	0.17				0.17			
	L_{pk} [c]	207	-	-	0.01	0.01	-	-	0.01	0.01
Sea turtles	L_E [d]	204	0.14				0.14			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.09	0.11	0.16	0.29	0.09	0.11	0.16	0.30

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-549. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location T1-L05 for different energy levels with 15 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
Fish equal to or greater than 2 g	L_E [a]	187	1.68						1.77					
	L_{pk} [a]	206	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [b]	150	2.47	2.75	3.07	3.71	4.08	4.35	2.62	2.96	3.41	4.08	4.50	4.83
Fish less than 2 g	L_E [a]	183	2.38						2.54					
	L_{pk} [a]	206	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [b]	150	2.47	2.75	3.07	3.71	4.08	4.35	2.62	2.96	3.41	4.08	4.50	4.83
Fish without swim bladder	L_E [c]	216	0.02						0.02					
	L_{pk} [c]	213	-	-	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.18						0.20					
	L_{pk} [c]	207	-	-	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.18						0.20					
	L_{pk} [c]	207	-	-	-	-	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.16						0.15					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.09	0.11	0.15	0.24	0.30	0.40	0.10	0.12	0.14	0.24	0.31	0.41

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-550. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location U3-L06 for different energy levels with 15 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			450	750	1000	1300	450	750	1000	1300
Fish equal to or greater than 2 g	L_E [a]	187	1.72				1.81			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	2.44	2.78	3.17	3.53	2.59	3.03	3.52	3.88
Fish less than 2 g	L_E [a]	183	2.45				2.61			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	2.44	2.78	3.17	3.53	2.59	3.03	3.52	3.88
Fish without swim bladder	L_E [c]	216	0.03				0.03			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.20				0.22			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.20				0.22			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.17				0.17			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.08	0.11	0.16	0.20	0.09	0.12	0.15	0.22

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-551. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location R3-L07 for different energy levels with 15 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	2000	500	750	1100	2000
Fish equal to or greater than 2 g	L_E [a]	187	1.73				1.82			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	2.73	2.99	3.53	4.38	2.87	3.29	3.85	4.84
Fish less than 2 g	L_E [a]	183	2.50				2.65			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	2.73	2.99	3.53	4.38	2.87	3.29	3.85	4.84
Fish without swim bladder	L_E [c]	216	0.02				0.02			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.17				0.17			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.17				0.17			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.13				0.14			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.11	0.12	0.18	0.30	0.11	0.13	0.18	0.31

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-552. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location T1-L08 for different energy levels with 15 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			500	750	1000	1500	2000	2500	500	750	1000	1500	2000	2500
Fish equal to or greater than 2 g	LE a	187	1.88						1.97					
	Lpk a	206	-	-	-	-	-	-	-	-	-	-	-	-
	Lp b	150	2.78	3.21	3.62	4.27	4.68	5.03	2.93	3.49	3.92	4.65	5.12	5.50
Fish less than 2 g	LE a	183	2.70						2.84					
	Lpk a	206	-	-	-	-	-	-	-	-	-	-	-	-
	Lp b	150	2.78	3.21	3.62	4.27	4.68	5.03	2.93	3.49	3.92	4.65	5.12	5.50
Fish without swim bladder	LE c	216	0.02						0.02					
	Lpk c	213	-	-	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	LE c	203	0.21						0.20					
	Lpk c	207	-	-	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	LE c	203	0.21						0.20					
	Lpk c	207	-	-	-	-	-	-	-	-	-	-	-	-
Sea turtles	LE d	204	0.17						0.16					
	Lpk d	232	-	-	-	-	-	-	-	-	-	-	-	-
	Lp e	175	0.11	0.13	0.16	0.23	0.35	0.44	0.11	0.13	0.14	0.27	0.35	0.45

L_{pk}= unweighted peak sound pressure (dB re 1 µPa); LE = unweighted sound exposure level (dB re 1 µPa2·s); Lp= unweighted sound pressure (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-553. Monopile foundation (11 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location U3-L09 for different energy levels with 15 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			450	750	1000	1300	450	750	1000	1300
Fish equal to or greater than 2 g	L_E [a]	187	1.89				2.02			
	L_{pk} [a]	206	-	0.01	0.01	0.01	-	0.01	0.01	0.01
	L_p [b]	150	2.69	3.16	3.62	3.98	2.82	3.44	3.91	4.30
Fish less than 2 g	L_E [a]	183	2.72				2.87			
	L_{pk} [a]	206	-	0.01	0.01	0.01	-	0.01	0.01	0.01
	L_p [b]	150	2.69	3.16	3.62	3.98	2.82	3.44	3.91	4.30
Fish without swim bladder	L_E [c]	216	0.02				0.02			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.21				0.21			
	L_{pk} [c]	207	-	0.01	0.01	0.01	-	0.01	0.01	0.01
Fish with swim bladder involved in hearing	L_E [c]	203	0.21				0.21			
	L_{pk} [c]	207	-	0.01	0.01	0.01	-	0.01	0.01	0.01
Sea turtles	L_E [d]	204	0.18				0.18			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.10	0.12	0.17	0.21	0.11	0.13	0.17	0.21

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

H.5.2. Monopile Foundation (Difficult-to-Drive)

Table H-554. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L01 for different energy levels with 0 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
Fish equal to or greater than 2 g	L_E [a]	187	6.32						7.59					
	L_{pk} [a]	206	0.06	0.08	0.11	0.12	0.15	0.32	0.06	0.08	0.11	0.13	0.16	0.33
	L_p [b]	150	5.17	6.16	7.40	7.78	8.13	10.47	6.01	7.34	8.98	9.69	10.57	14.16
Fish less than 2 g	L_E [a]	183	7.60						9.32					
	L_{pk} [a]	206	0.06	0.08	0.11	0.12	0.15	0.32	0.06	0.08	0.11	0.13	0.16	0.33
	L_p [b]	150	5.17	6.16	7.40	7.78	8.13	10.47	6.01	7.34	8.98	9.69	10.57	14.16
Fish without swim bladder	L_E [c]	216	0.70						0.74					
	L_{pk} [c]	213	-	0.03	0.05	0.06	0.07	0.11	-	0.03	0.05	0.06	0.07	0.11
Fish with swim bladder not involved in hearing	L_E [c]	203	2.51						2.68					
	L_{pk} [c]	207	0.06	0.07	0.10	0.11	0.13	0.30	0.06	0.07	0.10	0.12	0.13	0.30
Fish with swim bladder involved in hearing	L_E [c]	203	2.51						2.68					
	L_{pk} [c]	207	0.06	0.07	0.10	0.11	0.13	0.30	0.06	0.07	0.10	0.12	0.13	0.30
Sea turtles	L_E [d]	204	2.34						2.50					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.67	0.97	1.50	1.71	1.88	2.90	0.71	1.05	1.60	1.81	2.01	3.20

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-555. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L02 for different energy levels with 0 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
Fish equal to or greater than 2 g	L_E [a]	187	7.66						8.96					
	L_{pk} [a]	206	0.07	0.10	0.13	0.14	0.18	0.38	0.07	0.11	0.13	0.14	0.17	0.40
	L_p [b]	150	6.36	7.89	9.25	9.72	10.10	12.69	7.65	9.59	12.03	12.97	13.39	17.00
Fish less than 2 g	L_E [a]	183	9.16						11.66					
	L_{pk} [a]	206	0.07	0.10	0.13	0.14	0.18	0.38	0.07	0.11	0.13	0.14	0.17	0.40
	L_p [b]	150	6.36	7.89	9.25	9.72	10.10	12.69	7.65	9.59	12.03	12.97	13.39	17.00
Fish without swim bladder	L_E [c]	216	0.79						0.82					
	L_{pk} [c]	213	0.01	0.04	0.06	0.07	0.08	0.13	0.01	0.04	0.06	0.07	0.09	0.14
Fish with swim bladder not involved in hearing	L_E [c]	203	2.85						3.08					
	L_{pk} [c]	207	0.07	0.09	0.12	0.13	0.14	0.36	0.07	0.09	0.12	0.13	0.15	0.37
Fish with swim bladder involved in hearing	L_E [c]	203	2.85						3.08					
	L_{pk} [c]	207	0.07	0.09	0.12	0.13	0.14	0.36	0.07	0.09	0.12	0.13	0.15	0.37
Sea turtles	L_E [d]	204	2.67						2.81					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.76	1.12	1.69	1.89	2.15	3.42	0.79	1.19	1.78	2.00	2.28	3.66

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-556. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L03 for different energy levels with 0 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
Fish equal to or greater than 2 g	L_E [a]	187	8.14						9.34					
	L_{pk} [a]	206	0.08	0.11	0.14	0.15	0.20	0.45	0.08	0.12	0.14	0.15	0.19	0.46
	L_p [b]	150	6.88	8.46	9.99	10.35	10.63	12.85	8.27	10.41	12.82	13.15	13.27	16.11
Fish less than 2 g	L_E [a]	183	9.71						12.03					
	L_{pk} [a]	206	0.08	0.11	0.14	0.15	0.20	0.45	0.08	0.12	0.14	0.15	0.19	0.46
	L_p [b]	150	6.88	8.46	9.99	10.35	10.63	12.85	8.27	10.41	12.82	13.15	13.27	16.11
Fish without swim bladder	L_E [c]	216	0.82						0.85					
	L_{pk} [c]	213	-	0.02	0.07	0.08	0.09	0.14	-	0.02	0.06	0.08	0.10	0.15
Fish with swim bladder not involved in hearing	L_E [c]	203	3.12						3.39					
	L_{pk} [c]	207	0.07	0.10	0.13	0.14	0.15	0.40	0.07	0.11	0.13	0.14	0.16	0.41
Fish with swim bladder involved in hearing	L_E [c]	203	3.12						3.39					
	L_{pk} [c]	207	0.07	0.10	0.13	0.14	0.15	0.40	0.07	0.11	0.13	0.14	0.16	0.41
Sea turtles	L_E [d]	204	2.84						3.06					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.81	1.22	1.80	2.02	2.32	3.73	0.85	1.28	1.87	2.14	2.44	4.01

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-557. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L01 for different energy levels with 6 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
Fish equal to or greater than 2 g	L_E [a]	187	4.75						5.37					
	L_{pk} [a]	206	0.02	0.04	0.06	0.06	0.08	0.12	0.02	0.04	0.06	0.06	0.08	0.12
	L_p [b]	150	3.74	4.61	5.65	5.96	6.23	8.00	4.20	5.27	6.60	7.06	7.51	10.29
Fish less than 2 g	L_E [a]	183	5.77						6.75					
	L_{pk} [a]	206	0.02	0.04	0.06	0.06	0.08	0.12	0.02	0.04	0.06	0.06	0.08	0.12
	L_p [b]	150	3.74	4.61	5.65	5.96	6.23	8.00	4.20	5.27	6.60	7.06	7.51	10.29
Fish without swim bladder	L_E [c]	216	0.30						0.31					
	L_{pk} [c]	213	-	-	-	-	0.02	0.06	-	-	-	-	0.02	0.06
Fish with swim bladder not involved in hearing	L_E [c]	203	1.52						1.60					
	L_{pk} [c]	207	-	0.03	0.05	0.06	0.07	0.11	-	0.03	0.05	0.06	0.07	0.11
Fish with swim bladder involved in hearing	L_E [c]	203	1.52						1.60					
	L_{pk} [c]	207	-	0.03	0.05	0.06	0.07	0.11	-	0.03	0.05	0.06	0.07	0.11
Sea turtles	L_E [d]	204	1.38						1.46					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.30	0.47	0.75	0.91	1.04	1.85	0.31	0.48	0.78	0.94	1.13	1.94

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-558. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L02 for different energy levels with 6 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
Fish equal to or greater than 2 g	L_E [a]	187	5.58						6.23					
	L_{pk} [a]	206	0.01	0.05	0.07	0.08	0.09	0.14	0.01	0.05	0.07	0.08	0.09	0.15
	L_p [b]	150	4.47	5.66	6.93	7.33	7.60	9.34	5.07	6.62	8.35	8.82	9.04	12.09
Fish less than 2 g	L_E [a]	183	6.88						8.02					
	L_{pk} [a]	206	0.01	0.05	0.07	0.08	0.09	0.14	0.01	0.05	0.07	0.08	0.09	0.15
	L_p [b]	150	4.47	5.66	6.93	7.33	7.60	9.34	5.07	6.62	8.35	8.82	9.04	12.09
Fish without swim bladder	L_E [c]	216	0.33						0.33					
	L_{pk} [c]	213	-	-	0.01	0.01	0.01	0.07	-	-	0.01	0.01	0.01	0.07
Fish with swim bladder not involved in hearing	L_E [c]	203	1.73						1.82					
	L_{pk} [c]	207	0.01	0.04	0.06	0.07	0.08	0.13	0.01	0.04	0.06	0.07	0.09	0.14
Fish with swim bladder involved in hearing	L_E [c]	203	1.73						1.82					
	L_{pk} [c]	207	0.01	0.04	0.06	0.07	0.08	0.13	0.01	0.04	0.06	0.07	0.09	0.14
Sea turtles	L_E [d]	204	1.59						1.67					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.34	0.46	0.87	0.95	1.21	2.12	0.35	0.50	0.90	1.01	1.26	2.25

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-559. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L03 for different energy levels with 6 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
Fish equal to or greater than 2 g	L_E [a]	187	5.97						6.64					
	L_{pk} [a]	206	-	0.06	0.07	0.09	0.11	0.15	-	0.05	0.08	0.09	0.11	0.17
	L_p [b]	150	4.82	6.04	7.40	7.68	7.94	9.68	5.45	7.05	8.78	8.90	9.05	11.91
Fish less than 2 g	L_E [a]	183	7.38						8.45					
	L_{pk} [a]	206	-	0.06	0.07	0.09	0.11	0.15	-	0.05	0.08	0.09	0.11	0.17
	L_p [b]	150	4.82	6.04	7.40	7.68	7.94	9.68	5.45	7.05	8.78	8.90	9.05	11.91
Fish without swim bladder	L_E [c]	216	0.32						0.31					
	L_{pk} [c]	213	-	-	-	-	-	0.07	-	-	-	-	-	0.07
Fish with swim bladder not involved in hearing	L_E [c]	203	1.84						1.92					
	L_{pk} [c]	207	-	0.02	0.07	0.08	0.09	0.14	-	0.02	0.06	0.08	0.10	0.15
Fish with swim bladder involved in hearing	L_E [c]	203	1.84						1.92					
	L_{pk} [c]	207	-	0.02	0.07	0.08	0.09	0.14	-	0.02	0.06	0.08	0.10	0.15
Sea turtles	L_E [d]	204	1.68						1.75					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.37	0.51	0.90	1.10	1.28	2.35	0.37	0.54	0.91	1.14	1.34	2.47

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-560. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L01 for different energy levels with 15 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
Fish equal to or greater than 2 g	L_E [a]	187	2.68						2.85					
	L_{pk} [a]	206	-	-	-	-	-	0.04	-	-	-	-	-	0.04
	L_p [b]	150	1.87	2.55	3.43	3.74	3.99	5.29	2.04	2.76	3.86	4.17	4.44	6.08
Fish less than 2 g	L_E [a]	183	3.59						3.95					
	L_{pk} [a]	206	-	-	-	-	-	0.04	-	-	-	-	-	0.04
	L_p [b]	150	1.87	2.55	3.43	3.74	3.99	5.29	2.04	2.76	3.86	4.17	4.44	6.08
Fish without swim bladder	L_E [c]	216	0.06						0.06					
	L_{pk} [c]	213	-	-	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.54						0.58					
	L_{pk} [c]	207	-	-	-	-	-	0.03	-	-	-	-	-	0.03
Fish with swim bladder involved in hearing	L_E [c]	203	0.54						0.58					
	L_{pk} [c]	207	-	-	-	-	-	0.03	-	-	-	-	-	0.03
Sea turtles	L_E [d]	204	0.45						0.48					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.07	0.11	0.19	0.25	0.33	0.76	0.07	0.11	0.20	0.26	0.35	0.80

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-561. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L02 for different energy levels with 15 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
Fish equal to or greater than 2 g	L_E [a]	187	3.11						3.38					
	L_{pk} [a]	206	-	-	-	-	0.01	0.05	-	-	-	-	0.01	0.04
	L_p [b]	150	2.23	2.97	4.04	4.34	4.62	6.13	2.41	3.32	4.49	4.84	5.11	6.78
Fish less than 2 g	L_E [a]	183	4.18						4.53					
	L_{pk} [a]	206	-	-	-	-	0.01	0.05	-	-	-	-	0.01	0.04
	L_p [b]	150	2.23	2.97	4.04	4.34	4.62	6.13	2.41	3.32	4.49	4.84	5.11	6.78
Fish without swim bladder	L_E [c]	216	0.07						0.07					
	L_{pk} [c]	213	-	-	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.59						0.62					
	L_{pk} [c]	207	-	-	-	-	0.01	0.01	-	-	-	-	0.01	0.01
Fish with swim bladder involved in hearing	L_E [c]	203	0.59						0.62					
	L_{pk} [c]	207	-	-	-	-	0.01	0.01	-	-	-	-	0.01	0.01
Sea turtles	L_E [d]	204	0.50						0.53					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.09	0.12	0.21	0.29	0.34	0.83	0.09	0.12	0.21	0.30	0.35	0.87

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-562. Monopile foundation (9.6 m diameter, IHC S-5500) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location L03 for different energy levels with 15 dB attenuation.

Faunal group	Metric	Threshold	Hammer energy in kJ											
			Summer						Winter					
			450	800	1400	1700	2300	5500	450	800	1400	1700	2300	5500
Fish equal to or greater than 2 g	L_E [a]	187	3.42						3.69					
	L_{pk} [a]	206	-	-	-	-	-	0.02	-	-	-	-	-	0.02
	L_p [b]	150	2.43	3.24	4.26	4.53	4.84	6.51	2.58	3.56	4.69	4.95	5.27	7.24
Fish less than 2 g	L_E [a]	183	4.49						4.87					
	L_{pk} [a]	206	-	-	-	-	-	0.02	-	-	-	-	-	0.02
	L_p [b]	150	2.43	3.24	4.26	4.53	4.84	6.51	2.58	3.56	4.69	4.95	5.27	7.24
Fish without swim bladder	L_E [c]	216	0.07						0.07					
	L_{pk} [c]	213	-	-	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.58						0.60					
	L_{pk} [c]	207	-	-	-	-	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.58						0.60					
	L_{pk} [c]	207	-	-	-	-	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.52						0.54					
	L_{pk} [d]	232	-	-	-	-	-	-	-	-	-	-	-	-
	L_p [e]	175	0.09	0.13	0.23	0.31	0.38	0.87	0.09	0.13	0.23	0.32	0.38	0.90

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

H.5.3. Jacket Foundation

Table H-563. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS1 for different energy levels with 0 dB attenuation for 1 pin pile.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	2000	3200	500	750	2000	3200
Fish equal to or greater than 2 g	L_E [a]	187	2.29				2.37			
	L_{pk} [a]	206	0.01	0.01	0.03	0.03	0.01	0.01	0.03	0.03
	L_p [b]	150	3.41	4.48	5.74	6.17	3.79	5.10	6.78	7.42
Fish less than 2 g	L_E [a]	183	3.20				3.46			
	L_{pk} [a]	206	0.01	0.01	0.03	0.03	0.01	0.01	0.03	0.03
	L_p [b]	150	3.41	4.48	5.74	6.17	3.79	5.10	6.78	7.42
Fish without swim bladder	L_E [c]	216	0.03				0.03			
	L_{pk} [c]	213	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Fish with swim bladder not involved in hearing	L_E [c]	203	0.30				0.30			
	L_{pk} [c]	207	0.01	0.01	0.02	0.03	0.01	0.01	0.02	0.03
Fish with swim bladder involved in hearing	L_E [c]	203	0.30				0.30			
	L_{pk} [c]	207	0.01	0.01	0.02	0.03	0.01	0.01	0.02	0.03
Sea turtles	L_E [d]	204	0.26				0.26			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.18	0.25	0.45	0.63	0.19	0.25	0.45	0.59

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-564. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS1 for different energy levels with 0 dB attenuation for 2 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	2000	3200	500	750	2000	3200
Fish equal to or greater than 2 g	L_E [a]	187	2.89				3.11			
	L_{pk} [a]	206	0.01	0.01	0.03	0.03	0.01	0.01	0.03	0.03
	L_p [b]	150	3.41	4.48	5.74	6.17	3.79	5.10	6.78	7.42
Fish less than 2 g	L_E [a]	183	4.06				4.45			
	L_{pk} [a]	206	0.01	0.01	0.03	0.03	0.01	0.01	0.03	0.03
	L_p [b]	150	3.41	4.48	5.74	6.17	3.79	5.10	6.78	7.42
Fish without swim bladder	L_E [c]	216	0.07				0.08			
	L_{pk} [c]	213	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Fish with swim bladder not involved in hearing	L_E [c]	203	0.46				0.46			
	L_{pk} [c]	207	0.01	0.01	0.02	0.03	0.01	0.01	0.02	0.03
Fish with swim bladder involved in hearing	L_E [c]	203	0.46				0.46			
	L_{pk} [c]	207	0.01	0.01	0.02	0.03	0.01	0.01	0.02	0.03
Sea turtles	L_E [d]	204	0.41				0.42			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.18	0.25	0.45	0.63	0.19	0.25	0.45	0.59

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-565. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS1 for different energy levels with 0 dB attenuation for 3 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	2000	3200	500	750	2000	3200
Fish equal to or greater than 2 g	L_E [a]	187	3.43				3.72			
	L_{pk} [a]	206	0.01	0.01	0.03	0.03	0.01	0.01	0.03	0.03
	L_p [b]	150	3.41	4.48	5.74	6.17	3.79	5.10	6.78	7.42
Fish less than 2 g	L_E [a]	183	4.54				5.08			
	L_{pk} [a]	206	0.01	0.01	0.03	0.03	0.01	0.01	0.03	0.03
	L_p [b]	150	3.41	4.48	5.74	6.17	3.79	5.10	6.78	7.42
Fish without swim bladder	L_E [c]	216	0.10				0.10			
	L_{pk} [c]	213	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Fish with swim bladder not involved in hearing	L_E [c]	203	0.62				0.61			
	L_{pk} [c]	207	0.01	0.01	0.02	0.03	0.01	0.01	0.02	0.03
Fish with swim bladder involved in hearing	L_E [c]	203	0.62				0.61			
	L_{pk} [c]	207	0.01	0.01	0.02	0.03	0.01	0.01	0.02	0.03
Sea turtles	L_E [d]	204	0.52				0.52			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.18	0.25	0.45	0.63	0.19	0.25	0.45	0.59

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-566. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS2 for different energy levels with 0 dB attenuation for 1 pin pile.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	3200	500	750	1100	3200
Fish equal to or greater than 2 g	L_E [a]	187	2.36				2.45			
	L_{pk} [a]	206	0.00	0.02	0.02	0.03	0.00	0.02	0.02	0.03
	L_p [b]	150	3.88	5.46	5.62	7.00	4.30	6.43	6.36	8.17
Fish less than 2 g	L_E [a]	183	3.44				3.71			
	L_{pk} [a]	206	0.00	0.02	0.02	0.03	0.00	0.02	0.02	0.03
	L_p [b]	150	3.88	5.46	5.62	7.00	4.30	6.43	6.36	8.17
Fish without swim bladder	L_E [c]	216	0.03				0.03			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.28				0.28			
	L_{pk} [c]	207	0.00	0.00	0.02	0.03	0.00	0.00	0.02	0.03
Fish with swim bladder involved in hearing	L_E [c]	203	0.28				0.28			
	L_{pk} [c]	207	0.00	0.00	0.02	0.03	0.00	0.00	0.02	0.03
Sea turtles	L_E [d]	204	0.24				0.24			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.16	0.29	0.34	0.54	0.15	0.28	0.33	0.54

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-567. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS2 for different energy levels with 0 dB attenuation for 2 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	3200	500	750	1100	3200
Fish equal to or greater than 2 g	L_E [a]	187	3.12				3.34			
	L_{pk} [a]	206	0.00	0.02	0.02	0.03	0.00	0.02	0.02	0.03
	L_p [b]	150	3.88	5.46	5.62	7.00	4.30	6.43	6.36	8.17
Fish less than 2 g	L_E [a]	183	4.41				4.85			
	L_{pk} [a]	206	0.00	0.02	0.02	0.03	0.00	0.02	0.02	0.03
	L_p [b]	150	3.88	5.46	5.62	7.00	4.30	6.43	6.36	8.17
Fish without swim bladder	L_E [c]	216	0.05				0.05			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.43				0.44			
	L_{pk} [c]	207	0.00	0.00	0.02	0.03	0.00	0.00	0.02	0.03
Fish with swim bladder involved in hearing	L_E [c]	203	0.43				0.44			
	L_{pk} [c]	207	0.00	0.00	0.02	0.03	0.00	0.00	0.02	0.03
Sea turtles	L_E [d]	204	0.39				0.38			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.16	0.29	0.34	0.54	0.15	0.28	0.33	0.54

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-568. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS2 for different energy levels with 0 dB attenuation for 3 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	3200	500	750	1100	3200
Fish equal to or greater than 2 g	L_E [a]	187	3.71				3.98			
	L_{pk} [a]	206	0.00	0.02	0.02	0.03	0.00	0.02	0.02	0.03
	L_p [b]	150	3.88	5.46	5.62	7.00	4.30	6.43	6.36	8.17
Fish less than 2 g	L_E [a]	183	4.99				5.63			
	L_{pk} [a]	206	0.00	0.02	0.02	0.03	0.00	0.02	0.02	0.03
	L_p [b]	150	3.88	5.46	5.62	7.00	4.30	6.43	6.36	8.17
Fish without swim bladder	L_E [c]	216	0.06				0.06			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.57				0.57			
	L_{pk} [c]	207	0.00	0.00	0.02	0.03	0.00	0.00	0.02	0.03
Fish with swim bladder involved in hearing	L_E [c]	203	0.57				0.57			
	L_{pk} [c]	207	0.00	0.00	0.02	0.03	0.00	0.00	0.02	0.03
Sea turtles	L_E [d]	204	0.47				0.47			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.16	0.29	0.34	0.54	0.15	0.28	0.33	0.54

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-569. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS1 for different energy levels with 6 dB attenuation for 1 pin pile.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	2000	3200	500	750	2000	3200
Fish equal to or greater than 2 g	L_E [a]	187	1.23				1.23			
	L_{pk} [a]	206	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
	L_p [b]	150	2.15	2.80	3.95	4.29	2.32	3.05	4.28	4.64
Fish less than 2 g	L_E [a]	183	1.86				1.89			
	L_{pk} [a]	206	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
	L_p [b]	150	2.15	2.80	3.95	4.29	2.32	3.05	4.28	4.64
Fish without swim bladder	L_E [c]	216	0.01				0.01			
	L_{pk} [c]	213	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
Fish with swim bladder not involved in hearing	L_E [c]	203	0.13				0.13			
	L_{pk} [c]	207	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Fish with swim bladder involved in hearing	L_E [c]	203	0.13				0.13			
	L_{pk} [c]	207	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Sea turtles	L_E [d]	204	0.11				0.11			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.07	0.10	0.20	0.26	0.08	0.10	0.20	0.26

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-570. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS1 for different energy levels with 6 dB attenuation for 2 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	2000	3200	500	750	2000	3200
Fish equal to or greater than 2 g	L_E [a]	187	1.72				1.72			
	L_{pk} [a]	206	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
	L_p [b]	150	2.15	2.80	3.95	4.29	2.32	3.05	4.28	4.64
Fish less than 2 g	L_E [a]	183	2.50				2.59			
	L_{pk} [a]	206	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
	L_p [b]	150	2.15	2.80	3.95	4.29	2.32	3.05	4.28	4.64
Fish without swim bladder	L_E [c]	216	0.02				0.02			
	L_{pk} [c]	213	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
Fish with swim bladder not involved in hearing	L_E [c]	203	0.20				0.20			
	L_{pk} [c]	207	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Fish with swim bladder involved in hearing	L_E [c]	203	0.20				0.20			
	L_{pk} [c]	207	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Sea turtles	L_E [d]	204	0.17				0.18			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.07	0.10	0.20	0.26	0.08	0.10	0.20	0.26

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-571. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS1 for different energy levels with 6 dB attenuation for 3 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	2000	3200	500	750	2000	3200
Fish equal to or greater than 2 g	L_E [a]	187	2.02				2.02			
	L_{pk} [a]	206	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
	L_p [b]	150	2.15	2.80	3.95	4.29	2.32	3.05	4.28	4.64
Fish less than 2 g	L_E [a]	183	2.84				3.02			
	L_{pk} [a]	206	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
	L_p [b]	150	2.15	2.80	3.95	4.29	2.32	3.05	4.28	4.64
Fish without swim bladder	L_E [c]	216	0.03				0.03			
	L_{pk} [c]	213	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
Fish with swim bladder not involved in hearing	L_E [c]	203	0.26				0.26			
	L_{pk} [c]	207	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Fish with swim bladder involved in hearing	L_E [c]	203	0.26				0.26			
	L_{pk} [c]	207	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Sea turtles	L_E [d]	204	0.22				0.22			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.07	0.10	0.20	0.26	0.08	0.10	0.20	0.26

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-572. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS2 for different energy levels with 6 dB attenuation for 1 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	3200	500	750	1100	3200
Fish equal to or greater than 2 g	L_E [a]	187	1.19				1.20			
	L_{pk} [a]	206	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	L_p [b]	150	2.37	3.49	3.50	4.61	2.53	3.90	3.67	4.77
Fish less than 2 g	L_E [a]	183	1.88				1.91			
	L_{pk} [a]	206	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	L_p [b]	150	2.37	3.49	3.50	4.61	2.53	3.90	3.67	4.77
Fish without swim bladder	L_E [c]	216	0.00				0.00			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.10				0.11			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.10				0.11			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.09				0.10			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.07	0.10	0.12	0.24	0.07	0.10	0.13	0.24

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-573. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS2 for different energy levels with 6 dB attenuation for 2 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	3200	500	750	1100	3200
Fish equal to or greater than 2 g	L_E [a]	187	1.70				1.74			
	L_{pk} [a]	206	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	L_p [b]	150	2.37	3.49	3.50	4.61	2.53	3.90	3.67	4.77
Fish less than 2 g	L_E [a]	183	2.60				2.69			
	L_{pk} [a]	206	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	L_p [b]	150	2.37	3.49	3.50	4.61	2.53	3.90	3.67	4.77
Fish without swim bladder	L_E [c]	216	0.02				0.02			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.17				0.17			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.17				0.17			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.14				0.14			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.07	0.10	0.12	0.24	0.07	0.10	0.13	0.24

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-574. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS2 for different energy levels with 6 dB attenuation for 3 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	3200	500	750	1100	3200
Fish equal to or greater than 2 g	L_E [a]	187	2.06				2.12			
	L_{pk} [a]	206	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	L_p [b]	150	2.37	3.49	3.50	4.61	2.53	3.90	3.67	4.77
Fish less than 2 g	L_E [a]	183	3.04				3.24			
	L_{pk} [a]	206	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	L_p [b]	150	2.37	3.49	3.50	4.61	2.53	3.90	3.67	4.77
Fish without swim bladder	L_E [c]	216	0.03				0.03			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.23				0.23			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.23				0.23			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.20				0.20			
	L_{pk} [d]	232	0.07	0.10	0.12	0.24	0.07	0.10	0.13	0.24
	L_p [e]	175	0.07	0.10	0.12	0.24	0.07	0.10	0.13	0.24

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-575. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS1 for different energy levels with 10 dB attenuation for 1 pin pile.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	2000	3200	500	750	2000	3200
Fish equal to or greater than 2 g	L_E [a]	187	0.73				0.73			
	L_{pk} [a]	206	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
	L_p [b]	150	1.51	1.92	2.78	3.13	1.59	2.02	2.87	3.25
Fish less than 2 g	L_E [a]	183	1.23				1.23			
	L_{pk} [a]	206	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
	L_p [b]	150	1.51	1.92	2.78	3.13	1.59	2.02	2.87	3.25
Fish without swim bladder	L_E [c]	216	-				-			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.07				0.08			
	L_{pk} [c]	207	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
Fish with swim bladder involved in hearing	L_E [c]	203	0.07				0.08			
	L_{pk} [c]	207	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
Sea turtles	L_E [d]	204	0.05				0.05			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.04	0.04	0.12	0.15	0.04	0.04	0.12	0.16

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-576. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS1 for different energy levels with 10 dB attenuation for 2 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	2000	3200	500	750	2000	3200
Fish equal to or greater than 2 g	L_E [a]	187	1.11				1.09			
	L_{pk} [a]	206	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
	L_p [b]	150	1.51	1.92	2.78	3.13	1.59	2.02	2.87	3.25
Fish less than 2 g	L_E [a]	183	1.72				1.74			
	L_{pk} [a]	206	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
	L_p [b]	150	1.51	1.92	2.78	3.13	1.59	2.02	2.87	3.25
Fish without swim bladder	L_E [c]	216	0.01				0.01			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.11				0.11			
	L_{pk} [c]	207	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
Fish with swim bladder involved in hearing	L_E [c]	203	0.11				0.11			
	L_{pk} [c]	207	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
Sea turtles	L_E [d]	204	0.10				0.10			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.04	0.04	0.12	0.15	0.04	0.04	0.12	0.16

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-577. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS1 for different energy levels with 10 dB attenuation for 3 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	2000	3200	500	750	2000	3200
Fish equal to or greater than 2 g	L_E [a]	187	1.35				1.35			
	L_{pk} [a]	206	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
	L_p [b]	150	1.51	1.92	2.78	3.13	1.59	2.02	2.87	3.25
Fish less than 2 g	L_E [a]	183	2.02				2.07			
	L_{pk} [a]	206	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
	L_p [b]	150	1.51	1.92	2.78	3.13	1.59	2.02	2.87	3.25
Fish without swim bladder	L_E [c]	216	0.01				0.01			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.14				0.14			
	L_{pk} [c]	207	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
Fish with swim bladder involved in hearing	L_E [c]	203	0.14				0.14			
	L_{pk} [c]	207	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
Sea turtles	L_E [d]	204	0.12				0.12			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.04	0.04	0.12	0.15	0.04	0.04	0.12	0.16

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-578. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS2 for different energy levels with 10 dB attenuation for 1 pin pile.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	3200	500	750	1100	3200
Fish equal to or greater than 2 g	L_E [a]	187	0.67				0.67			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	2.07	2.07	2.07	2.07	2.07	2.07	2.07	2.07
Fish less than 2 g	L_E [a]	183	1.19				1.20			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	1.60	2.38	2.35	3.23	1.67	2.54	2.36	3.20
Fish without swim bladder	L_E [c]	216	-				-			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.05				0.05			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.05				0.05			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.05				0.05			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.04	0.06	0.06	0.14	0.04	0.06	0.06	0.14

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-579. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS2 for different energy levels with 10 dB attenuation for 2 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	3200	500	750	1100	3200
Fish equal to or greater than 2 g	L_E [a]	187	1.02				1.04			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	1.60	2.38	2.35	3.23	1.67	2.54	2.36	3.20
Fish less than 2 g	L_E [a]	183	1.70				1.74			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	1.60	2.38	2.35	3.23	1.67	2.54	2.36	3.20
Fish without swim bladder	L_E [c]	216	-				-			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.09				0.10			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.09				0.10			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.06				0.07			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.04	0.06	0.06	0.14	0.04	0.06	0.06	0.14

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-580. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS2 for different energy levels with 10 dB attenuation for 3 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	3200	500	750	1100	3200
Fish equal to or greater than 2 g	L_E [a]	187	1.32				1.34			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	1.60	2.38	2.35	3.23	1.67	2.54	2.36	3.20
Fish less than 2 g	L_E [a]	183	2.06				2.12			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	1.60	2.38	2.35	3.23	1.67	2.54	2.36	3.20
Fish without swim bladder	L_E [c]	216	-				-			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.12				0.12			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.12				0.12			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.10				0.10			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.04	0.06	0.06	0.14	0.04	0.06	0.06	0.14

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-581. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS1 for different energy levels with 15 dB attenuation for 1 pin pile.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	2000	3200	500	750	2000	3200
Fish equal to or greater than 2 g	L_E [a]	187	0.34				0.34			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	0.89	1.13	1.75	1.97	0.92	1.13	1.73	1.92
Fish less than 2 g	L_E [a]	183	0.65				0.64			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	0.89	1.13	1.75	1.97	0.92	1.13	1.73	1.92
Fish without swim bladder	L_E [c]	216	-				-			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.03				0.02			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.03				0.02			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.02				0.02			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.01	0.02	0.04	0.09	0.01	0.02	0.03	0.09

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-582. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS1 for different energy levels with 15 dB attenuation for 2 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	2000	3200	500	750	2000	3200
Fish equal to or greater than 2 g	L_E [a]	187	0.54				0.53			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	0.89	1.13	1.75	1.97	0.92	1.13	1.73	1.92
Fish less than 2 g	L_E [a]	183	0.93				0.93			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	0.89	1.13	1.75	1.97	0.92	1.13	1.73	1.92
Fish without swim bladder	L_E [c]	216	-				-			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.04				0.04			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.04				0.04			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.03				0.03			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.01	0.02	0.04	0.09	0.01	0.02	0.03	0.09

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-583. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS1 for different energy levels with 15 dB attenuation for 3 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	2000	3200	500	750	2000	3200
Fish equal to or greater than 2 g	L_E [a]	187	0.71				0.70			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	0.89	1.13	1.75	1.97	0.92	1.13	1.73	1.92
Fish less than 2 g	L_E [a]	183	1.20				1.21			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	0.89	1.13	1.75	1.97	0.92	1.13	1.73	1.92
Fish without swim bladder	L_E [c]	216	-				-			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.07				0.07			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.07				0.07			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.04				0.05			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.01	0.02	0.04	0.09	0.01	0.02	0.03	0.09

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-584. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS2 for different energy levels with 15 dB attenuation for 1 pin pile.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	3200	500	750	1100	3200
Fish equal to or greater than 2 g	L_E [a]	187	0.34				0.34			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	0.90	1.35	1.33	1.95	0.93	1.39	1.32	1.88
Fish less than 2 g	L_E [a]	183	0.59				0.59			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	0.90	1.35	1.33	1.95	0.93	1.39	1.32	1.88
Fish without swim bladder	L_E [c]	216	-				-			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.02				0.02			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.02				0.02			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.02				0.02			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.00	0.03	0.03	0.05	0.00	0.03	0.03	0.05

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).

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

[c] Popper et al. (2014).

[d] Finneran et al. (2017).

[e] McCauley et al. (2000).

Table H-585. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS2 for different energy levels with 15 dB attenuation for 2 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	3200	500	750	1100	3200
Fish equal to or greater than 2 g	L_E [a]	187	0.48				0.49			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	0.90	1.35	1.33	1.95	0.93	1.39	1.32	1.88
Fish less than 2 g	L_E [a]	183	0.91				0.91			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	0.90	1.35	1.33	1.95	0.93	1.39	1.32	1.88
Fish without swim bladder	L_E [c]	216	-				-			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.04				0.04			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.04				0.04			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.03				0.03			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.00	0.03	0.03	0.05	0.00	0.03	0.03	0.05

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 (dB re 1 µPa).
[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Table H-586. Jacket foundation (2.5 m diameter, IHC S-4000) acoustic ranges (R_{max} in km) to fish and sea turtle injury and behavioral thresholds at location OSS2 for different energy levels with 15 dB attenuation for 3 pin piles.

Faunal group	Metric	Threshold	Hammer energy in kJ							
			Summer				Winter			
			500	750	1100	3200	500	750	1100	3200
Fish equal to or greater than 2 g	L_E [a]	187	0.65				0.65			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	0.90	1.35	1.33	1.95	0.93	1.39	1.32	1.88
Fish less than 2 g	L_E [a]	183	1.15				1.15			
	L_{pk} [a]	206	-	-	-	-	-	-	-	-
	L_p [b]	150	0.90	1.35	1.33	1.95	0.93	1.39	1.32	1.88
Fish without swim bladder	L_E [c]	216	-				-			
	L_{pk} [c]	213	-	-	-	-	-	-	-	-
Fish with swim bladder not involved in hearing	L_E [c]	203	0.05				0.05			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Fish with swim bladder involved in hearing	L_E [c]	203	0.05				0.05			
	L_{pk} [c]	207	-	-	-	-	-	-	-	-
Sea turtles	L_E [d]	204	0.04				0.04			
	L_{pk} [d]	232	-	-	-	-	-	-	-	-
	L_p [e]	175	0.00	0.03	0.03	0.05	0.00	0.03	0.03	0.05

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 (dB re 1 µPa).

[a] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007).
[c] Popper et al. (2014).
[d] Finneran et al. (2017).
[e] McCauley et al. (2000).

Appendix I. Animal Movement and Exposure Modeling

To assess the risk of impacts from anthropogenic sound exposure, an estimate of the received sound levels for individuals of each species known to occur in the Project Area during the assessed activities is required. Both sound sources and animals move. The sound fields may be complex, and the sound received by an animal is a function of where the animal is at any given time. To a reasonable approximation, the locations of the Project sound sources are known, and acoustic modeling can be used to predict the individual and aggregate 3-D sound fields of the sources. The location and movement of animals within the sound field, however, is unknown. Realistic animal movement within the sound field can be simulated. Repeated random sampling (Monte Carlo method simulating many animals within the operations area) is used to estimate the sound exposure history of the population of simulated animals (animats) during the operation.

Monte Carlo methods provide a heuristic approach for determining the probability distribution function (PDF) of complex situations, such as animals moving in a sound field. The probability of an event's occurrence is determined by the frequency with which it occurs in the simulation. The greater the number of random samples, in this case the more animats, the better the approximation of the PDF. Animats are randomly placed, or seeded, within the simulation boundary at a specified density (animats/km^2). Higher densities provide a finer PDF estimate resolution but require more computational resources. To ensure good representation of the PDF, the animat density is set as high as practical allowing for computation time. The animat density is much higher than the real-world density to ensure good representation of the PDF. The resulting PDF is scaled using the real-world density.

Several models for marine mammal movement have been developed (Ellison et al. 1999, Frankel et al. 2002, Houser 2006). These models use an underlying Markov chain to transition from one state to another based on probabilities determined from measured swimming behavior. The parameters may represent simple states, such as the speed or heading of the animal, or complex states, such as likelihood of participating in foraging, play, rest, or travel. Attractions and aversions to variables like anthropogenic sounds and different depth ranges can be included in the models.

The JASCO Animal Simulation Model Including Noise Exposure (JASMINE) was based on the open-source marine mammal movement and behavior model (3MB; Houser 2006) and used to predict the exposure of animats (virtual marine mammals and sea turtles) to sound arising from sound sources in simulated representative surveys. Within JASMINE simulations, the modeled sound fields are repeated at proposed foundation locations, mimicking the impact pile driving activity throughout the lease area. Animats are programmed to behave like the marine animals likely to be present in the survey area. The parameters used for forecasting realistic behaviors (e.g., diving, foraging, aversion, surface times, etc.) are determined and interpreted from marine species studies (e.g., tagging studies) where available, or reasonably extrapolated from related species. An individual animat's modeled sound exposure levels are summed over the total simulation duration, such as 24 hours or the entire simulation, to determine its total received energy, and then compared to the assumed threshold criteria.

JASMINE uses the same animal movement algorithms as the 3MB model (Houser 2006) but has been extended to be directly compatible with MONM and FWRAM acoustic field predictions, for inclusion of source tracks, and importantly for animats to change behavioral states based on time and space dependent modeled variables such as received levels for aversion behavior (Ellison et al. 2016).

I.1. Animal Movement Parameters

JASMINE uses previously measured behavior to forecast behavior in new situations and locations. The parameters used for forecasting realistic behavior are determined (and interpreted) from marine species studies (e.g., tagging studies). Each parameter in the model is described as a probability distribution. When limited or no information is available for a species parameter, a Gaussian or uniform distribution may be chosen for that parameter. For the Gaussian distribution, the user determines the mean and standard deviation of the distribution from which parameter values are drawn. For the uniform distribution, the user determines the maximum and minimum distribution from which parameter values are drawn. When detailed information about the movement and behavior of a species are available, a user-created distribution vector, including cumulative transition probabilities, may be used (referred to here as a vector model; Houser 2006). Different sets of parameters can be defined for different behavior states. The probability of an animat starting out in or transitioning into a given behavior state can in turn be defined in terms of the animat's current behavioral state, depth, and the time of day. In addition, each travel parameter and behavioral state has a termination function that governs how long the parameter value or overall behavioral state persists in simulation.

The parameters used in JASMINE describe animal movement in both the vertical and horizontal planes. The parameters relating to travel in these two planes are briefly described below. JASCO maintains species-specific choices of values for the behavioral parameters used in this study. The parameter values are available for limited distribution upon request.

Travel sub-models

- **Direction**–determines an animat's choice of direction in the horizontal plane. Sub-models are available for determining the heading of animats, allowing for movement to range from strongly biased to undirected. A random walk model can be used for behaviors with no directional preference, such as feeding and playing. In a random walk, all bearings are equally likely at each parameter transition time step. A correlated random walk can be used to smooth the changes in bearing by using the current heading as the mean of the distribution from which to draw the next heading. An additional variant of the correlated random walk is available that includes a directional bias for use in situations where animals have a preferred absolute direction, such as migration. A user-defined vector of directional probabilities can also be input to control animat heading. For more detailed discussion of these parameters, see Houser (2006) and Houser and Cross (1999).
- **Travel rate**–defines an animat's rate of travel in the horizontal plane. When combined with vertical speed and dive depth, the dive profile of the animat is produced.

Dive sub-models

- **Ascent rate**–defines an animat's rate of travel in the vertical plane during the ascent portion of a dive.
- **Descent rate**–defines an animat's rate of travel in the vertical plane during the descent portion of a dive.
- **Depth**–defines an animat's maximum dive depth.
- **Bottom following**–determines whether an animat returns to the surface once reaching the ocean floor, or whether it follows the contours of the bathymetry.
- **Reversals**–determines whether multiple vertical excursions occur once an animat reaches the maximum dive depth. This behavior is used to emulate the foraging behavior of some marine mammal species at depth. Reversal-specific ascent and descent rates may be specified.
- **Surface interval**–determines the duration an animat spends at, or near, the surface before diving again.

I.1.1. Exposure Integration Time

The interval over which acoustic exposure (L_E) should be integrated and maximal exposure (*SPL*) determined is not well defined. Both Southall et al. (2007) and the NMFS (2018) recommend a 24 h baseline accumulation period, but state that there may be situations where this is not appropriate (e.g., a high-level source and confined population). Resetting the integration after 24 h can lead to overestimating the number of individual animals exposed because individuals can be counted multiple times during an operation. The type of animal movement engine used in this study simulates realistic movement using swimming behavior collected over relatively short periods (hours to days) and does not include large-scale movement such as migratory circulation patterns. Therefore, the simulation time should be limited to a few weeks, the approximate scale of the collected data (e.g., marine mammal tag data) (Houser 2006). For this study, one-week simulations (i.e., 7 days) were modeled.

Ideally, a simulation area is large enough to encompass the entire range of a population so that any animal that might be present in the Project Area during sound-producing activities is included. However, there are limits to the simulation area, and computational overhead increases with area. For practical reasons, the simulation area is limited in this analysis to a maximum distance of 38 miles (70 km) from the OCS-0512 Lease Area (see figures in Section 3). In the simulation, every animat that reaches and leaves a border of the simulation area is replaced by another animat entering at an opposite border—e.g., an animat departing at the northern border of the simulation area is replaced by an animat entering the simulation area at the southern border at the same longitude. When this action places the animat in an inappropriate water depth, the animat is randomly placed on the map at a depth suited to its species definition. The exposures of all animats (including those leaving the simulation and those entering) are kept for analysis. This approach maintains a consistent animat density and allows for longer integration periods with finite simulation areas.

I.1.2. Aversion

Aversion is a common response of animals to sound, particularly at relatively high sound exposure levels (Ellison et al. 2012). As received sound level generally decreases with distance from a source, this aspect of natural behavior can strongly influence the estimated maximum sound levels an animal is predicted to receive and significantly affects the probability of more pronounced direct or subsequent behavioral effects. Additionally, animals are less likely to respond to sound levels distant from a source, even when those same levels elicit response at closer distances; both proximity and received levels are important factors in aversive responses (Dunlop et al. 2017b). As a supplement to this modeling study for comparison purposes only, parameters determining aversion at specified sound levels were implemented for the North Atlantic right whale, in recognition of its Endangered status, and harbor porpoise, a species known to have a strong aversive response to loud sounds.

Aversion is implemented in JASMINE by defining a new behavioral state that an animat may transition in to when a received level is exceeded. There are very few data on which aversive behavior can be based. Because of the dearth of information and to be consistent within this report, aversion probability is based on the Wood et al. (2012) step function that was used to estimate potential behavioral disruption. Animats will be assumed to avert by changing their headings by a fixed amount away from the source, with greater deflections associated with higher received levels (Tables J-1 and J-2). Aversion thresholds for marine mammals are based on the Wood et al. (2012) step function. Animats remain in the aversive state for a specified amount of time, depending on the level of exposure that triggered aversion (Tables J-1 and J-2). During this time, travel parameters are recalculated periodically as with normal behaviors. At the end of the aversion interval, the animat model parameters are changed (see Tables J-1 and J-2), depending on the current level of exposure and the animat either begins another aversion interval or transitions to a non-aversive behavior; while if aversion begins immediately, transition to a regular behavior occurs at the end of the next surface interval, consistent with regular behavior transitions.

Table I-1. North Atlantic right whales: Aversion parameters for the animal movement simulation based on Wood et al. (2012) behavioral response criteria.

Probability of aversion (%)	Received sound level (L_p, dB re 1 µPa)	Change in course (°)	Duration of aversion (s)
10	140	10	300
50	160	20	60
90	180	30	30

Table I-2. Harbor porpoises: Aversion parameters for the animal movement simulation based on Wood et al. (2012) behavioral response criteria.

Probability of aversion (%)	Received sound level (L_p, dB re 1 µPa)	Change in course (°)	Duration of aversion (s)
50	120	20	60
90	140	30	30

I.1.3. Seeding Density and Scaling

The exposure criteria for impulsive sounds were used to determine the number of animats exceeding exposure thresholds. To generate statistically reliable probability density functions, all simulations were seeded with an animat density of 0.5 animats/km^2 over the entire simulation area. Some species have depth preference restrictions, e.g., sperm whales prefer water greater than 1,000 m (Aoki et al. 2007), and the simulation location contained a relatively high portion of shallow water areas. For each species, the local modeling density, that is the density of animats near the construction area, was determined by dividing the simulation seeding density by the proportion of seedable area. To evaluate potential Level B or Level A harassment, threshold exceedance was determined in 24 h time windows for each species. From the numbers of animats exceeding threshold, the numbers of individual animals for each species predicted to exceed threshold were determined by scaling the animat results by the ratio of local real-world density to local modeling density. As described in Section 3, the local density estimates were obtained from the 2022 updated habitat-based models of Roberts et al. (2016, 2022).

I.2. Animal Movement Modeling Supplemental Results

This section contains complete marine mammal and sea turtle animal movement modeling results, for all attenuations (0, 6, 10, and 15 dB) and seasons (summer and winter), for each year of the four proposed construction schedules (see Section 1.2.2).

I.2.1. Exposure Estimates

I.2.1.1. Marine Mammals

This section contains yearly mean marine mammal exposure estimates predicted by the animal movement modeling using the four proposed construction schedules described in Section 1.2.2 and shown in Tables 11–14, assuming 0, 6, 10, and 15 dB of broadband attenuation.

Table I-3. Construction schedule 1 (1 monopile per day/2 pin piles per day), year 1: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	5.61	2.11	1.15	0.40	<0.01	0	0	0	27.25	14.57	8.78	4.52	27.24	15.90	10.66	6.32
	Minke whale (migrating)	26.08	9.43	3.72	0.57	0.16	0	0	0	152.96	94.66	65.05	37.17	497.79	345.43	267.57	189.37
	Humpback whale (migrating)	2.85	0.87	0.36	0.04	0.01	<0.01	<0.01	<0.01	21.65	12.20	8.12	4.76	91.78	59.58	44.29	30.16
	North Atlantic right whale[c] (migrating)	0.83	0.29	0.10	0.02	0	0	0	0	6.04	3.49	2.36	1.25	30.15	18.27	13.02	8.57
	Sei whale[c] (migrating)	1.37	0.50	0.27	0.09	0.01	<0.01	<0.01	0	7.65	4.32	2.78	1.48	41.14	25.14	18.01	11.81
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	292.48	173.31	116.00	68.13	103.86	59.29	39.89	22.86
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0	0	0	0	2114.21	1286.56	902.19	570.94	801.93	454.46	294.37	171.44
	Bottlenose dolphin	0	0	0	0	0	0	0	0	534.11	321.25	226.02	126.30	206.92	118.37	75.48	41.69
	Risso's dolphin	0	0	0	0	0	0	0	0	17.82	9.50	5.96	3.57	7.42	3.72	2.37	1.24
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	1.61	0.91	0.56	0.28	0.59	0.29	0.19	0.11
HF	Harbor porpoise (sensitive)	0.09	0	0	0	5.75	0.61	0.09	0	400.81	211.36	133.70	79.17	4867.73	2291.02	1436.13	804.21
PW	Gray seal	2.13	1.06	0.17	0.17	0.90	0	0	0	500.47	260.03	162.46	85.74	368.92	194.79	124.73	64.75
	Harbor seal	4.26	0.37	0	0	2.01	0	0	0	1207.64	607.70	356.44	187.76	834.77	441.33	286.68	154.81

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-4. Construction schedule 1 (1 monopile per day/2 pin piles per day), year 2: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.52	0.94	0.52	0.18	0	0	0	0	12.90	6.88	4.00	2.02	12.22	7.19	4.84	2.91
	Minke whale (migrating)	19.30	6.82	2.18	0.15	0.15	0	0	0	110.55	69.64	47.73	26.84	355.94	247.33	191.78	135.78
	Humpback whale (migrating)	1.32	0.35	0.14	0	0	0	0	0	9.99	5.69	3.82	2.21	36.77	24.92	19.04	13.26
	North Atlantic right whale[c] (migrating)	0.52	0.17	0.05	<0.01	0	0	0	0	4.11	2.35	1.57	0.81	19.41	11.85	8.61	5.72
	Sei whale[c] (migrating)	0.80	0.28	0.16	0.05	<0.01	0	0	0	4.84	2.68	1.66	0.85	26.99	16.25	11.65	7.60
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	149.48	88.77	59.23	34.32	49.49	29.67	20.03	11.42
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0	0	0	0	1327.33	802.01	560.75	353.56	490.52	277.89	176.86	102.39
	Bottlenose dolphin	0	0	0	0	0	0	0	0	260.45	157.49	110.28	60.64	98.20	56.28	35.73	19.25
	Risso's dolphin	0	0	0	0	0	0	0	0	13.10	6.75	4.09	2.52	5.20	2.67	1.70	0.85
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	0.85	0.47	0.29	0.14	0.30	0.14	0.10	0.06
HF	Harbor porpoise (sensitive)	0	0	0	0	3.74	0	0	0	306.63	159.53	98.43	58.48	3301.27	1616.88	1018.82	576.61
PW	Gray seal	1.45	0.73	0	0	0.73	0	0	0	354.95	181.89	111.95	58.27	258.87	136.48	87.05	44.55
	Harbor seal	1.63	0	0	0	1.63	0	0	0	843.72	406.34	229.89	117.72	570.96	301.32	193.56	102.07

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-5. Construction schedule 2 (1 monopile per day/3 pin piles per day), year 1: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	5.62	2.12	1.15	0.40	<0.01	0	0	0	27.00	14.46	8.73	4.52	26.84	15.69	10.52	6.26
	Minke whale (migrating)	26.21	9.45	3.72	0.57	0.16	0	0	0	155.16	96.19	65.86	37.56	492.07	342.85	266.18	189.08
	Humpback whale (migrating)	2.85	0.87	0.36	0.04	0.01	<0.01	<0.01	<0.01	21.65	12.22	8.15	4.76	90.91	59.18	44.04	30.01
	North Atlantic right whale[c] (migrating)	0.83	0.29	0.10	0.02	0	0	0	0	6.12	3.52	2.37	1.26	30.00	18.23	13.04	8.61
	Sei whale[c] (migrating)	1.37	0.50	0.27	0.09	0.01	<0.01	<0.01	0	7.58	4.30	2.78	1.48	38.73	24.03	17.36	11.47
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	291.77	173.13	115.90	68.28	103.18	59.17	39.83	22.83
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0	0	0	0	2117.10	1291.32	905.93	572.31	803.15	455.14	294.72	172.12
	Bottlenose dolphin	0	0	0	0	0	0	0	0	531.77	320.36	226.15	126.32	205.18	117.62	75.13	41.51
	Risso's dolphin	0	0	0	0	0	0	0	0	17.92	9.59	6.02	3.61	7.44	3.77	2.40	1.26
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	1.60	0.91	0.56	0.29	0.58	0.28	0.19	0.11
HF	Harbor porpoise (sensitive)	0.09	0	0	0	5.75	0.61	0.09	0	402.03	213.06	134.33	79.63	4747.25	2241.98	1405.09	791.43
PW	Gray seal	2.13	1.06	0.17	0.17	0.90	0	0	0	496.43	259.62	162.23	85.90	358.09	190.21	122.48	64.12
	Harbor seal	4.26	0.37	0	0	2.01	0	0	0	1198.81	608.60	356.63	187.45	811.95	432.80	282.22	153.04

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-6. Construction schedule 2 (1 monopile per day/3 pin piles per day), year 2: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.52	0.94	0.52	0.18	0	0	0	0	12.90	6.88	4.00	2.02	12.22	7.19	4.84	2.91
	Minke whale (migrating)	19.30	6.82	2.18	0.15	0.15	0	0	0	110.55	69.64	47.73	26.84	355.94	247.33	191.78	135.78
	Humpback whale (migrating)	1.32	0.35	0.14	0	0	0	0	0	9.99	5.69	3.82	2.21	36.77	24.92	19.04	13.26
	North Atlantic right whale[c] (migrating)	0.52	0.17	0.05	<0.01	0	0	0	0	4.11	2.35	1.57	0.81	19.41	11.85	8.61	5.72
	Sei whale[c] (migrating)	0.80	0.28	0.16	0.05	<0.01	0	0	0	4.84	2.68	1.66	0.85	26.99	16.25	11.65	7.60
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	149.48	88.77	59.23	34.32	49.49	29.67	20.03	11.42
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0	0	0	0	1327.33	802.01	560.75	353.56	490.52	277.89	176.86	102.39
	Bottlenose dolphin	0	0	0	0	0	0	0	0	260.45	157.49	110.28	60.64	98.20	56.28	35.73	19.25
	Risso's dolphin	0	0	0	0	0	0	0	0	13.10	6.75	4.09	2.52	5.20	2.67	1.70	0.85
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	0.85	0.47	0.29	0.14	0.30	0.14	0.10	0.06
HF	Harbor porpoise (sensitive)	0	0	0	0	3.74	0	0	0	306.63	159.53	98.43	58.48	3301.27	1616.88	1018.82	576.61
PW	Gray seal	1.45	0.73	0	0	0.73	0	0	0	354.95	181.89	111.95	58.27	258.87	136.48	87.05	44.55
	Harbor seal	1.63	0	0	0	1.63	0	0	0	843.72	406.34	229.89	117.72	570.96	301.32	193.56	102.07

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-7. Construction schedule 3 (2 monopiles per day/2 pin piles per day), year 1: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	5.57	2.25	1.12	0.37	0.02	0	0	0	21.08	12.09	8.03	4.43	19.10	11.66	8.14	5.01
	Minke whale (migrating)	26.73	9.27	3.15	0.50	0.15	0	0	0	149.77	92.27	63.23	37.57	418.25	299.97	235.86	171.68
	Humpback whale (migrating)	3.07	0.92	0.28	0.02	<0.01	<0.01	<0.01	<0.01	22.23	12.59	8.42	4.84	79.97	53.96	41.30	29.03
	North Atlantic right whale[c] (migrating)	0.85	0.26	0.09	0.02	0	0	0	0	5.99	3.53	2.36	1.33	28.59	17.28	12.40	8.28
	Sei whale[c] (migrating)	1.35	0.50	0.23	0.06	0.01	<0.01	<0.01	0	5.96	3.63	2.48	1.42	24.49	15.78	11.75	8.03
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	256.20	160.15	110.28	69.45	95.03	54.14	35.82	21.37
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0.71	0	0	0	1928.59	1178.12	826.21	521.59	739.38	418.09	284.54	162.79
	Bottlenose dolphin	0	0	0	0	0	0	0	0	479.11	292.70	197.35	112.85	180.35	104.78	71.41	43.02
	Risso's dolphin	0	0	0	0	<0.01	0	0	0	15.40	8.86	5.93	3.49	6.63	3.40	2.18	1.21
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	1.41	0.81	0.53	0.29	0.51	0.27	0.18	0.10
HF	Harbor porpoise (sensitive)	0.41	0.18	0	0	7.89	1.10	0.53	0.48	342.72	190.92	123.32	72.15	4123.74	1894.36	1184.59	677.96
PW	Gray seal	1.07	0.56	0.45	0.09	0.47	0.07	0	0	404.28	223.54	139.84	68.48	265.46	144.30	93.54	51.40
	Harbor seal	5.68	0.21	0	0	1.38	0	0	0	1000.34	563.85	375.08	211.09	652.46	369.51	249.22	148.56

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-8. Construction schedule 3 (2 monopiles per day/2 pin piles per day), year 2: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.54	1.02	0.47	0.16	0.01	0	0	0	10.11	5.77	3.79	2.09	8.56	5.31	3.71	2.34
	Minke whale (migrating)	19.58	6.24	1.60	0.07	0.07	0	0	0	104.12	65.30	44.91	26.77	270.18	197.43	156.60	115.04
	Humpback whale (migrating)	1.46	0.38	0.10	0	0	0	0	0	10.27	5.88	3.94	2.30	33.37	23.28	18.17	12.98
	North Atlantic right whale[c] (migrating)	0.54	0.14	0.04	<0.01	0	0	0	0	3.90	2.31	1.55	0.86	15.58	9.94	7.44	5.13
	Sei whale[c] (migrating)	0.80	0.27	0.11	0.03	<0.01	<0.01	0	0	3.69	2.26	1.52	0.84	16.04	10.00	7.40	5.01
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	128.03	82.06	56.03	35.64	45.59	26.39	17.58	10.49
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0.52	0	0	0	1173.71	721.51	504.58	317.03	431.05	244.60	168.56	95.18
	Bottlenose dolphin	0	0	0	0	0	0	0	0	232.25	141.49	95.09	53.64	84.12	48.94	33.33	20.05
	Risso's dolphin	0	0	0	0	<0.01	0	0	0	10.53	6.00	4.00	2.36	4.03	2.18	1.43	0.78
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	0.74	0.42	0.27	0.15	0.25	0.13	0.09	0.05
HF	Harbor porpoise (sensitive)	0.33	0.21	0	0	5.77	0.41	0.41	0.41	251.48	141.24	90.16	52.92	2078.91	1048.62	676.04	411.98
PW	Gray seal	0.73	0.37	0.36	0	0.37	0	0	0	282.85	153.96	94.11	43.52	177.36	96.43	61.95	34.35
	Harbor seal	2.44	0	0	0	0.82	0	0	0	677.12	380.31	251.40	138.49	433.13	244.15	164.80	99.40

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-9. Construction schedule 4 (2 monopiles per day/3 pin piles per day), year 1: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	5.58	2.25	1.12	0.37	0.02	0	0	0	20.82	11.97	7.98	4.43	18.69	11.44	8.00	4.95
	Minke whale (migrating)	26.77	9.28	3.15	0.50	0.15	0	0	0	149.10	92.38	63.19	37.53	401.46	289.98	228.90	167.43
	Humpback whale (migrating)	3.07	0.92	0.28	0.02	<0.01	<0.01	<0.01	<0.01	22.22	12.61	8.45	4.84	79.07	53.53	41.04	28.87
	North Atlantic right whale[c] (migrating)	0.85	0.26	0.09	0.02	0	0	0	0	5.98	3.53	2.36	1.33	26.76	16.51	11.99	8.10
	Sei whale[c] (migrating)	1.36	0.50	0.23	0.06	0.01	<0.01	<0.01	0	5.88	3.60	2.47	1.42	23.70	15.29	11.41	7.83
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	254.95	159.74	110.03	69.56	94.11	53.91	35.68	21.30
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0.71	0	0	0	1918.37	1177.59	827.21	521.45	729.57	414.37	282.67	162.48
	Bottlenose dolphin	0	0	0	0	0	0	0	0	475.95	291.44	197.32	112.82	178.22	103.81	70.94	42.79
	Risso's dolphin	0	0	0	0	<0.01	0	0	0	15.12	8.77	5.87	3.48	6.33	3.32	2.14	1.20
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	1.39	0.81	0.53	0.30	0.50	0.27	0.18	0.10
HF	Harbor porpoise (sensitive)	0.41	0.18	0	0	7.89	1.10	0.53	0.48	339.82	191.00	123.11	72.32	3628.79	1711.33	1084.08	632.25
PW	Gray seal	1.07	0.56	0.45	0.09	0.47	0.07	0	0	397.90	221.46	139.05	68.55	256.36	140.20	91.06	50.57
	Harbor seal	5.68	0.21	0	0	1.38	0	0	0	984.66	561.55	373.70	209.79	635.22	361.24	244.10	146.26

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-10. Construction schedule 4 (2 monopiles per day/3 pin piles per day), year 2: The mean number of marine mammals predicted to receive sound levels above exposure criteria with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

	Species	Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.54	1.02	0.47	0.16	0.01	0	0	0	10.11	5.77	3.79	2.09	8.56	5.31	3.71	2.34
	Minke whale (migrating)	19.58	6.24	1.60	0.07	0.07	0	0	0	104.12	65.30	44.91	26.77	270.18	197.43	156.60	115.04
	Humpback whale (migrating)	1.46	0.38	0.10	0	0	0	0	0	10.27	5.88	3.94	2.30	33.37	23.28	18.17	12.98
	North Atlantic right whale[c] (migrating)	0.54	0.14	0.04	<0.01	0	0	0	0	3.90	2.31	1.55	0.86	15.58	9.94	7.44	5.13
	Sei whale[c] (migrating)	0.80	0.27	0.11	0.03	<0.01	<0.01	0	0	3.69	2.26	1.52	0.84	16.04	10.00	7.40	5.01
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	128.03	82.06	56.03	35.64	45.59	26.39	17.58	10.49
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0.52	0	0	0	1173.71	721.51	504.58	317.03	431.05	244.60	168.56	95.18
	Bottlenose dolphin	0	0	0	0	0	0	0	0	232.25	141.49	95.09	53.64	84.12	48.94	33.33	20.05
	Risso's dolphin	0	0	0	0	<0.01	0	0	0	10.53	6.00	4.00	2.36	4.03	2.18	1.43	0.78
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	0.74	0.42	0.27	0.15	0.25	0.13	0.09	0.05
HF	Harbor porpoise (sensitive)	0.33	0.21	0	0	5.77	0.41	0.41	0.41	251.48	141.24	90.16	52.92	2078.91	1048.62	676.04	411.98
PW	Gray seal	0.73	0.37	0.36	0	0.37	0	0	0	282.85	153.96	94.11	43.52	177.36	96.43	61.95	34.35
	Harbor seal	2.44	0	0	0	0.82	0	0	0	677.12	380.31	251.40	138.49	433.13	244.15	164.80	99.40

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

I.2.1.2. Sea Turtles

This section yearly mean sea turtle exposure estimates predicted by the animal movement modeling using the four proposed construction schedules described in Section 1.2.2 and shown in Tables 11–14, assuming 0, 6, 10, and 15 dB of broadband attenuation..

Table I-11. Construction schedule 1 (1 monopile per day/2 pin piles per day), year 1: The mean number of sea turtles predicted to receive sound levels above exposure criteria (Finneran et al. 2017) with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	2.69	0.49	0.33	0	0	0	0	0	22.03	9.69	5.48	1.90
Leatherback turtle[a]	1.70	0.29	0.03	0.03	0	0	0	0	14.64	5.01	1.65	0.32
Loggerhead turtle	4.99	1.00	0	0	0	0	0	0	297.99	90.71	29.57	5.99
Green turtle	0.08	0.02	<0.01	0	0	0	0	0	0.68	0.22	0.10	0.05

[a] Listed as Endangered under the ESA

Table I-12. Construction schedule 1 (1 monopile per day/2 pin piles per day), year 2: The mean number of sea turtles predicted to receive sound levels above exposure criteria (Finneran et al. 2017) with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	1.01	0.14	0.14	0	0	0	0	0	11.84	5.05	2.74	0.72
Leatherback turtle[a]	0.53	0.11	0	0	0	0	0	0	7.49	2.11	0.42	0.11
Loggerhead turtle	0	0	0	0	0	0	0	0	160.11	39.05	11.72	0
Green turtle	0.03	<0.01	0	0	0	0	0	0	0.36	0.10	0.04	0.03

[a] Listed as Endangered under the ESA

Table I-13. Construction schedule 2 (1 monopile per day/3 pin piles per day), year 1: The mean number of sea turtles predicted to receive sound levels above exposure criteria (Finneran et al. 2017) with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	2.69	0.49	0.33	0	0	0	0	0	21.99	9.71	5.48	1.90
Leatherback turtle[a]	1.70	0.29	0.03	0.03	0	0	0	0	14.63	5.01	1.65	0.32
Loggerhead turtle	4.99	1.00	0	0	0	0	0	0	298.91	91.47	29.57	5.99
Green turtle	0.08	0.02	<0.01	0	0	0	0	0	0.68	0.22	0.10	0.05

[a] Listed as Endangered under the ESA

Table I-14. Construction schedule 2 (1 monopile per day/3 pin piles per day), year 2: The mean number of sea turtles predicted to receive sound levels above exposure criteria (Finneran et al. 2017) with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	1.01	0.14	0.14	0	0	0	0	0	11.84	5.05	2.74	0.72
Leatherback turtle[a]	0.53	0.11	0	0	0	0	0	0	7.49	2.11	0.42	0.11
Loggerhead turtle	0	0	0	0	0	0	0	0	160.11	39.05	11.72	0
Green turtle	0.03	<0.01	0	0	0	0	0	0	0.36	0.10	0.04	0.03

[a] Listed as Endangered under the ESA

Table I-15. Construction schedule 3 (2 monopiles per day/2 pin piles per day), year 1: The mean number of sea turtles predicted to receive sound levels above exposure criteria (Finneran et al. 2017) with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	3.35	0.35	0.05	0	0.02	0	0	0	21.38	9.76	5.14	2.59
Leatherback turtle[a]	1.70	0.26	0.04	<0.01	0	0	0	0	12.44	4.58	1.26	0.40
Loggerhead turtle	9.52	1.00	0.46	0	0	0	0	0	340.09	139.79	62.83	22.12
Green turtle	0.14	0.04	<0.01	0	0	0	0	0	0.75	0.32	0.16	0.08

[a] Listed as Endangered under the ESA

Table I-16. Construction schedule 3 (2 monopiles per day/2 pin piles per day), year 2: The mean number of sea turtles predicted to receive sound levels above exposure criteria (Finneran et al. 2017) with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	1.65	<0.01	<0.01	0	0	0	0	0	11.91	5.20	2.67	1.29
Leatherback turtle[a]	0.63	0.11	0	0	0	0	0	0	6.15	2.01	0.32	0.16
Loggerhead turtle	1.91	0	0	0	0	0	0	0	202.22	79.25	32.77	11.49
Green turtle	0.08	0.02	0	0	0	0	0	0	0.43	0.18	0.09	0.04

[a] Listed as Endangered under the ESA

Table I-17. Construction schedule 4 (2 monopiles per day/3 pin piles per day), year 1: The mean number of sea turtles predicted to receive sound levels above exposure criteria (Finneran et al. 2017) with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	3.35	0.35	0.05	0	0.02	0	0	0	21.34	9.78	5.14	2.59
Leatherback turtle[a]	1.70	0.26	0.04	<0.01	0	0	0	0	12.44	4.58	1.26	0.40
Loggerhead turtle	9.52	1.00	0.46	0	0	0	0	0	341.01	140.56	62.83	22.12
Green turtle	0.14	0.04	<0.01	0	0	0	0	0	0.74	0.32	0.16	0.08

[a] Listed as Endangered under the ESA

Table I-18. Construction schedule 4 (2 monopiles per day/3 pin piles per day), year 2: The mean number of sea turtles predicted to receive sound levels above exposure criteria (Finneran et al. 2017) with sound attenuation. Construction schedule assumptions are summarized in Section 1.2.2.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	1.65	<0.01	<0.01	0	0	0	0	0	11.91	5.20	2.67	1.29
Leatherback turtle[a]	0.63	0.11	0	0	0	0	0	0	6.15	2.01	0.32	0.16
Loggerhead turtle	1.91	0	0	0	0	0	0	0	202.22	79.25	32.77	11.49
Green turtle	0.08	0.02	0	0	0	0	0	0	0.43	0.18	0.09	0.04

[a] Listed as Endangered under the ESA

I.2.2. Exposure Ranges

I.2.2.1. Marine Mammals

This section contains marine mammal exposure ranges ($ER_{95\%}$) for each of the modeled foundation types and seasons assuming 0, 6, 10, and 15 dB broadband attenuation.

Table I-19. 9.6 m typical monopile foundation (one pile per day, summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

	Species	Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	3.04	1.57	0.86	0.52	0	0	0	0	6.11	4.28	3.18	2.12	6.05	4.27	3.18	2.14
LF	Minke whale (migrating)	1.67	0.70	0.22	<0.01	<0.01	0	0	0	5.96	4.15	3.13	1.98	15.35	12.20	10.22	7.94
LF	Humpback whale (migrating)	1.43	0.45	0.24	0	0	0	0	0	6.21	4.23	3.15	1.88	15.80	12.18	10.33	8.01
LF	North Atlantic right whale[c] (migrating)	2.24	1.15	0.33	0.09	0	0	0	0	5.55	4.08	2.89	1.81	15.28	11.87	9.88	7.53
LF	Sei whale[c] (migrating)	1.87	1.07	0.43	0.09	0.01	0	0	0	6.14	4.19	3.09	1.91	15.80	12.30	10.33	8.04
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	5.88	4.01	2.98	1.85	2.53	1.51	1.02	0.47
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	0	0	0	0	0	0	5.89	4.06	3.07	2.03	2.58	1.55	1.11	0.52
MF	Bottlenose dolphin	0	0	0	0	0	0	0	0	5.11	3.39	2.46	1.58	2.36	1.37	0.99	0.40
MF	Risso's dolphin	0	0	0	0	0	0	0	0	5.95	4.20	3.07	1.97	2.68	1.60	1.14	0.54
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0	0	0	0	0	0	5.97	4.14	3.25	2.12	2.64	1.49	1.13	0.53
HF	Harbor porpoise (sensitive)	0	0	0	0	0.22	0	0	0	5.98	3.89	3.07	2.03	20.86	16.25	13.74	10.70
PW	Gray seal	0.11	<0.01	0	0	<0.01	0	0	0	6.22	4.50	3.33	2.15	4.50	2.85	2.12	1.34
PW	Harbor seal	0.04	0	0	0	<0.01	0	0	0	6.30	4.39	3.02	2.00	4.35	2.64	1.95	1.05

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-20. 9.6 m typical monopile foundation (two piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

	Species	Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.52	1.73	0.94	0.18	0.02	0	0	0	6.19	4.29	3.09	2.11	6.21	4.29	3.09	2.11
	Minke whale (migrating)	1.69	0.68	0.54	0.01	0.01	0	0	0	5.81	3.98	3.02	1.96	15.04	11.88	10.03	7.74
	Humpback whale (migrating)	1.49	0.59	0.33	0	0	0	0	0	6.01	4.16	3.01	1.87	15.62	11.96	10.31	7.86
	North Atlantic right whale[c] (migrating)	1.94	0.84	0.47	0.04	0	0	0	0	5.51	3.86	2.87	1.89	14.98	11.68	9.76	7.55
	Sei whale[c] (migrating)	2.13	0.92	0.54	0.04	<0.01	<0.01	0	0	5.96	4.12	3.07	2.05	15.79	12.20	10.30	7.93
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	5.81	3.97	2.94	1.88	2.49	1.52	1.05	0.51
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	<0.01	0	0	0	5.89	3.97	2.92	1.99	2.53	1.50	1.10	0.55
	Bottlenose dolphin	0	0	0	0	0	0	0	0	4.90	3.34	2.41	1.69	2.34	1.47	0.89	0.50
	Risso's dolphin	0	0	0	0	<0.01	0	0	0	5.92	4.18	2.93	1.93	2.65	1.54	1.12	0.55
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	5.94	4.12	2.96	1.97	2.60	1.52	1.13	0.49
HF	Harbor porpoise (sensitive)	<0.01	<0.01	0	0	0.24	<0.01	<0.01	<0.01	5.88	4.20	3.05	1.88	20.66	16.05	13.21	10.41
PW	Gray seal	0.04	<0.01	<0.01	0	<0.01	0	0	0	6.29	4.39	3.26	2.19	4.45	2.85	2.08	1.28
	Harbor seal	0.13	0	0	0	0.03	0	0	0	5.92	4.05	2.97	1.80	4.10	2.64	1.69	1.18

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-21. 9.6 m typical monopile foundation (one pile per day, winter): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	3.07	1.65	0.88	0.52	0	0	0	0	7.35	4.74	3.40	2.17	7.33	4.74	3.33	2.17
	Minke whale (migrating)	1.82	0.83	0.26	<0.01	<0.01	0	0	0	6.83	4.61	3.31	2.10	22.61	16.28	13.06	9.72
	Humpback whale (migrating)	1.44	0.69	0.24	0	0	0	0	0	7.17	4.55	3.38	2.05	23.69	16.81	13.25	9.76
	North Atlantic right whale[c] (migrating)	2.29	1.21	0.43	0.09	0	0	0	0	6.64	4.41	3.04	2.05	22.64	16.45	12.85	9.60
	Sei whale[c] (migrating)	2.10	1.05	0.43	0.09	0.01	0	0	0	6.98	4.60	3.28	2.18	23.53	16.91	13.33	9.84
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	6.67	4.39	3.30	1.99	2.83	1.54	1.10	0.47
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0	0	0	0	6.89	4.55	3.28	2.10	2.82	1.66	1.12	0.55
	Bottlenose dolphin	0	0	0	0	0	0	0	0	6.12	3.86	2.73	1.66	2.55	1.43	0.98	0.40
	Risso's dolphin	0	0	0	0	0	0	0	0	7.09	4.84	3.39	2.03	2.96	1.61	1.20	0.54
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	6.97	4.64	3.40	2.20	2.98	1.57	1.13	0.53
HF	Harbor porpoise (sensitive)	0	0	0	0	0.22	0	0	0	7.04	4.72	3.15	2.11	57.70	31.52	22.38	15.71
PW	Gray seal	0.11	<0.01	0	0	<0.01	0	0	0	7.37	4.94	3.54	2.32	4.95	3.14	2.14	1.34
	Harbor seal	0.04	0	0	0	<0.01	0	0	0	6.94	4.67	3.28	2.01	4.66	2.80	1.99	1.17

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-22. 9.6 m typical monopile foundation (two piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

	Species	Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	3.14	1.89	1.01	0.18	0.02	0	0	0	7.10	4.69	3.46	2.14	7.10	4.67	3.29	2.14
LF	Minke whale (migrating)	1.82	0.85	0.48	0.01	0.01	0	0	0	6.76	4.45	3.29	2.07	22.28	15.86	12.74	9.55
LF	Humpback whale (migrating)	1.60	0.59	0.36	0	0	0	0	0	7.05	4.76	3.31	2.07	23.27	16.55	13.19	9.67
LF	North Atlantic right whale[c] (migrating)	2.24	1.01	0.47	0.11	0	0	0	0	6.55	4.27	3.11	1.96	22.12	15.82	12.62	9.26
LF	Sei whale[c] (migrating)	2.40	1.12	0.58	0.11	<0.01	<0.01	0	0	6.84	4.57	3.43	2.11	23.29	16.83	13.23	9.66
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	6.69	4.35	3.19	2.03	2.69	1.60	1.05	0.53
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	0	0	<0.01	0	0	0	6.77	4.45	3.08	2.06	2.77	1.62	1.11	0.57
MF	Bottlenose dolphin	0	0	0	0	0	0	0	0	5.62	3.77	2.77	1.84	2.42	1.53	0.94	0.49
MF	Risso's dolphin	0	0	0	0	<0.01	0	0	0	6.86	4.47	3.32	2.10	2.83	1.62	1.13	0.55
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0	0	0	0	0	0	6.82	4.50	3.19	2.14	2.80	1.55	1.07	0.53
HF	Harbor porpoise (sensitive)	<0.01	<0.01	0	0	0.27	<0.01	<0.01	<0.01	6.80	4.56	3.22	1.95	59.50	31.86	22.17	15.52
PW	Gray seal	0.04	<0.01	<0.01	0	<0.01	0	0	0	7.22	4.89	3.50	2.29	4.89	3.08	2.20	1.32
PW	Harbor seal	0.13	0	0	0	0.03	0	0	0	6.74	4.38	3.29	1.96	4.47	2.82	1.91	1.21

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-23. 9.6 m difficult to drive monopile foundation (one pile per day, summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	3.94	2.69	1.35	0.88	0	0	0	0	7.80	5.80	4.74	3.45	7.80	5.81	4.73	3.43
	Minke whale (migrating)	2.75	1.45	0.89	0.26	<0.01	0	0	0	7.51	5.73	4.46	3.28	17.88	14.05	11.97	9.53
	Humpback whale (migrating)	2.51	1.54	0.74	0.23	<0.01	<0.01	<0.01	<0.01	7.67	5.71	4.47	3.32	18.31	14.61	12.18	9.60
	North Atlantic right whale[c] (migrating)	2.87	1.79	1.09	0.51	0	0	0	0	7.15	5.24	4.33	3.13	17.84	13.84	11.56	9.41
	Sei whale[c] (migrating)	3.11	1.77	1.04	0.29	0.05	<0.01	<0.01	0	7.59	5.81	4.47	3.44	18.27	14.47	12.15	9.65
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	7.29	5.51	4.24	3.15	3.65	2.44	1.78	1.10
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0	0	0	0	7.35	5.44	4.48	3.14	3.78	2.52	1.75	1.09
	Bottlenose dolphin	0	0	0	0	0	0	0	0	6.45	4.71	3.77	2.70	3.44	2.28	1.60	1.10
	Risso's dolphin	0	0	0	0	0	0	0	0	7.49	5.65	4.73	3.43	3.90	2.59	1.76	0.97
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	7.31	5.75	4.59	3.31	3.86	2.61	1.79	1.02
HF	Harbor porpoise (sensitive)	0.02	0	0	0	0.57	0.21	0.08	0	7.62	5.56	4.52	3.21	23.52	18.75	15.95	12.59
PW	Gray seal	0.36	0.08	<0.01	<0.01	<0.01	0	0	0	7.99	5.98	4.91	3.43	5.89	4.18	3.21	2.12
	Harbor seal	0.54	0.04	0	0	<0.01	0	0	0	7.37	5.79	4.68	3.20	5.74	3.92	2.88	1.99

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-24. 9.6 m difficult to drive monopile foundation (two piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	4.09	2.22	1.84	1.00	0.04	0	0	0	7.57	5.78	4.51	3.42	7.65	5.82	4.53	3.35
LF	Minke whale (migrating)	2.72	1.54	0.90	0.29	0.02	0	0	0	7.25	5.40	4.45	3.22	17.45	13.81	11.63	9.44
LF	Humpback whale (migrating)	2.39	1.39	0.69	0.41	0	0	0	0	7.51	5.55	4.53	3.28	18.20	14.27	11.96	9.58
LF	North Atlantic right whale[c] (migrating)	3.00	2.07	1.13	0.54	0	0	0	0	6.93	5.42	4.30	3.02	17.57	13.57	11.47	9.16
LF	Sei whale[c] (migrating)	3.13	1.93	1.21	0.51	0.05	<0.01	0	0	7.47	5.45	4.52	3.20	18.25	14.42	12.04	9.57
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	7.24	5.43	4.30	3.16	3.60	2.36	1.72	1.06
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	0	0	<0.01	0	0	0	7.23	5.46	4.42	3.19	3.64	2.54	1.78	1.11
MF	Bottlenose dolphin	0	0	0	0	0	0	0	0	6.37	4.64	3.83	2.52	3.51	2.21	1.61	0.96
MF	Risso's dolphin	0	0	0	0	<0.01	0	0	0	7.45	5.45	4.41	3.37	3.87	2.52	1.73	1.03
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0	0	0	0	0	0	7.41	5.55	4.47	3.30	3.82	2.37	1.66	1.10
HF	Harbor porpoise (sensitive)	0.04	0	0	0	0.55	0.24	0.04	<0.01	7.24	5.48	4.37	3.24	23.30	18.55	15.49	12.24
PW	Gray seal	0.31	0.04	<0.01	<0.01	<0.01	<0.01	0	0	7.72	5.88	4.87	3.44	5.86	4.08	3.19	2.11
PW	Harbor seal	0.38	0.06	0	0	0.07	0	0	0	7.29	5.34	4.38	3.37	5.38	3.85	2.95	1.82

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-25. 9.6 m difficult to drive monopile foundation (one pile per day, winter): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	4.28	2.98	1.80	0.88	<0.01	0	0	0	8.97	6.41	5.24	3.77	8.98	6.41	5.18	3.77
LF	Minke whale (migrating)	3.08	1.65	0.89	0.30	<0.01	0	0	0	8.72	6.34	4.88	3.44	25.92	18.99	15.55	11.83
LF	Humpback whale (migrating)	2.96	1.67	0.74	0.23	<0.01	<0.01	<0.01	<0.01	8.96	6.34	5.10	3.51	27.10	19.76	16.01	12.07
LF	North Atlantic right whale[c] (migrating)	3.23	1.90	1.13	0.51	0	0	0	0	8.72	5.90	4.73	3.37	26.04	18.98	15.56	11.59
LF	Sei whale[c] (migrating)	3.41	1.92	1.24	0.38	0.05	<0.01	<0.01	0	8.95	6.19	4.95	3.65	26.76	19.65	15.90	12.11
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	8.24	6.13	4.73	3.43	4.02	2.57	1.85	1.14
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	0	0	0	0	0	0	8.65	6.20	4.89	3.45	4.12	2.62	1.81	1.18
MF	Bottlenose dolphin	0	0	0	0	0	0	0	0	7.50	5.47	4.23	2.93	3.72	2.39	1.62	1.13
MF	Risso's dolphin	0	0	0	0	0	0	0	0	8.82	6.29	5.14	3.67	4.24	2.69	1.77	0.99
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0	0	0	0	0	0	8.79	6.23	4.96	3.72	4.22	2.71	1.91	1.02
HF	Harbor porpoise (sensitive)	0.02	0	0	0	0.57	0.21	0.08	0	8.71	6.25	5.04	3.57	66.92	37.79	26.72	19.20
PW	Gray seal	0.36	0.08	<0.01	<0.01	<0.01	0	0	0	9.09	6.54	5.35	3.71	6.61	4.48	3.35	2.27
PW	Harbor seal	0.54	0.04	0	0	<0.01	0	0	0	8.72	6.38	4.93	3.38	6.31	4.33	3.06	2.00

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-26. 9.6 m difficult to drive monopile foundation (two piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	4.46	2.70	1.95	0.99	0.04	0	0	0	8.79	6.21	4.87	3.54	8.84	6.23	4.87	3.51
	Minke whale (migrating)	3.05	1.73	1.05	0.38	0.02	0	0	0	8.52	6.06	4.66	3.42	25.47	18.70	15.32	11.60
	Humpback whale (migrating)	2.75	1.50	0.83	0.41	0	0	0	0	8.72	6.18	5.07	3.57	26.86	19.95	15.93	11.88
	North Atlantic right whale[c] (migrating)	3.30	2.08	1.19	0.65	0	0	0	0	8.39	5.89	4.62	3.25	25.90	19.10	15.26	11.56
	Sei whale[c] (migrating)	3.70	2.14	1.29	0.50	0.05	<0.01	0	0	8.70	6.22	4.85	3.45	26.78	19.85	15.96	12.03
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	8.42	5.94	4.72	3.33	4.05	2.47	1.82	1.11
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	<0.01	0	0	0	8.38	5.97	4.73	3.36	4.08	2.67	1.90	1.16
	Bottlenose dolphin	0	0	0	0	0	0	0	0	7.31	5.21	4.12	2.67	3.82	2.32	1.64	0.99
	Risso's dolphin	0	0	0	0	<0.01	0	0	0	8.49	6.24	4.92	3.52	4.27	2.53	1.84	1.04
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	8.56	6.04	4.92	3.54	4.14	2.48	1.94	1.11
HF	Harbor porpoise (sensitive)	0.04	0	0	0	0.55	0.23	0.04	<0.01	8.56	6.18	4.75	3.35	67.35	37.39	26.41	19.05
PW	Gray seal	0.44	0.04	<0.01	<0.01	<0.01	<0.01	0	0	8.96	6.47	5.19	3.63	6.52	4.41	3.32	2.32
	Harbor seal	0.52	0.06	0	0	0.07	0	0	0	8.64	5.99	4.71	3.50	6.12	4.24	3.17	2.04

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-27. 11 m U3 monopile foundation (one pile per day, summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.62	1.19	0.90	0.28	0	0	0	0	5.02	3.49	2.65	1.60	5.01	3.49	2.60	1.60
	Minke whale (migrating)	1.09	0.38	0.02	0	<0.01	<0.01	0	0	4.76	3.18	2.32	1.39	13.19	10.22	8.19	6.37
	Humpback whale (migrating)	1.00	0.27	<0.01	<0.01	<0.01	<0.01	<0.01	0	4.81	3.26	2.26	1.45	13.27	10.18	8.34	6.37
	North Atlantic right whale[c] (migrating)	1.43	0.55	0.37	0.05	0	0	0	0	4.54	3.10	2.21	1.33	12.79	9.88	8.15	6.05
	Sei whale[c] (migrating)	1.71	0.76	0.13	0.05	<0.01	0	0	0	4.91	3.37	2.33	1.50	13.24	10.27	8.38	6.41
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	4.61	3.12	2.24	1.48	1.92	1.02	0.61	0.27
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0	0	0	0	4.79	3.18	2.38	1.42	2.01	1.14	0.72	0.38
	Bottlenose dolphin	0	0	0	0	0	0	0	0	4.13	2.76	1.92	1.19	1.83	1.10	0.60	0.27
	Risso's dolphin	0	0	0	0	0	0	0	0	5.01	3.41	2.41	1.30	2.06	0.96	0.65	0.24
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	4.94	3.30	2.36	1.44	2.11	1.16	0.74	0.19
HF	Harbor porpoise (sensitive)	0	0	0	0	0.20	0.08	0	0	4.86	3.19	2.19	1.35	16.65	13.25	10.84	8.31
PW	Gray seal	0.08	<0.01	0	0	0	0	0	0	5.20	3.49	2.60	1.59	3.55	2.28	1.49	0.80
	Harbor seal	0	0	0	0	0	0	0	0	4.79	3.20	2.50	1.67	3.19	2.01	1.44	0.80

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-28. 11 m U3 monopile foundation (two piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.10	1.11	0.58	0.11	0	0	0	0	4.78	3.31	2.48	1.62	4.79	3.32	2.37	1.62
	Minke whale (migrating)	1.18	0.36	0.16	0	0.01	0	0	0	4.64	3.16	2.27	1.41	12.92	10.00	8.18	6.27
	Humpback whale (migrating)	0.99	0.45	0.11	0	0	0	0	0	4.90	3.28	2.31	1.41	13.04	10.13	8.28	6.36
	North Atlantic right whale[c] (migrating)	1.41	0.59	0.28	0	0	0	0	0	4.48	3.08	2.20	1.30	12.74	9.80	7.90	6.09
	Sei whale[c] (migrating)	1.64	0.66	0.23	0.10	<0.01	<0.01	0	0	4.80	3.29	2.47	1.57	13.19	10.27	8.32	6.52
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	4.63	3.14	2.23	1.41	1.98	1.09	0.67	0.26
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0	0	0	0	4.68	3.19	2.41	1.44	2.06	1.12	0.72	0.32
	Bottlenose dolphin	0	0	0	0	0	0	0	0	4.02	2.57	1.95	1.27	1.87	0.98	0.63	0.26
	Risso's dolphin	0	0	0	0	0	0	0	0	4.78	3.35	2.40	1.48	1.98	1.05	0.68	0.26
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	4.78	3.25	2.26	1.46	2.15	1.13	0.63	0.32
HF	Harbor porpoise (sensitive)	0	0	0	0	0.24	<0.01	<0.01	<0.01	4.73	3.11	2.28	1.44	16.67	12.93	10.67	8.14
PW	Gray seal	0.04	<0.01	<0.01	0	<0.01	<0.01	<0.01	0	5.07	3.44	2.58	1.56	3.49	2.29	1.54	0.72
	Harbor seal	0	0	0	0	0	0	0	0	4.61	3.24	2.36	1.39	3.24	2.02	1.40	0.86

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-29. 11 m U3 monopile foundation (one pile per day, winter): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.70	1.17	0.89	0.28	0	0	0	0	5.61	3.78	2.71	1.61	5.60	3.73	2.69	1.64
	Minke whale (migrating)	1.23	0.49	0.20	0	<0.01	<0.01	0	0	5.52	3.41	2.50	1.48	17.77	13.11	10.31	7.61
	Humpback whale (migrating)	1.12	0.29	<0.01	<0.01	<0.01	<0.01	<0.01	0	5.53	3.54	2.46	1.53	18.15	13.13	10.50	7.66
	North Atlantic right whale[c] (migrating)	1.70	0.75	0.49	0.05	0	0	0	0	5.18	3.37	2.37	1.36	17.81	12.69	10.23	7.36
	Sei whale[c] (migrating)	1.78	0.90	0.13	0.09	<0.01	0	0	0	5.64	3.60	2.60	1.60	18.18	13.19	10.51	7.71
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	5.33	3.46	2.43	1.53	2.09	1.03	0.67	0.27
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0	0	0	0	5.33	3.54	2.50	1.49	2.09	1.21	0.74	0.38
	Bottlenose dolphin	0	0	0	0	0	0	0	0	4.72	3.10	2.07	1.21	1.95	1.14	0.60	0.27
	Risso’s dolphin	0	0	0	0	0	0	0	0	5.45	3.67	2.63	1.46	2.25	1.12	0.67	0.24
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	5.55	3.69	2.60	1.62	2.20	1.28	0.74	0.19
HF	Harbor porpoise (sensitive)	0	0	0	0	0.20	0.08	0	0	5.39	3.54	2.53	1.48	29.88	20.24	15.61	11.21
PW	Gray seal	0.08	<0.01	0	0	0	0	0	0	5.79	3.76	2.70	1.64	3.76	2.43	1.61	0.80
	Harbor seal	0	0	0	0	0	0	0	0	5.59	3.43	2.58	1.70	3.45	2.05	1.65	0.97

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-30. 11 m U3 monopile foundation (two piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.30	1.23	0.82	0.11	0.02	0	0	0	5.55	3.63	2.54	1.65	5.55	3.57	2.54	1.66
	Minke whale (migrating)	1.35	0.39	0.23	0	0.01	0	0	0	5.25	3.49	2.59	1.51	17.51	12.85	10.17	7.42
	Humpback whale (migrating)	1.18	0.43	0.11	0	0	0	0	0	5.47	3.63	2.54	1.48	17.89	12.97	10.50	7.60
	North Atlantic right whale[c] (migrating)	1.68	0.68	0.32	0	0	0	0	0	5.23	3.30	2.38	1.37	17.75	12.69	10.19	7.23
	Sei whale[c] (migrating)	1.97	0.75	0.28	0.10	<0.01	<0.01	0	0	5.34	3.50	2.56	1.60	18.03	13.15	10.40	7.55
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	5.22	3.40	2.40	1.48	2.05	1.19	0.71	0.29
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0	0	0	0	5.31	3.43	2.53	1.48	2.19	1.13	0.72	0.35
	Bottlenose dolphin	0	0	0	0	0	0	0	0	4.54	2.87	2.11	1.30	1.96	1.03	0.66	0.29
	Risso's dolphin	0	0	0	0	0	0	0	0	5.39	3.67	2.53	1.51	2.13	1.08	0.71	0.26
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	5.40	3.51	2.38	1.51	2.18	1.13	0.65	0.32
HF	Harbor porpoise (sensitive)	0	0	0	0	0.23	<0.01	<0.01	<0.01	5.32	3.46	2.51	1.49	29.39	20.02	15.22	11.08
PW	Gray seal	0.04	<0.01	<0.01	0	<0.01	<0.01	<0.01	0	5.71	3.73	2.67	1.57	3.73	2.34	1.56	0.88
	Harbor seal	0	0	0	0	0	0	0	0	5.25	3.56	2.54	1.43	3.57	2.11	1.41	0.86

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-31. 11 m T1 monopile foundation (one pile per day, summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

	Species	Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.75	1.21	0.87	0.09	0	0	0	0	5.96	4.27	3.32	2.20	5.98	4.29	3.31	2.20
LF	Minke whale (migrating)	1.47	0.59	0.17	0	<0.01	0	0	0	5.86	4.13	3.10	1.88	14.80	11.69	9.95	7.69
LF	Humpback whale (migrating)	1.34	0.49	0.25	0	0	0	0	0	6.05	4.16	3.01	2.06	15.50	12.01	10.17	7.91
LF	North Atlantic right whale[c] (migrating)	2.05	1.08	0.20	0.16	0	0	0	0	5.52	4.06	3.09	1.88	14.62	11.41	9.73	7.33
LF	Sei whale[c] (migrating)	1.86	0.99	0.44	0.06	0	0	0	0	6.07	4.27	3.19	1.90	15.24	12.03	10.04	7.87
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	5.78	4.07	2.97	1.94	2.57	1.38	0.99	0.50
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	0	0	0	0	0	0	5.82	3.93	3.08	2.07	2.64	1.65	1.08	0.45
MF	Bottlenose dolphin	0	0	0	0	0	0	0	0	5.14	3.48	2.60	1.59	2.45	1.38	1.00	0.43
MF	Risso's dolphin	0	0	0	0	0	0	0	0	5.85	4.35	3.21	1.94	2.59	1.59	1.06	0.55
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0	0	0	0	0	0	5.91	4.20	3.40	2.19	2.79	1.56	1.03	0.57
HF	Harbor porpoise (sensitive)	0	0	0	0	0.22	0	0	0	5.86	4.07	3.06	1.98	19.82	15.41	12.97	9.93
PW	Gray seal	0.12	<0.01	0	0	<0.01	0	0	0	6.17	4.68	3.39	2.26	4.67	2.89	2.16	1.39
PW	Harbor seal	0	0	0	0	<0.01	0	0	0	6.20	4.46	3.25	2.06	4.33	2.79	2.01	1.30

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-32. 11 m T1 monopile foundation (two piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.32	1.21	0.83	0.17	0	0	0	0	6.08	4.40	3.16	2.13	6.11	4.41	3.18	2.14
	Minke whale (migrating)	1.56	0.76	0.35	0	0	0	0	0	5.77	4.06	2.98	2.00	14.65	11.54	9.75	7.55
	Humpback whale (migrating)	1.38	0.52	0.16	0	0	0	0	0	5.99	4.12	3.10	1.99	15.45	11.80	10.09	7.92
	North Atlantic right whale[c] (migrating)	1.76	0.65	0.44	0.04	0	0	0	0	5.52	3.87	2.93	1.89	14.54	11.43	9.48	7.22
	Sei whale[c] (migrating)	1.85	0.90	0.27	0.04	0.01	<0.01	0	0	6.00	4.12	3.26	2.15	15.23	11.89	9.90	7.65
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	5.66	3.99	2.98	2.02	2.58	1.50	0.96	0.55
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	<0.01	0	0	0	5.66	4.04	2.94	2.01	2.55	1.53	1.05	0.55
	Bottlenose dolphin	0	0	0	0	0	0	0	0	4.98	3.48	2.62	1.68	2.28	1.58	0.89	0.51
	Risso's dolphin	0	0	0	0	<0.01	0	0	0	5.84	4.09	3.11	1.92	2.57	1.63	1.08	0.55
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	5.82	4.16	3.19	1.99	2.64	1.67	1.10	0.46
HF	Harbor porpoise (sensitive)	0	0	0	0	0.24	0.08	<0.01	<0.01	5.70	4.08	3.04	2.02	19.42	15.26	12.72	9.89
PW	Gray seal	0.04	<0.01	0	0	<0.01	0	0	0	6.33	4.54	3.40	2.31	4.54	2.94	2.24	1.35
	Harbor seal	0.14	0	0	0	0	0	0	0	5.71	4.03	3.09	2.00	4.05	2.77	1.91	1.30

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-33. 11 m T1 monopile foundation (one pile per day, winter): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.87	1.39	0.87	0.09	0	0	0	0	7.20	4.73	3.56	2.23	7.22	4.73	3.58	2.22
	Minke whale (migrating)	1.62	0.64	0.27	0	<0.01	0	0	0	6.74	4.51	3.29	2.11	21.40	15.60	12.60	9.41
	Humpback whale (migrating)	1.41	0.48	0.25	0	0	0	0	0	7.03	4.77	3.24	2.27	22.56	16.30	12.83	9.41
	North Atlantic right whale[c] (migrating)	2.14	1.12	0.20	0.09	0	0	0	0	6.48	4.44	3.17	2.04	21.43	15.72	12.36	9.24
	Sei whale[c] (migrating)	1.85	0.98	0.44	0.06	0	0	0	0	6.95	4.56	3.33	2.23	22.13	15.99	12.78	9.37
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	6.65	4.30	3.28	2.09	2.81	1.63	0.99	0.49
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0	0	0	0	6.65	4.54	3.26	2.19	2.90	1.73	1.09	0.43
	Bottlenose dolphin	0	0	0	0	0	0	0	0	6.06	4.02	2.73	1.79	2.56	1.40	1.00	0.54
	Risso's dolphin	0	0	0	0	0	0	0	0	6.72	4.78	3.48	2.24	2.66	1.79	1.12	0.55
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	6.87	4.64	3.48	2.19	3.14	1.86	1.03	0.57
HF	Harbor porpoise (sensitive)	0	0	0	0	0.22	0	0	0	6.87	4.63	3.41	2.05	37.58	24.51	19.57	14.22
PW	Gray seal	0.12	<0.01	0	0	<0.01	0	0	0	7.30	4.98	3.66	2.46	5.00	3.14	2.28	1.44
	Harbor seal	0	0	0	0	<0.01	0	0	0	6.93	4.72	3.36	2.28	4.80	2.91	2.04	1.48

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-34. 11 m T1 monopile foundation (two piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.66	1.27	0.82	0.16	0	0	0	0	6.99	4.71	3.53	2.28	7.00	4.71	3.52	2.24
LF	Minke whale (migrating)	1.70	0.76	0.35	0	0	0	0	0	6.49	4.48	3.31	2.13	21.01	15.24	12.30	9.26
LF	Humpback whale (migrating)	1.49	0.55	0.16	0	0	0	0	0	6.88	4.70	3.40	2.13	21.76	16.00	12.63	9.43
LF	North Atlantic right whale[c] (migrating)	2.08	0.69	0.44	0.11	0	0	0	0	6.42	4.32	3.28	2.03	21.18	15.34	12.14	9.09
LF	Sei whale[c] (migrating)	2.11	0.90	0.41	0.04	0.01	<0.01	0	0	6.73	4.51	3.53	2.29	21.81	16.01	12.72	9.37
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	6.47	4.41	3.31	2.08	2.73	1.68	1.06	0.50
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	0	0	<0.01	0	0	0	6.57	4.41	3.16	2.16	2.70	1.63	1.12	0.57
MF	Bottlenose dolphin	0	0	0	0	0	0	0	0	5.76	3.84	2.93	1.75	2.41	1.63	0.88	0.50
MF	Risso's dolphin	0	0	0	0	<0.01	0	0	0	6.76	4.52	3.44	2.11	2.91	1.69	1.15	0.61
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0	0	0	0	0	0	6.74	4.65	3.35	2.17	2.88	1.72	1.15	0.46
HF	Harbor porpoise (sensitive)	0	0	0	0	0.24	0.08	<0.01	<0.01	6.64	4.73	3.35	2.20	37.23	24.51	19.19	13.90
PW	Gray seal	0.04	<0.01	0	0	<0.01	0	0	0	7.20	4.96	3.66	2.49	4.96	3.15	2.26	1.47
PW	Harbor seal	0.14	0	0	0	0	0	0	0	6.64	4.50	3.36	2.20	4.58	2.93	1.99	1.34

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-35. 11 m R3 monopile foundation (one pile per day, summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

	Species	Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.23	1.23	0.87	0.08	0	0	0	0	5.73	3.96	3.02	1.91	5.75	3.95	3.02	1.88
LF	Minke whale (migrating)	1.24	0.56	0.16	<0.01	<0.01	0	0	0	5.47	3.84	2.78	1.80	13.81	10.85	9.20	7.09
LF	Humpback whale (migrating)	1.20	0.49	0.14	0	0	0	0	0	5.54	3.72	2.68	1.78	14.03	10.82	9.11	7.15
LF	North Atlantic right whale[c] (migrating)	1.86	1.10	0.20	0.07	0	0	0	0	5.42	3.58	2.72	1.68	13.40	10.68	8.69	7.00
LF	Sei whale[c] (migrating)	1.62	0.70	0.31	0.09	0	0	0	0	5.45	3.72	2.96	1.91	13.94	10.96	9.01	7.21
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	5.35	3.64	2.75	1.80	2.50	1.43	0.80	0.40
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	0	0	0	0	0	0	5.50	3.72	2.86	1.88	2.42	1.44	0.92	0.51
MF	Bottlenose dolphin	0	0	0	0	0	0	0	0	4.98	3.36	2.29	1.56	2.20	1.34	0.91	0.39
MF	Risso's dolphin	0	0	0	0	<0.01	0	0	0	5.60	3.81	2.86	1.66	2.40	1.46	0.79	0.42
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0	0	0	0	0	0	5.47	3.86	2.77	1.90	2.43	1.41	0.74	0.23
HF	Harbor porpoise (sensitive)	0	0	0	0	0.20	0.08	0	0	5.53	3.69	2.76	1.82	18.47	14.23	11.74	9.30
PW	Gray seal	0.12	<0.01	0	0	<0.01	0	0	0	5.73	3.92	2.87	1.92	3.87	2.54	1.88	1.08
PW	Harbor seal	0	0	0	0	<0.01	0	0	0	5.51	3.58	2.91	1.91	3.66	2.34	1.73	1.06

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-36. 11 m R3 monopile foundation (two piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.15	1.28	0.43	0.17	0	0	0	0	5.45	3.94	2.89	1.92	5.39	3.90	2.89	1.91
	Minke whale (migrating)	1.43	0.62	0.26	0	0	0	0	0	5.28	3.71	2.82	1.81	13.54	10.67	8.93	7.04
	Humpback whale (migrating)	1.34	0.52	0.15	0	0	0	0	0	5.56	3.77	2.79	1.72	13.75	10.82	9.11	7.13
	North Atlantic right whale[c] (migrating)	1.84	0.76	0.37	0.12	0	0	0	0	5.18	3.62	2.67	1.73	13.29	10.53	8.63	6.83
	Sei whale[c] (migrating)	1.70	0.80	0.27	0.04	0.01	<0.01	<0.01	0	5.44	3.86	2.91	1.82	13.92	10.76	8.86	7.10
MF	Atlantic white-sided dolphin	0	0	0	0	<0.01	0	0	0	5.27	3.66	2.73	1.78	2.35	1.46	0.88	0.47
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	<0.01	0	0	0	5.36	3.67	2.76	1.82	2.45	1.44	0.93	0.52
	Bottlenose dolphin	0	0	0	0	0	0	0	0	4.67	3.12	2.32	1.61	2.19	1.28	0.79	0.35
	Risso's dolphin	0	0	0	0	0	0	0	0	5.53	3.87	2.79	1.84	2.44	1.43	0.92	0.51
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	5.46	3.74	2.86	1.79	2.35	1.46	0.94	0.41
HF	Harbor porpoise (sensitive)	0	0	0	0	0.26	0.10	<0.01	<0.01	5.31	3.60	2.73	1.77	18.07	13.97	11.71	9.09
PW	Gray seal	0.04	0.01	0	0	0.01	0	0	0	5.66	3.79	3.01	1.92	3.77	2.51	1.91	1.11
	Harbor seal	0.03	0	0	0	0.01	0	0	0	5.29	3.76	2.75	1.82	3.72	2.34	1.74	1.08

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-37. 11 m R3 monopile foundation (one pile per day, winter): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

	Species	Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.73	1.23	0.87	0.08	0	0	0	0	6.35	4.31	3.17	2.14	6.32	4.23	3.18	2.12
LF	Minke whale (migrating)	1.72	0.63	0.19	<0.01	<0.01	0	0	0	6.23	4.20	3.12	1.93	19.73	14.33	11.40	8.48
LF	Humpback whale (migrating)	1.38	0.49	0.14	0	0	0	0	0	6.41	4.24	3.04	1.90	19.93	14.52	11.57	8.52
LF	North Atlantic right whale[c] (migrating)	2.06	1.10	0.20	0.07	0	0	0	0	6.14	4.06	2.93	1.85	19.79	14.11	11.16	8.24
LF	Sei whale[c] (migrating)	1.89	0.73	0.46	0.09	0	0	0	0	6.40	4.33	3.09	1.93	20.07	14.70	11.70	8.48
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	6.18	4.14	2.90	1.93	2.54	1.44	0.82	0.40
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	0	0	0	0	0	0	6.22	4.23	3.08	1.94	2.52	1.49	0.97	0.51
MF	Bottlenose dolphin	0	0	0	0	0	0	0	0	5.67	3.60	2.63	1.58	2.26	1.38	0.98	0.38
MF	Risso's dolphin	0	0	0	0	<0.01	0	0	0	6.35	4.25	3.04	1.97	2.53	1.56	0.82	0.42
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0	0	0	0	0	0	6.42	4.18	3.10	2.05	2.48	1.63	0.73	0.23
HF	Harbor porpoise (sensitive)	0	0	0	0	0.23	0.08	0	0	6.27	4.10	3.07	1.93	36.61	23.33	18.62	12.90
PW	Gray seal	0.12	<0.01	0	0	<0.01	0	0	0	6.46	4.49	3.25	2.13	4.45	2.68	1.90	1.16
PW	Harbor seal	0	0	0	0	<0.01	0	0	0	6.44	4.15	3.09	1.99	4.17	2.39	1.93	1.06

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-38. 11 m R3 monopile foundation (two piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	2.50	1.42	0.48	0.17	0	0	0	0	6.42	4.28	3.14	2.09	6.37	4.25	3.09	2.02
	Minke whale (migrating)	1.64	0.68	0.28	0.13	0	0	0	0	6.17	4.13	3.02	1.95	19.30	14.01	11.18	8.40
	Humpback whale (migrating)	1.38	0.56	0.19	0	0	0	0	0	6.29	4.23	2.96	1.90	19.86	14.46	11.41	8.57
	North Atlantic right whale[c] (migrating)	1.90	0.85	0.37	0.12	0	0	0	0	6.11	4.11	2.89	1.80	19.59	14.10	11.07	8.21
	Sei whale[c] (migrating)	1.81	0.78	0.27	0.04	0.01	<0.01	<0.01	0	6.29	4.16	3.11	1.89	19.93	14.62	11.34	8.34
MF	Atlantic white-sided dolphin	0	0	0	0	<0.01	0	0	0	6.05	4.00	2.98	1.89	2.51	1.54	0.99	0.50
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	<0.01	0	0	0	6.13	4.09	3.08	1.93	2.55	1.56	0.98	0.53
	Bottlenose dolphin	0	0	0	0	0	0	0	0	5.45	3.64	2.41	1.63	2.32	1.49	0.87	0.35
	Risso's dolphin	0	0	0	0	0	0	0	0	6.25	4.21	3.08	1.91	2.52	1.57	0.93	0.51
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	6.15	4.16	3.04	1.98	2.55	1.52	0.98	0.40
HF	Harbor porpoise (sensitive)	0	0	0	0	0.26	0.10	<0.01	<0.01	6.23	4.19	3.09	1.89	36.37	23.24	18.16	12.83
PW	Gray seal	0.04	0.01	0	0	0.01	0	0	0	6.42	4.35	3.25	2.11	4.35	2.63	1.92	1.17
	Harbor seal	0.03	0	0	0	0.01	0	0	0	6.03	4.11	3.03	1.83	4.15	2.50	1.84	1.10

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-39. OSS1 Jacket foundation (2.5 m diameter, two pin piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	0.84	0.37	0	0	0	0	0	0	3.08	1.59	1.04	0.45	3.09	1.59	1.05	0.45
	Minke whale (migrating)	0.28	0.05	0	0	0	0	0	0	2.88	1.59	1.00	0.48	9.95	7.24	5.68	4.28
	Humpback whale (migrating)	0.18	0.07	0	0	0	0	0	0	2.97	1.65	1.02	0.52	10.01	7.37	5.91	4.26
	North Atlantic right whale[c] (migrating)	0.35	<0.01	0	0	0	0	0	0	2.74	1.54	0.85	0.42	9.71	7.17	5.69	4.14
	Sei whale[c] (migrating)	0.43	<0.01	<0.01	0	0	0	0	0	2.98	1.67	1.08	0.53	9.98	7.42	5.87	4.28
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	2.79	1.52	0.98	0.44	1.14	0.49	0.17	0.14
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0	0	0	0	2.92	1.54	1.03	0.54	1.39	0.54	0.18	0.10
	Bottlenose dolphin	0	0	0	0	0	0	0	0	2.25	1.41	0.82	0.46	1.07	0.47	0.13	0.10
	Risso's dolphin	0	0	0	0	0	0	0	0	2.90	1.47	1.08	0.53	1.27	0.53	0.36	0.11
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	2.94	1.54	0.88	0.45	1.03	0.46	0.32	0.09
HF	Harbor porpoise (sensitive)	0	0	0	0	0	0	0	0	2.97	1.63	0.95	0.54	16.74	12.91	10.90	8.43
PW	Gray seal	0	0	0	0	0	0	0	0	3.09	1.87	1.15	0.56	2.24	1.13	0.71	0.23
	Harbor seal	0	0	0	0	0	0	0	0	2.91	1.70	1.12	0.53	2.15	1.17	0.73	0.34

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-40. OSS1 Jacket foundation (2.5 m diameter, three pin piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	0.81	0.29	0	0	0	0	0	0	3.05	1.60	1.10	0.51	3.06	1.60	1.04	0.51
	Minke whale (migrating)	0.29	0.06	0	0	0	0	0	0	2.89	1.54	0.99	0.48	9.84	7.21	5.68	4.21
	Humpback whale (migrating)	0.18	0.07	0	0	0	0	0	0	2.93	1.66	1.02	0.52	10.02	7.35	5.85	4.27
	North Atlantic right whale[c] (migrating)	0.33	0.07	0	0	0	0	0	0	2.81	1.58	0.89	0.42	9.66	7.04	5.58	4.07
	Sei whale[c] (migrating)	0.59	0.02	<0.01	0	0	0	0	0	2.91	1.51	1.04	0.49	9.85	7.38	5.89	4.27
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	2.79	1.48	0.98	0.44	1.28	0.49	0.17	0.14
	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Common dolphin	0	0	0	0	0	0	0	0	2.87	1.55	1.03	0.56	1.38	0.57	0.20	0.13
	Bottlenose dolphin	0	0	0	0	0	0	0	0	2.24	1.37	0.81	0.48	1.03	0.51	0.15	0.09
	Risso's dolphin	0	0	0	0	0	0	0	0	2.87	1.50	1.05	0.53	1.27	0.50	0.27	0.10
	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperm whale[c]	0	0	0	0	0	0	0	0	2.79	1.40	0.95	0.50	1.02	0.51	0.31	0.09
HF	Harbor porpoise (sensitive)	0	0	0	0	0	0	0	0	2.96	1.64	1.02	0.48	16.77	12.86	10.86	8.40
PW	Gray seal	0	0	0	0	0	0	0	0	3.12	1.85	1.14	0.56	2.26	1.21	0.70	0.31
	Harbor seal	0	0	0	0	0	0	0	0	2.90	1.70	0.99	0.51	2.07	1.12	0.75	0.32

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-41. OSS1 Jacket foundation (2.5 m diameter, two pin piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	0.84	0.36	0	0	0	0	0	0	3.13	1.59	1.08	0.43	3.13	1.59	1.08	0.43
LF	Minke whale (migrating)	0.33	0.05	0	0	0	0	0	0	3.01	1.56	1.01	0.51	14.44	9.27	6.97	4.58
LF	Humpback whale (migrating)	0.18	0.07	0	0	0	0	0	0	3.11	1.64	1.02	0.52	15.57	9.53	7.09	4.75
LF	North Atlantic right whale[c] (migrating)	0.34	<0.01	0	0	0	0	0	0	2.81	1.58	0.79	0.42	14.86	9.39	6.98	4.56
LF	Sei whale[c] (migrating)	0.58	0.02	<0.01	0	0	0	0	0	3.01	1.67	1.08	0.57	14.85	9.46	7.11	4.79
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	2.88	1.46	0.93	0.49	1.24	0.50	0.19	0.14
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	0	0	0	0	0	0	3.04	1.53	0.96	0.54	1.37	0.55	0.30	0.11
MF	Bottlenose dolphin	0	0	0	0	0	0	0	0	2.53	1.37	0.85	0.47	1.17	0.49	0.18	0.09
MF	Risso's dolphin	0	0	0	0	0	0	0	0	3.03	1.47	0.92	0.53	1.27	0.56	0.36	0.11
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0	0	0	0	0	0	2.99	1.51	0.91	0.45	1.13	0.46	0.32	0.10
HF	Harbor porpoise (sensitive)	0	0	0	0	0	0	0	0	3.02	1.62	0.95	0.55	52.96	28.43	19.89	12.40
PW	Gray seal	0	0	0	0	0	0	0	0	3.15	1.82	1.08	0.56	2.39	1.20	0.71	0.23
PW	Harbor seal	0	0	0	0	0	0	0	0	2.91	1.66	1.06	0.53	2.23	1.12	0.73	0.33

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-42. OSS1 Jacket foundation (2.5 m diameter, three pin piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	0.90	0.34	0.18	0	0	0	0	0	3.07	1.53	1.04	0.42	3.07	1.54	1.04	0.42
LF	Minke whale (migrating)	0.35	0.06	0	0	0	0	0	0	3.00	1.53	1.01	0.50	14.22	9.22	6.92	4.58
LF	Humpback whale (migrating)	0.23	0.07	0	0	0	0	0	0	3.07	1.60	1.02	0.52	15.59	9.55	7.06	4.69
LF	North Atlantic right whale[c] (migrating)	0.40	0.07	0	0	0	0	0	0	2.89	1.61	0.88	0.42	14.79	9.25	6.89	4.46
LF	Sei whale[c] (migrating)	0.59	0.02	<0.01	0	0	0	0	0	2.96	1.57	1.05	0.54	14.88	9.36	7.04	4.67
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	2.84	1.43	0.96	0.49	1.28	0.50	0.18	0.14
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	0	0	0	0	0	0	3.03	1.54	0.86	0.56	1.29	0.57	0.25	0.13
MF	Bottlenose dolphin	0	0	0	0	0	0	0	0	2.53	1.44	0.84	0.47	1.17	0.54	0.17	0.09
MF	Risso's dolphin	0	0	0	0	0	0	0	0	2.90	1.54	0.89	0.53	1.27	0.53	0.27	0.10
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0	0	0	0	0	0	2.89	1.40	0.89	0.50	1.09	0.57	0.31	0.10
HF	Harbor porpoise (sensitive)	0	0	0	0	0	0	0	0	3.04	1.62	0.95	0.54	53.09	28.32	19.65	12.36
PW	Gray seal	0	0	0	0	0	0	0	0	3.18	1.80	1.10	0.56	2.38	1.14	0.70	0.31
PW	Harbor seal	0	0	0	0	0	0	0	0	2.92	1.68	0.95	0.51	2.13	0.99	0.75	0.31

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-43. OSS2 Jacket foundation (2.5 m diameter, two pin piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	0.84	0.01	0	0	0	0	0	0	3.19	1.55	1.10	0.39	3.02	1.56	1.10	0.39
LF	Minke whale (migrating)	0.29	0.03	0	0	0	0	0	0	2.97	1.56	1.01	0.38	11.92	8.60	6.54	4.68
LF	Humpback whale (migrating)	0.20	0	0	0	0	0	0	0	3.08	1.57	0.94	0.48	12.37	8.63	6.66	4.62
LF	North Atlantic right whale[c] (migrating)	0.23	0.09	0	0	0	0	0	0	2.79	1.56	1.06	0.41	11.76	8.26	6.29	4.37
LF	Sei whale[c] (migrating)	0.39	0.03	0	0	0	0	0	0	2.97	1.49	0.94	0.42	12.25	8.67	6.58	4.62
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	2.83	1.42	0.82	0.46	1.25	0.43	0.22	0
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	0	0	0	0	0	0	3.02	1.52	0.96	0.45	1.27	0.48	0.23	0.12
MF	Bottlenose dolphin	0	0	0	0	0	0	0	0	2.44	1.18	0.72	0.38	1.07	0.32	0.15	0.12
MF	Risso's dolphin	0	0	0	0	0	0	0	0	3.00	1.55	0.87	0.43	1.23	0.43	0.19	0.07
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0	0	0	0	0	0	2.99	1.46	1.03	0.43	1.25	0.44	0.13	0.11
HF	Harbor porpoise (sensitive)	0	0	0	0	0	0	0	0	2.94	1.57	0.94	0.47	21.35	16.00	13.18	9.88
PW	Gray seal	0	0	0	0	0	0	0	0	3.23	1.69	0.78	0.51	2.34	0.78	0.63	0
PW	Harbor seal	0	0	0	0	0	0	0	0	3.15	1.57	1.05	0.43	2.11	1.05	0.53	0.22

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-44. OSS2 Jacket foundation (2.5 m diameter, three pin piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	0.89	0.01	0	0	0	0	0	0	3.13	1.57	0.99	0.50	3.11	1.57	0.99	0.50
LF	Minke whale (migrating)	0.24	0.03	0	0	0	0	0	0	2.87	1.58	1.01	0.39	11.83	8.52	6.47	4.60
LF	Humpback whale (migrating)	0.20	0	0	0	0	0	0	0	3.10	1.54	0.93	0.50	12.15	8.69	6.57	4.69
LF	North Atlantic right whale[c] (migrating)	0.43	0.09	0	0	0	0	0	0	2.80	1.53	1.01	0.49	11.57	8.15	6.17	4.29
LF	Sei whale[c] (migrating)	0.54	0.03	0	0	0	0	0	0	2.94	1.50	0.91	0.45	12.20	8.66	6.67	4.54
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	2.67	1.43	0.84	0.46	1.19	0.43	0.23	0.04
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	0	0	0	0	0	0	2.92	1.53	0.96	0.49	1.27	0.50	0.22	0.12
MF	Bottlenose dolphin	0	0	0	0	0	0	0	0	2.39	1.11	0.74	0.38	1.01	0.36	0.14	0.12
MF	Risso's dolphin	0	0	0	0	0	0	0	0	2.97	1.40	0.86	0.38	1.22	0.38	0.20	0.07
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0	0	0	0	0	0	2.85	1.57	1.02	0.44	1.25	0.46	0.15	0.11
HF	Harbor porpoise (sensitive)	0	0	0	0	0	0	0	0	2.93	1.53	0.92	0.49	21.43	16.01	13.20	9.91
PW	Gray seal	0	0	0	0	0	0	0	0	3.21	1.77	0.77	0.47	2.36	0.77	0.62	0
PW	Harbor seal	0	0	0	0	0	0	0	0	2.95	1.41	1.04	0.41	2.00	1.04	0.50	0.21

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-45. OSS2 Jacket foundation (2.5 m diameter, two pin piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

Species		Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	0.87	0.01	0	0	0	0	0	0	3.25	1.47	1.10	0.39	3.01	1.47	1.10	0.39
LF	Minke whale (migrating)	0.26	0.03	0	0	0	0	0	0	2.97	1.48	1.06	0.38	17.99	10.96	7.65	4.90
LF	Humpback whale (migrating)	0.21	0	0	0	0	0	0	0	3.11	1.51	0.94	0.48	18.89	11.44	7.90	4.83
LF	North Atlantic right whale[c] (migrating)	0.32	0.09	0	0	0	0	0	0	2.81	1.51	1.06	0.42	18.19	10.82	7.64	4.82
LF	Sei whale[c] (migrating)	0.46	0.03	0	0	0	0	0	0	3.18	1.41	0.94	0.42	18.46	11.16	7.77	4.93
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	2.86	1.32	0.86	0.46	1.16	0.45	0.24	0
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	0	0	0	0	0	0	3.02	1.51	0.96	0.46	1.11	0.48	0.23	0.12
MF	Bottlenose dolphin	0	0	0	0	0	0	0	0	2.62	1.28	0.80	0.38	1.04	0.31	0.19	0.12
MF	Risso's dolphin	0	0	0	0	0	0	0	0	3.02	1.42	0.87	0.43	1.03	0.43	0.19	0.13
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0	0	0	0	0	0	3.01	1.25	1.03	0.43	1.22	0.43	0.13	0.11
HF	Harbor porpoise (sensitive)	0	0	0	0	0	0	0	0	3.02	1.54	0.94	0.43	61.74	32.71	23.52	14.40
PW	Gray seal	0	0	0	0	0	0	0	0	3.35	1.65	0.78	0.51	2.36	0.78	0.67	0
PW	Harbor seal	0	0	0	0	0	0	0	0	3.19	1.45	1.04	0.42	2.21	1.04	0.59	0.22

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

Table I-46. OSS2 Jacket foundation (2.5 m diameter, three pin piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to marine mammal threshold criteria with sound attenuation.

	Species	Injury								Behavior							
		L_E				L_{PK}				L_p [a]				L_p [b]			
		Attenuation (dB)								Attenuation (dB)							
		0	6	10	15	0	6	10	15	0	6	10	15	0	6	10	15
LF	Fin whale[c]	0.94	0.01	0	0	0	0	0	0	3.20	1.55	0.99	0.50	3.03	1.56	0.99	0.50
LF	Minke whale (migrating)	0.35	0.03	0	0	0	0	0	0	2.90	1.48	1.03	0.41	17.96	10.82	7.63	4.90
LF	Humpback whale (migrating)	0.21	0	0	0	0	0	0	0	3.13	1.49	0.92	0.50	18.87	11.24	7.80	4.92
LF	North Atlantic right whale[c] (migrating)	0.51	0.09	0	0	0	0	0	0	2.82	1.46	1.04	0.49	18.01	10.82	7.55	4.68
LF	Sei whale[c] (migrating)	0.48	0.03	0	0	0	0	0	0	3.05	1.36	0.90	0.45	18.46	11.16	7.85	4.90
MF	Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	2.77	1.42	0.86	0.46	1.13	0.45	0.26	0.05
MF	Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Common dolphin	0	0	0	0	0	0	0	0	2.92	1.49	0.96	0.50	1.11	0.49	0.22	0.12
MF	Bottlenose dolphin	0	0	0	0	0	0	0	0	2.48	1.28	0.74	0.38	0.91	0.34	0.18	0.12
MF	Risso's dolphin	0	0	0	0	0	0	0	0	3.04	1.34	0.86	0.38	1.05	0.38	0.20	0.12
MF	Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF	Sperm whale[c]	0	0	0	0	0	0	0	0	2.91	1.49	1.02	0.44	1.24	0.45	0.15	0.11
HF	Harbor porpoise (sensitive)	0	0	0	0	0	0	0	0	2.98	1.53	0.92	0.44	61.76	32.68	23.47	14.25
PW	Gray seal	0	0	0	0	0	0	0	0	3.32	1.68	0.77	0.47	2.36	0.77	0.65	0
PW	Harbor seal	0	0	0	0	0	0	0	0	3.06	1.38	1.04	0.41	2.22	1.04	0.57	0.21

[a] NOAA (2005), [b] Wood et al. (2012), [c] Listed as Endangered under the ESA.

I.2.2.2. Sea Turtles

This section contains sea turtle exposure ranges for each of the modeled foundation types and seasons assuming 0, 6, 10, and 15 dB broadband attenuation.

Table I-47. 9.6 m typical monopile foundation (one pile per day, summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.41	<0.01	<0.01	0	0	0	0	0	1.90	0.93	0.47	0.19
Leatherback turtle[a]	0.68	0.15	0	0	0	0	0	0	2.25	1.22	0.68	0.15
Loggerhead turtle	0	0	0	0	0	0	0	0	1.84	1.00	0.38	0
Green turtle	0.39	0.05	0	0	0	0	0	0	2.01	0.99	0.36	0.16

[a] Listed as Endangered under the ESA.

Table I-48. 9.6 m typical monopile foundation (two piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.37	0	0	0	0	0	0	0	1.87	1.03	0.57	0.23
Leatherback turtle[a]	0.79	0.17	0	0	0	0	0	0	2.23	1.19	0.68	0.33
Loggerhead turtle	0.45	0	0	0	0	0	0	0	1.73	0.96	0.49	0.14
Green turtle	0.50	0.15	0	0	0	0	0	0	2.04	1.11	0.57	0.25

[a] Listed as Endangered under the ESA.

Table I-49. 9.6 m typical monopile foundation (one pile per day, winter): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.41	<0.01	<0.01	0	0	0	0	0	1.96	0.98	0.51	0.19
Leatherback turtle[a]	0.79	0.15	0	0	0	0	0	0	2.37	1.25	0.73	0.15
Loggerhead turtle	0	0	0	0	0	0	0	0	1.99	1.01	0.38	0
Green turtle	0.37	0.16	0	0	0	0	0	0	2.13	1.01	0.36	0.16

[a] Listed as Endangered under the ESA.

Table I-50. 9.6 m typical monopile foundation (two piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.37	0.03	0	0	0	0	0	0	1.90	1.07	0.67	0.23
Leatherback turtle[a]	0.80	0.17	0.06	0	0	0	0	0	2.35	1.34	0.75	0.33
Loggerhead turtle	0.45	0	0	0	0	0	0	0	1.89	0.93	0.47	0.14
Green turtle	0.50	0.15	0	0	0	0	0	0	2.11	1.19	0.66	0.30

[a] Listed as Endangered under the ESA.

Table I-51. 9.6 m difficult to drive monopile foundation (one pile per day, summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.87	0.21	0.10	0	0	0	0	0	3.15	1.95	1.27	0.66
Leatherback turtle[a]	1.44	0.68	0.15	0.15	0	0	0	0	3.58	2.37	1.54	0.78
Loggerhead turtle	0.48	0.17	0	0	0	0	0	0	3.07	1.83	1.00	0.61
Green turtle	1.14	0.39	0.17	0	0	0	0	0	3.27	1.99	1.34	0.66

[a] Listed as Endangered under the ESA.

Table I-52. 9.6 m difficult to drive monopile foundation (two piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.88	0.33	0.12	0	<0.01	0	0	0	3.05	1.89	1.23	0.67
Leatherback turtle[a]	1.55	0.70	0.31	0	0	0	0	0	3.55	2.36	1.52	0.80
Loggerhead turtle	0.56	0.03	0.03	0	0	0	0	0	2.74	1.72	1.09	0.55
Green turtle	1.16	0.45	0.11	0	0	0	0	0	3.18	2.12	1.50	0.59

[a] Listed as Endangered under the ESA.

Table I-53. 9.6 m difficult to drive monopile foundation (one pile per day, winter): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.97	0.21	0.10	0	0	0	0	0	3.37	1.97	1.29	0.66
Leatherback turtle[a]	1.54	0.68	0.15	0.15	0	0	0	0	3.87	2.38	1.60	0.79
Loggerhead turtle	0.48	0.17	0	0	0	0	0	0	3.19	1.81	1.24	0.61
Green turtle	1.44	0.39	0.17	0	0	0	0	0	3.61	2.09	1.67	0.80

[a] Listed as Endangered under the ESA.

Table I-54. 9.6 m difficult to drive monopile foundation (two piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.96	0.33	0.12	0	<0.01	0	0	0	3.36	2.03	1.35	0.67
Leatherback turtle[a]	1.57	0.79	0.31	0	0	0	0	0	3.85	2.37	1.57	0.82
Loggerhead turtle	0.56	0.03	0.03	0	0	0	0	0	2.91	1.70	1.09	0.55
Green turtle	1.48	0.45	0.19	0	0	0	0	0	3.61	2.19	1.55	0.67

[a] Listed as Endangered under the ESA.

Table I-55. 11 m U3 monopile foundation (one pile per day, summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.15	<0.01	0	0	0	0	0	0	1.32	0.72	0.36	0.19
Leatherback turtle[a]	0.68	0.15	0	0	0	0	0	0	1.59	0.90	0.15	0.15
Loggerhead turtle	0	0	0	0	0	0	0	0	1.16	0.71	0.17	0.17
Green turtle	0.17	0	0	0	0	0	0	0	1.64	0.67	0.17	0.17

[a] Listed as Endangered under the ESA.

Table I-56. 11 m U3 monopile foundation (two piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.20	0	0	0	0	0	0	0	1.37	0.64	0.32	0.20
Leatherback turtle[a]	0.66	0.17	0	0	0	0	0	0	1.71	0.80	0.44	0.17
Loggerhead turtle	0.03	0	0	0	0	0	0	0	1.20	0.56	0.21	0.11
Green turtle	0.28	0	0	0	0	0	0	0	1.52	0.69	0.38	0.21

[a] Listed as Endangered under the ESA.

Table I-57. 11 m U3 monopile foundation (one pile per day, winter): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.15	<0.01	0	0	0	0	0	0	1.41	0.72	0.45	0.19
Leatherback turtle[a]	0.68	0.15	0	0	0	0	0	0	1.65	0.93	0.15	0.15
Loggerhead turtle	0	0	0	0	0	0	0	0	1.37	0.71	0.44	0.17
Green turtle	0.17	0	0	0	0	0	0	0	1.75	0.79	0.35	0.17

[a] Listed as Endangered under the ESA.

Table I-58. 11 m U3 monopile foundation (two piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.21	0	0	0	0	0	0	0	1.45	0.66	0.33	0.20
Leatherback turtle[a]	0.70	0.17	0	0	0	0	0	0	1.76	0.87	0.58	0.17
Loggerhead turtle	0.03	0	0	0	0	0	0	0	1.38	0.60	0.21	0.11
Green turtle	0.36	0	0	0	0	0	0	0	1.60	0.76	0.38	0.21

[a] Listed as Endangered under the ESA.

Table I-59. 11 m T1 monopile foundation (one pile per day, summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.34	<0.01	0	0	0	0	0	0	2.05	1.01	0.44	0.18
Leatherback turtle[a]	0.70	0.15	0	0	0	0	0	0	2.39	1.26	0.74	0.15
Loggerhead turtle	0	0	0	0	0	0	0	0	1.88	0.93	0.39	0
Green turtle	0.16	0	0	0	0	0	0	0	2.26	1.12	0.81	0.16

[a] Listed as Endangered under the ESA.

Table I-60. 11 m T1 monopile foundation (two piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.38	0	0	0	0	0	0	0	1.99	1.10	0.59	0.20
Leatherback turtle[a]	0.68	0.17	0	0	0	0	0	0	2.41	1.21	0.81	0.33
Loggerhead turtle	0	0	0	0	0	0	0	0	1.73	0.84	0.49	0.11
Green turtle	0.64	0.14	0	0	0	0	0	0	2.20	1.16	0.71	0.25

[a] Listed as Endangered under the ESA.

Table I-61. 11 m T1 monopile foundation (one pile per day, winter): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.33	<0.01	0	0	0	0	0	0	2.21	1.02	0.44	0.19
Leatherback turtle[a]	0.70	0.15	0	0	0	0	0	0	2.50	1.36	0.74	0.15
Loggerhead turtle	0	0	0	0	0	0	0	0	2.00	0.93	0.39	0
Green turtle	0.16	0	0	0	0	0	0	0	2.32	1.12	0.81	0.16

[a] Listed as Endangered under the ESA.

Table I-62. 11 m T1 monopile foundation (two piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.38	0.03	0	0	0	0	0	0	1.99	1.20	0.59	0.20
Leatherback turtle[a]	0.76	0.17	0	0	0	0	0	0	2.47	1.38	0.81	0.33
Loggerhead turtle	0.45	0	0	0	0	0	0	0	2.02	0.84	0.59	0.11
Green turtle	0.62	0.14	0	0	0	0	0	0	2.29	1.16	0.75	0.25

[a] Listed as Endangered under the ESA.

Table I-63. 11 m R3 monopile foundation (one pile per day, summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.18	<0.01	<0.01	0	0	0	0	0	1.72	0.73	0.50	0.19
Leatherback turtle[a]	0.57	0.15	0	0	0	0	0	0	1.92	0.99	0.71	0.15
Loggerhead turtle	0	0	0	0	0	0	0	0	1.48	0.60	0.39	0.10
Green turtle	0.16	0.07	0	0	0	0	0	0	1.98	0.98	0.45	0.16

[a] Listed as Endangered under the ESA.

Table I-64. 11 m R3 monopile foundation (two piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.28	0	0	0	0	0	0	0	1.73	0.78	0.51	0.18
Leatherback turtle[a]	0.51	0.17	0	0	0	0	0	0	2.01	1.07	0.71	0.17
Loggerhead turtle	0.14	0	0	0	0	0	0	0	1.60	0.70	0.45	0.14
Green turtle	0.31	0.06	0	0	0	0	0	0	1.89	1.01	0.48	0.25

[a] Listed as Endangered under the ESA.

Table I-65. 11 m R3 monopile foundation (one pile per day, winter): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.37	<0.01	<0.01	0	0	0	0	0	1.79	0.77	0.53	0.19
Leatherback turtle[a]	0.57	0.15	0	0	0	0	0	0	2.20	1.08	0.71	0.15
Loggerhead turtle	0	0	0	0	0	0	0	0	1.66	0.58	0.38	0.10
Green turtle	0.16	0.07	0	0	0	0	0	0	2.05	1.04	0.61	0.16

[a] Listed as Endangered under the ESA.

Table I-66. 11 m R3 monopile foundation (two piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0.34	0	0	0	0	0	0	0	1.84	0.84	0.51	0.18
Leatherback turtle[a]	0.51	0.17	0	0	0	0	0	0	2.15	1.08	0.75	0.17
Loggerhead turtle	0.14	0	0	0	0	0	0	0	1.81	0.73	0.45	0.14
Green turtle	0.47	0.09	0	0	0	0	0	0	1.99	1.06	0.58	0.25

[a] Listed as Endangered under the ESA.

Table I-67. OSS1 Jacket foundation (2.5 m diameter, two pin piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0	0	0	0	0	0	0	0	0.56	0.10	0.11	0
Leatherback turtle[a]	0	0	0	0	0	0	0	0	0.52	0	0	0
Loggerhead turtle	0	0	0	0	0	0	0	0	0.37	0	0	0
Green turtle	0	0	0	0	0	0	0	0	0.47	0.16	0	0

[a] Listed as Endangered under the ESA.

Table I-68. OSS1 Jacket foundation (2.5 m diameter, three pin piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0	0	0	0	0	0	0	0	0.41	0.09	0.10	0
Leatherback turtle[a]	0	0	0	0	0	0	0	0	0.58	0	0	0
Loggerhead turtle	0	0	0	0	0	0	0	0	0.39	<0.01	0	0
Green turtle	0	0	0	0	0	0	0	0	0.55	0.16	0	0

[a] Listed as Endangered under the ESA.

Table I-69. OSS1 Jacket foundation(2.5 m diameter, two pin piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0	0	0	0	0	0	0	0	0.56	0.10	0.11	0
Leatherback turtle[a]	0	0	0	0	0	0	0	0	0.52	0	0	0
Loggerhead turtle	0	0	0	0	0	0	0	0	0.43	0	0	0
Green turtle	0	0	0	0	0	0	0	0	0.47	0.16	0	0

[a] Listed as Endangered under the ESA.

Table I-70. OSS1 Jacket foundation (2.5 m diameter, three pin piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0	0	0	0	0	0	0	0	0.48	0.09	0.10	0
Leatherback turtle[a]	0	0	0	0	0	0	0	0	0.58	0	0	0
Loggerhead turtle	0	0	0	0	0	0	0	0	0.42	<0.01	0	0
Green turtle	0	0	0	0	0	0	0	0	0.57	0.16	0	0

[a] Listed as Endangered under the ESA.

Table I-71. OSS2 Jacket foundation (2.5 m diameter, two pin piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0	0	0	0	0	0	0	0	0.48	0.17	0.07	0
Leatherback turtle[a]	0	0	0	0	0	0	0	0	0	0	0	0
Loggerhead turtle	0	0	0	0	0	0	0	0	0.50	0.20	0	0
Green turtle	0	0	0	0	0	0	0	0	0.42	0.16	0.12	0

[a] Listed as Endangered under the ESA.

Table I-72. OSS2 Jacket foundation (2.5 m diameter, three pin piles per day, summer): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0	0	0	0	0	0	0	0	0.46	0.17	0.07	0
Leatherback turtle[a]	0	0	0	0	0	0	0	0	0	0	0	0
Loggerhead turtle	0	0	0	0	0	0	0	0	0.50	0.19	0	0
Green turtle	0	0	0	0	0	0	0	0	0.46	0.19	0.12	0

[a] Listed as Endangered under the ESA.

Table I-73. OSS2 Jacket foundation (2.5 m diameter, two pin piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0	0	0	0	0	0	0	0	0.47	0.17	0.07	0
Leatherback turtle[a]	0	0	0	0	0	0	0	0	0	0	0	0
Loggerhead turtle	0	0	0	0	0	0	0	0	0.49	0.20	0	0
Green turtle	0	0	0	0	0	0	0	0	0.42	0.16	0.13	0

[a] Listed as Endangered under the ESA.

Table I-74. OSS2 Jacket foundation (2.5 m diameter, three pin piles per day, winter): Exposure ranges ($ER_{95\%}$) in km to sea turtle threshold criteria (Finneran et al. 2017) with sound attenuation.

Species	Injury								Behavior			
	L_E				L_{pk}				L_p			
	Attenuation (dB)								Attenuation (dB)			
	0	6	10	15	0	6	10	15	0	6	10	15
Kemp's ridley turtle[a]	0	0	0	0	0	0	0	0	0.46	0.17	0.07	0
Leatherback turtle[a]	0	0	0	0	0	0	0	0	0	0	0	0
Loggerhead turtle	0	0	0	0	0	0	0	0	0.48	0.19	0	0
Green turtle	0	0	0	0	0	0	0	0	0.46	0.19	0.13	0

[a] Listed as Endangered under the ESA.

I.3. Animat Seeding Area

Exposure modeling seeding areas are set using each species' preferred depth range. The following maps show seeding areas for each species, overlaid on a density map, if available, displaying the highest density month for that species. If density surfaces are unavailable for a particular species, a surrogate may be used, and for some species, the density data source shown in the image may not coincide with the data source used in predicting exposures. Please refer to Section 3.2 for a detailed description of density sources and calculations.

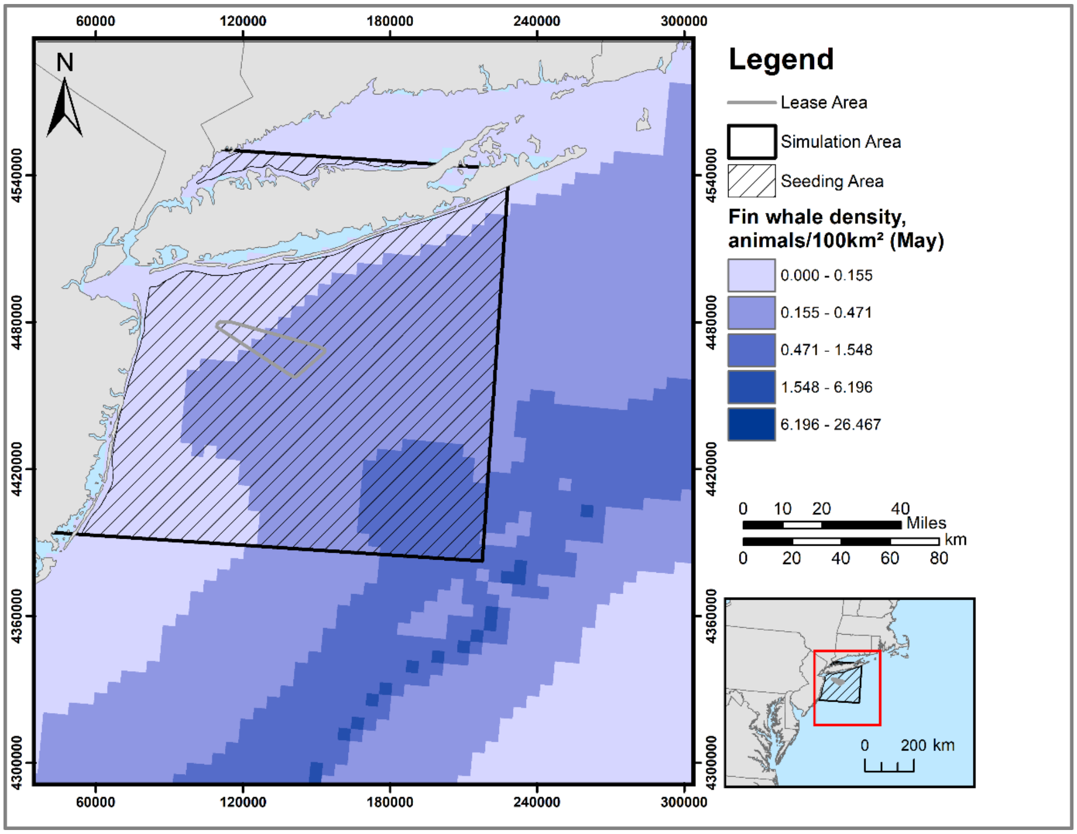

Figure I-1. Map of fin whale animat seeding range.

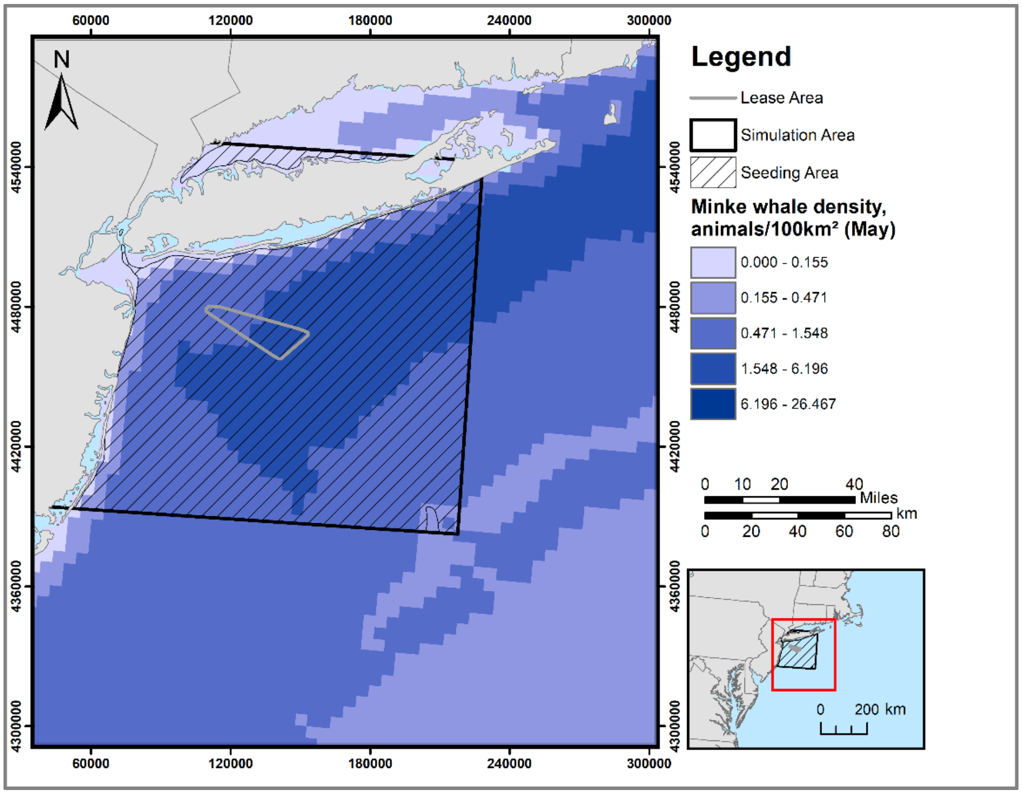

Figure I-2. Map of minke whale animat seeding range.

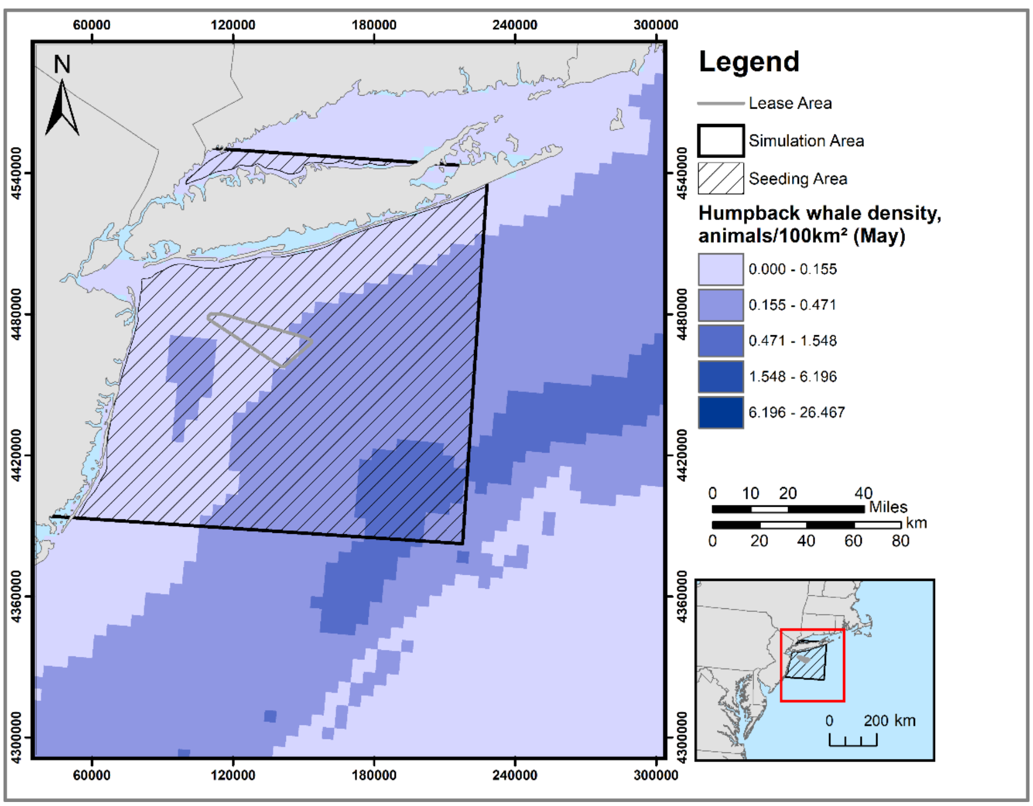

Figure I-3. Map of humpback whale animat seeding range.

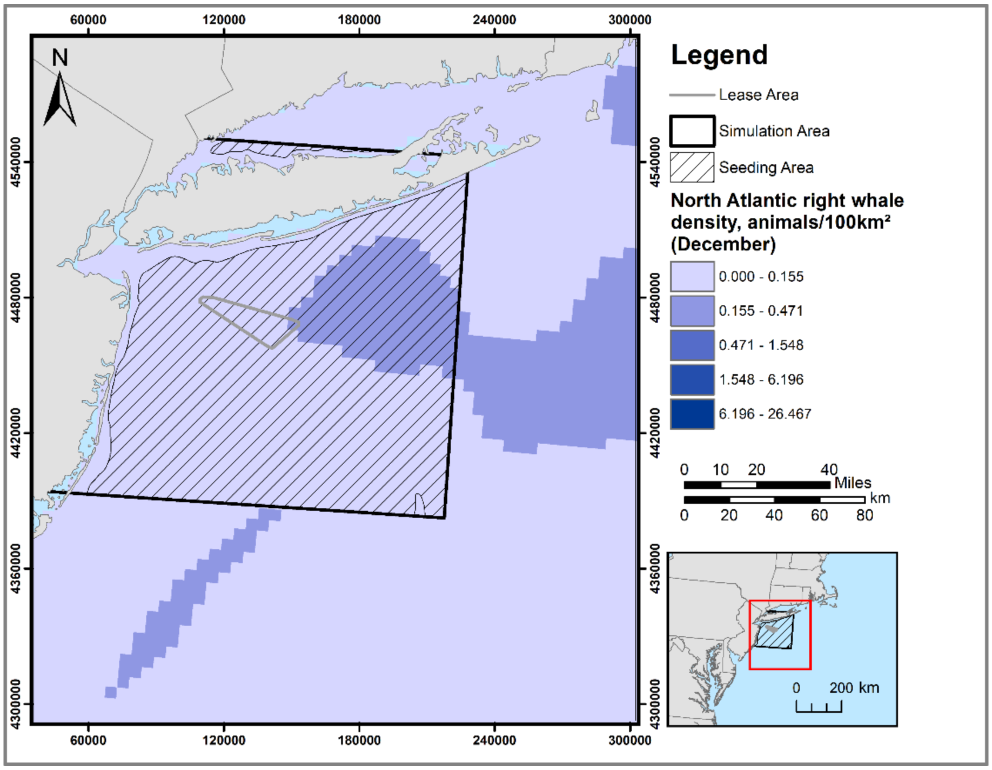

Figure I-4. Map of North Atlantic right whale animat seeding range.

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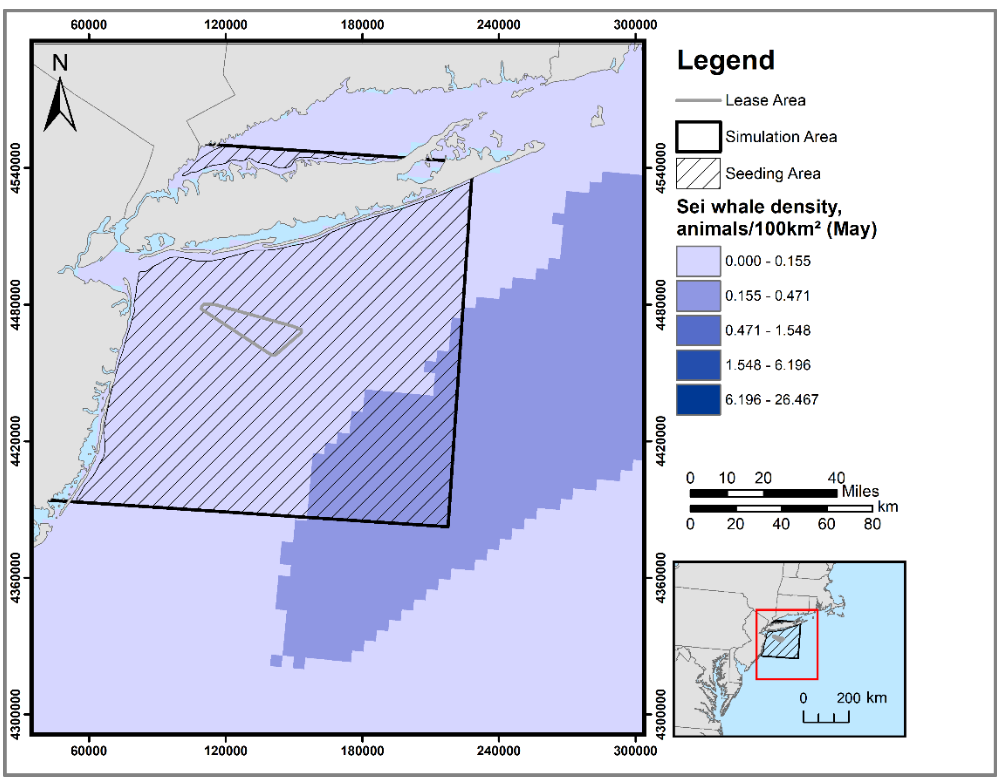

Figure I-5. Map of sei whale animat seeding range.

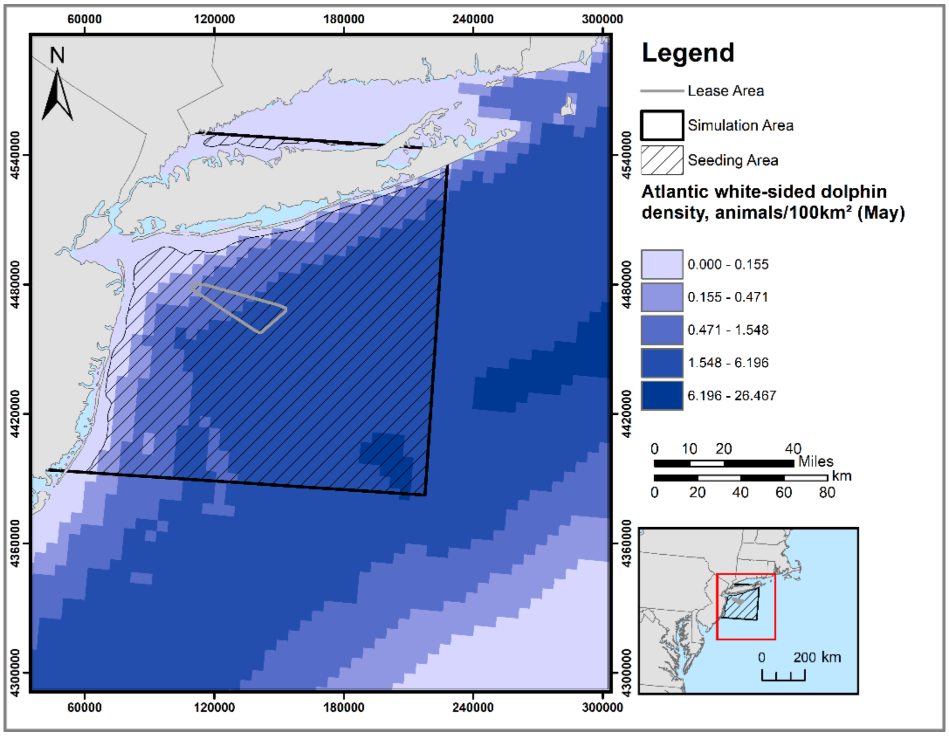

Figure I-6. Map of Atlantic white-sided dolphin animat seeding range.

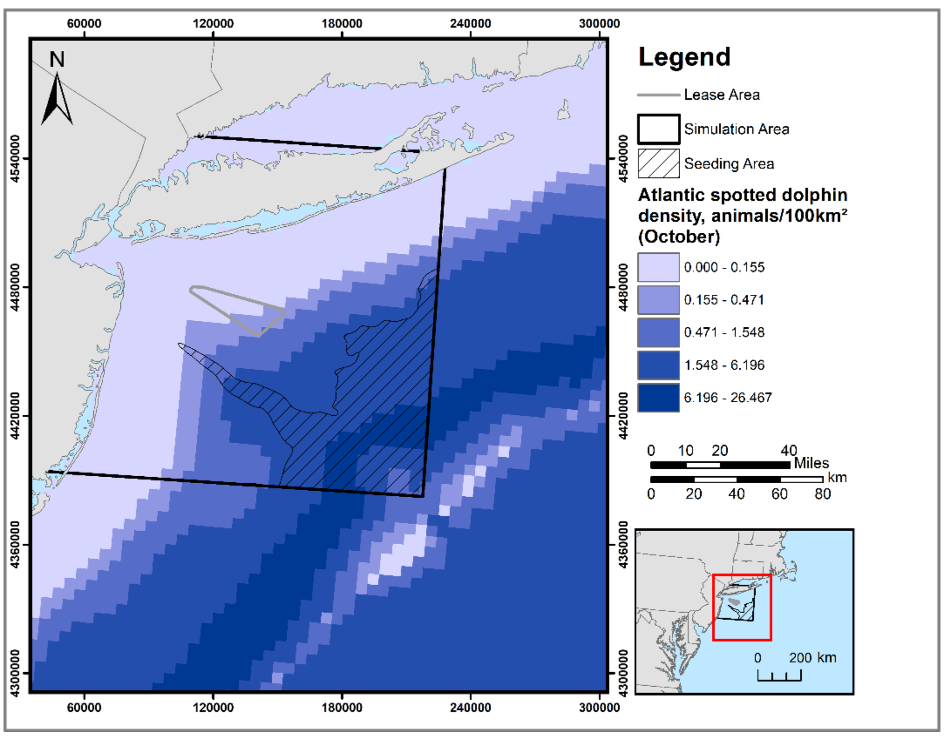

Figure I-7. Map of Atlantic spotted dolphin animat seeding range.

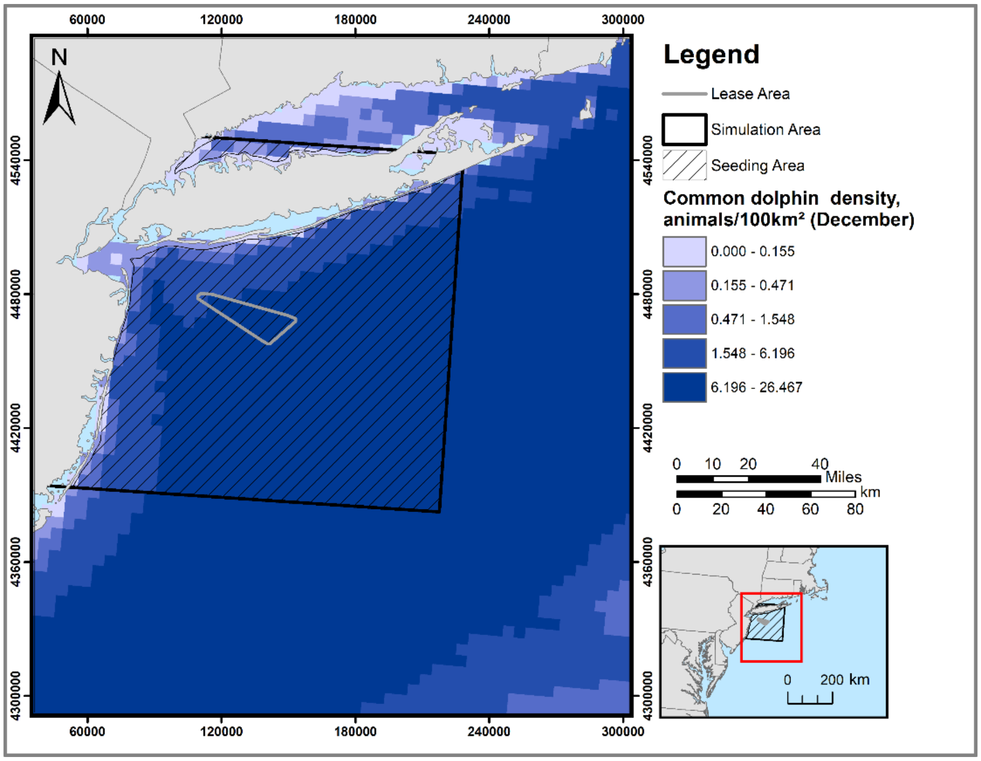

Figure I-8. Map of Common dolphin animat seeding range.

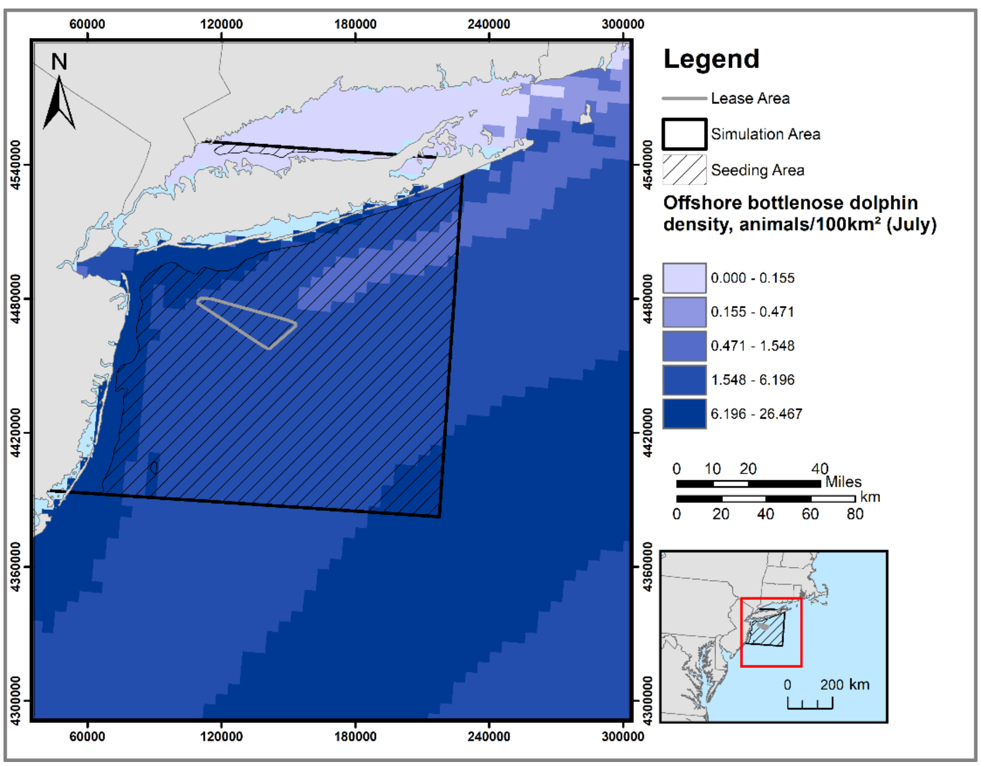

Figure I-9. Map of offshore bottlenose dolphin animat seeding range.

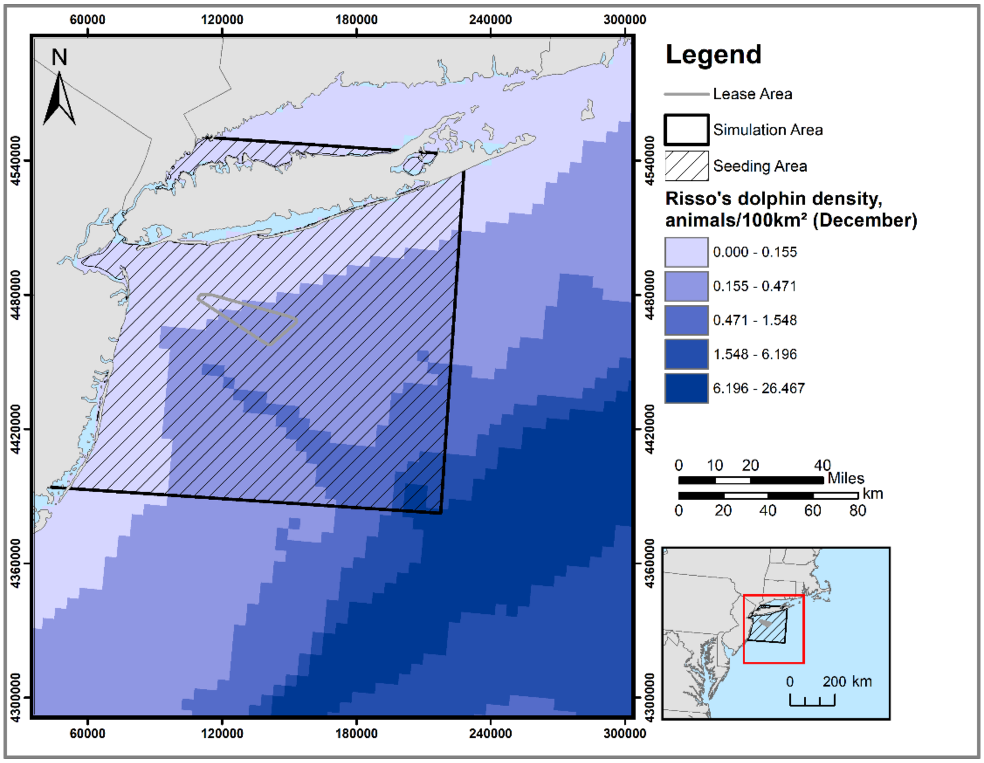

Figure I-10. Map of Risso's dolphin animat seeding range.

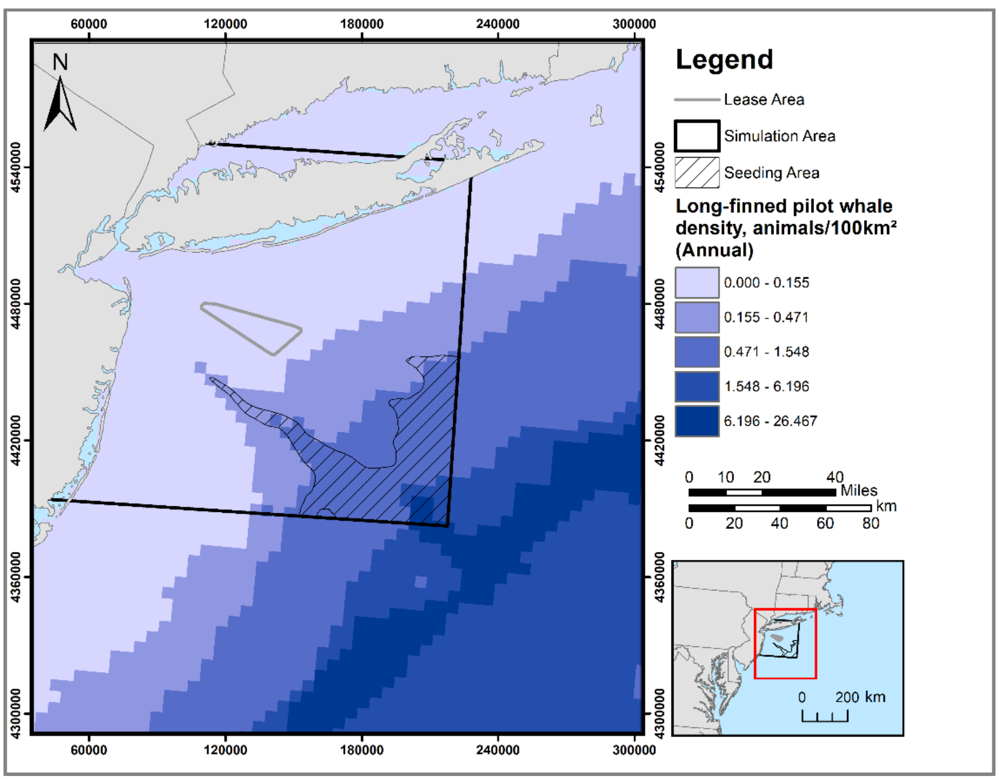

Figure I-11. Map of long-finned pilot whale animat seeding range.

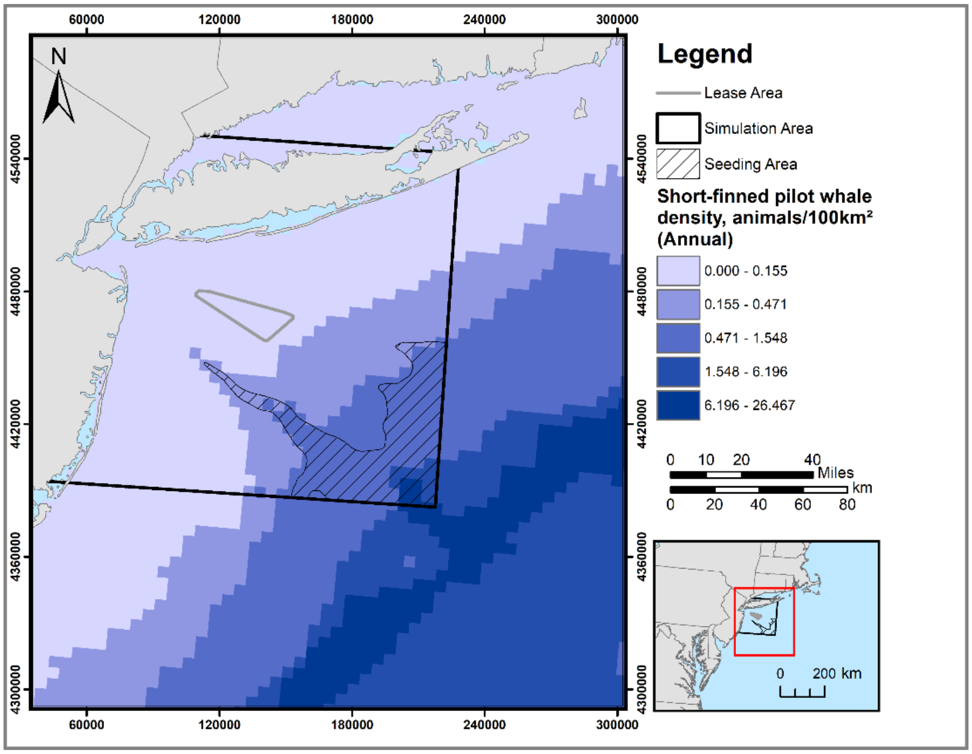

Figure I-12. Map of short-finned pilot whale animat seeding range.

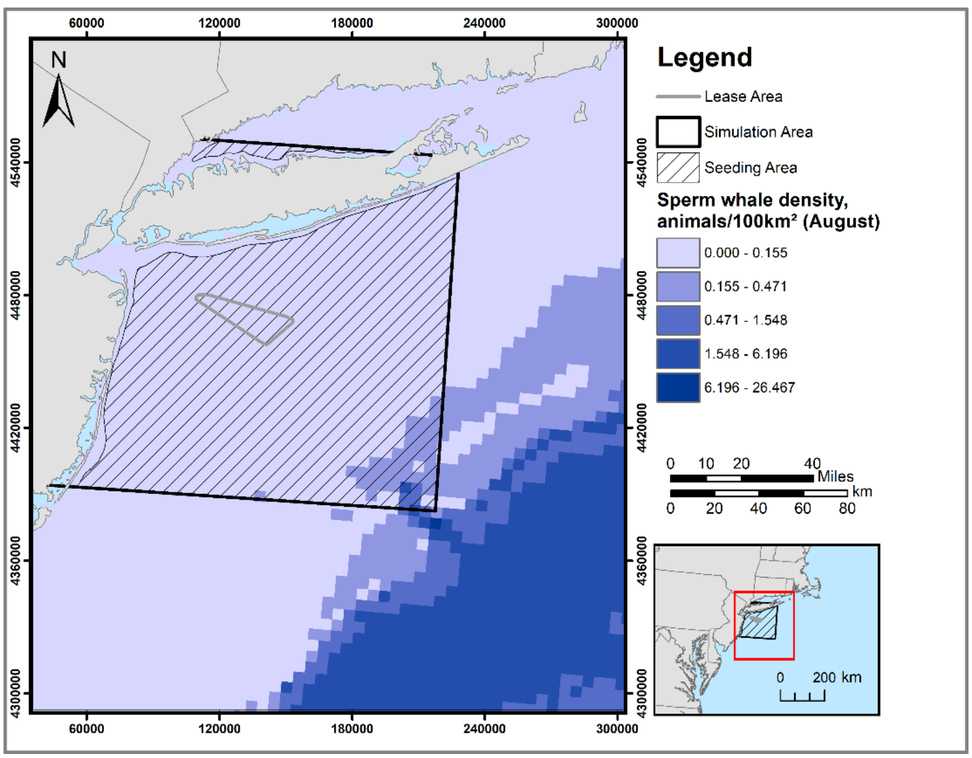

Figure I-13. Map of sperm whale animat seeding range.

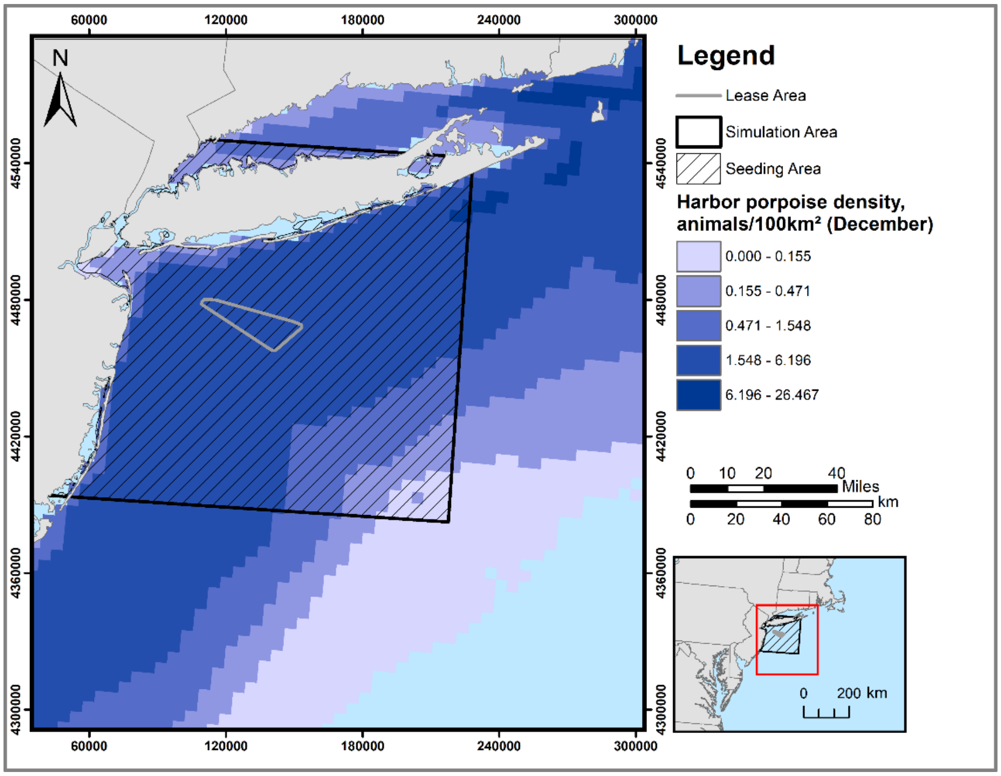

Figure I-14. Map of harbor porpoise animat seeding range.

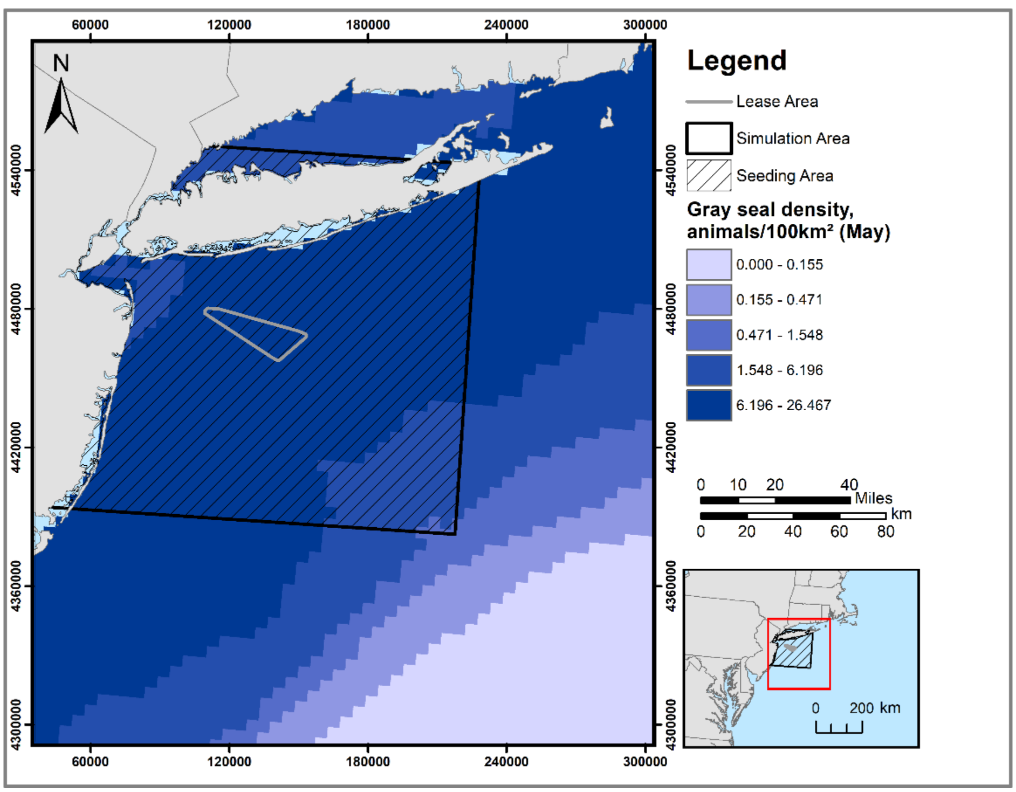

Figure I-15. Map of gray seal animat seeding range.

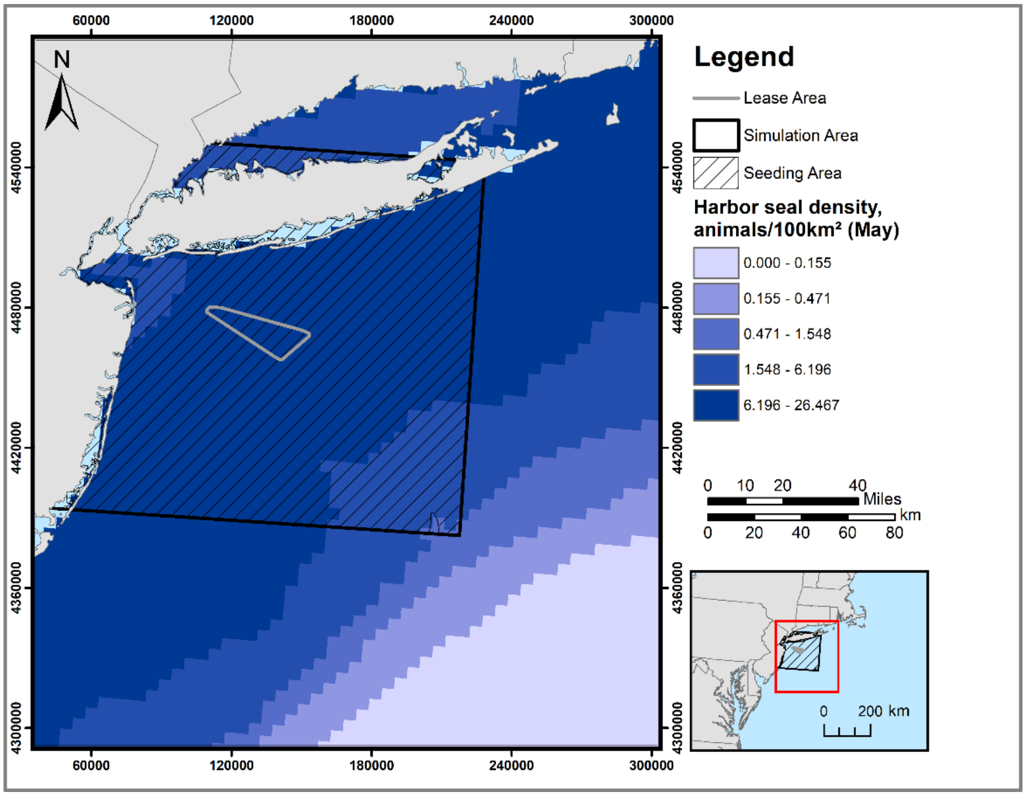

Figure I-16. Map of harbor seal animat seeding range.

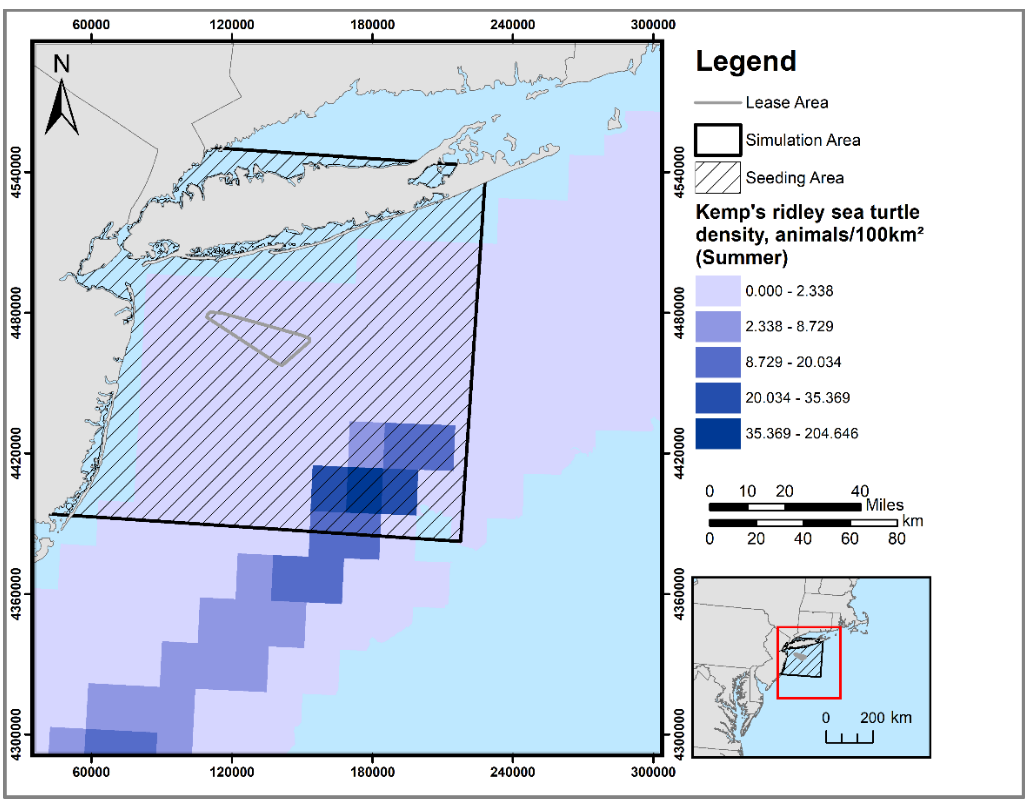

Figure I-17. Map of Kemp's ridley sea turtle animat seeding range.

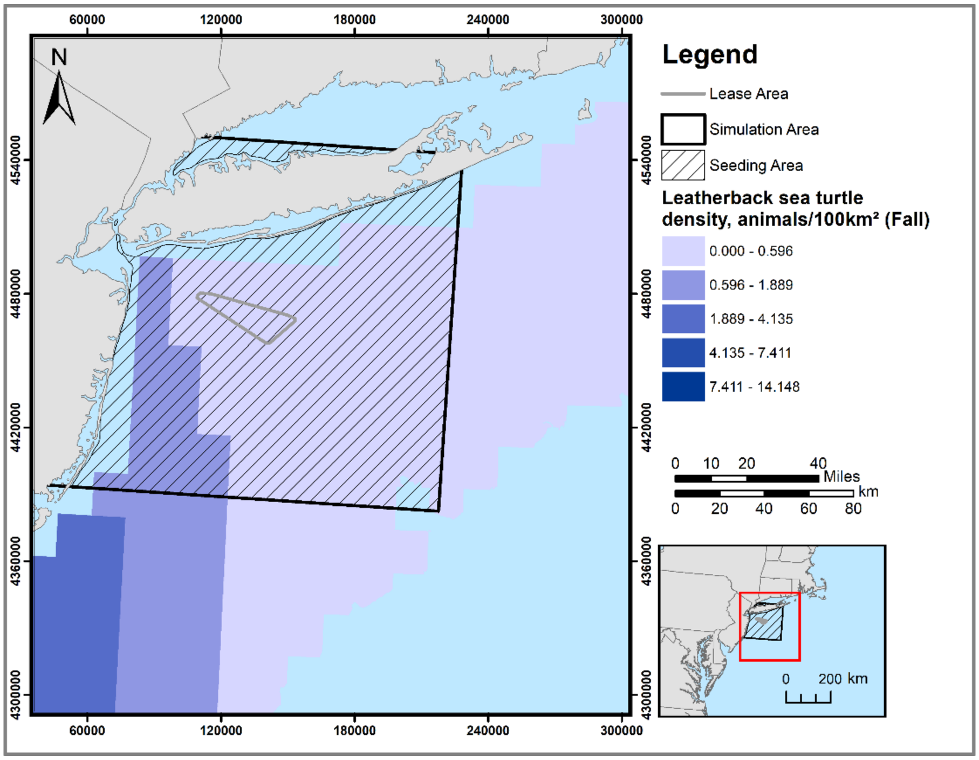

Figure I-18. Map of leatherback sea turtle animat seeding range.

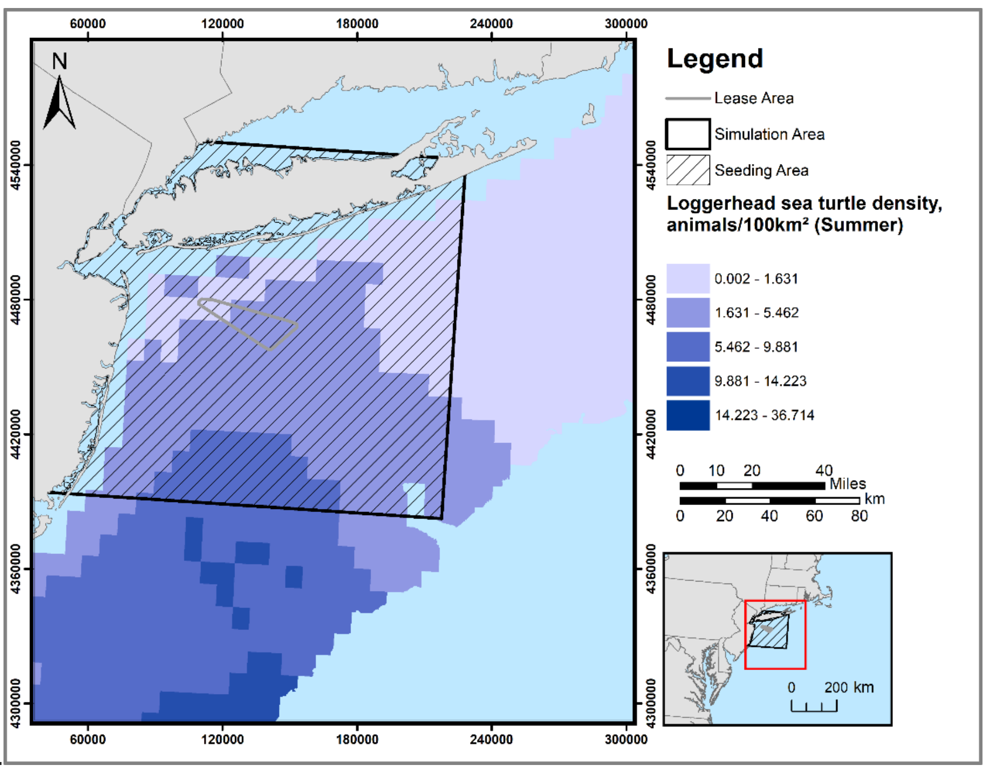

Figure I-19. Map of loggerhead sea turtle animat seeding range.

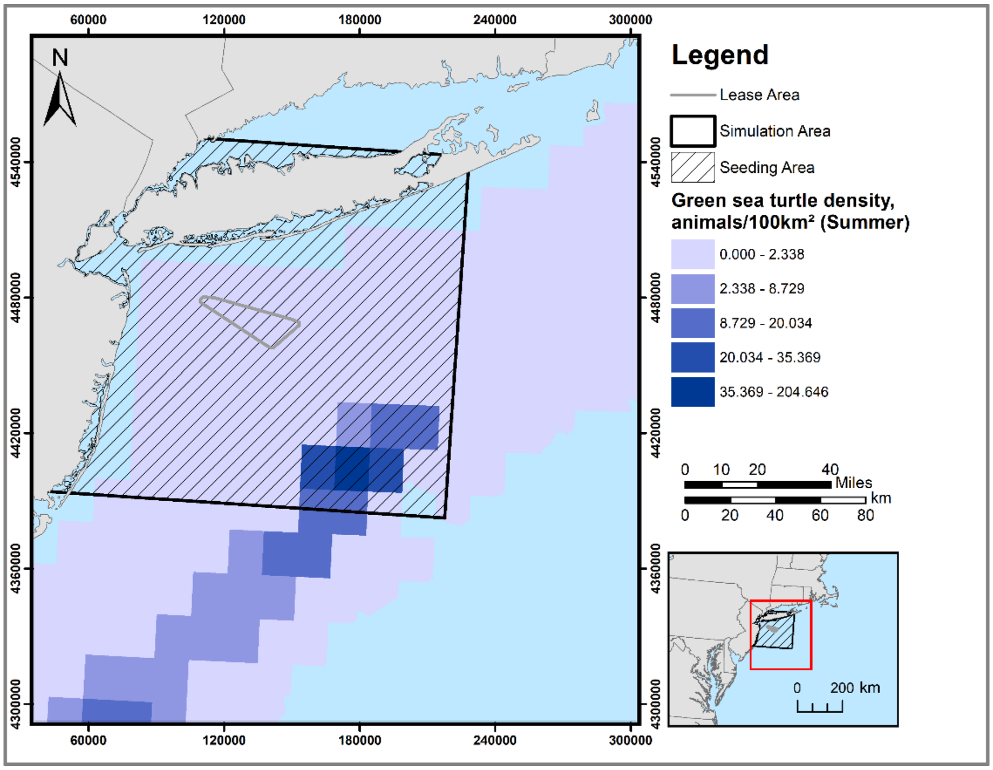

Figure I-20. Map of Green sea turtle animat seeding range.

Appendix B: Survey Equipment and Calculated Level A and Level B Harassment Thresholds

USER SPREADSHEET INTRODUCTION

VERSION: 2.0 (2018)

Companion* User Spreadsheet to:

National Marine Fisheries Service (NMFS): 2018 Revision to: Technical Guidance For Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing: Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts (Version 2.0)

2018 Revised Technical Guidance web page

***For more information on the optional methodology provided within this User Spreadsheet, see Appendix D of Technical Guidance (2018)**

DISCLAIMER: NMFS has provided this spreadsheet as an optional tool to provide estimated effect distances (i.e., isopleths) where PTS onset thresholds may be exceeded. Results provided by this spreadsheet do not represent the entirety of the comprehensive effects analysis, but rather serve as one tool to help evaluate the effects of a proposed action on marine mammal hearing and make findings required by NOAA's various statutes. Input values are the responsibility of the individual user.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance.

INSTRUCTIONS

STEP 1: Determine what spreadsheet is appropriate for activity

HOW TO DETERMINE WHICH SPREADSHEET TO USE

1) Is the sound source NON-IMPULSIVE or IMPULSIVE? (If it is unclear which category describes your source, consult NOAA)
- a) NON-IMPULSIVE (e.g., drilling, vibratory pile driving, tactical sonar): Go to Question 2
- b) IMPULSIVE (e.g., explosives, impact pile driving, seismic): Go to Question 5

2) Is the NON-IMPULSIVE sound source STATIONARY or MOBILE?
- a) STATIONARY: Go to Question 3
- b) MOBILE: Go to Question 4

3) Is the NON-IMPULSIVE, STATIONARY source CONTINUOUS or INTERMITTENT?
- a) CONTINUOUS: Use Spreadsheet A* — **RED**
- *If source is vibratory pile driving: Use Spreadsheet A.1 — **BRICK**
- b) INTERMITTENT: Use Spreadsheet B — **YELLOW**

4) Is the NON-IMPULSIVE, MOBILE source CONTINUOUS or INTERMITTENT?
- a) CONTINUOUS: Use Spreadsheet C ("safe distance" methodology from Sivle et al. 2014) — **BLUE**
- b) INTERMITTENT: Use Spreadsheet D ("safe distance" methodology from Sivle et al. 2014) — **ORANGE**

5) Is the IMPULSIVE sound source STATIONARY or MOBILE?
- a) STATIONARY: Use Spreadsheet E* — **GREEN**
- *If source is impact pile driving: Use Spreadsheet E.1 — **EVRGRN**
- b) MOBILE: Use Spreadsheet F ("safe distance" methodology from Sivle et al. 2014) — **PURPLE**

STEP 2: Within the appropriate spreadsheet, fill-in: **SAGE CELLS** specific to the activity
- a) Please provide information used to support values in provided in sage boxes (e.g., surrogate data, direct measurements, etc.)
- b) If information is unavailable to fill-out one or more of the sage boxes, please consult NMFS

STEP 3: Estimated PTS isopleths (meter) will be provided in: **SKY BLUE CELLS** by marine mammal hearing group

STEP 4: When using this spreadsheet to estimate marine mammal takes, please provide a copy of completed spreadsheet used to estimate isopleths

ASSUMPTIONS & ADDITIONAL INFORMATION

1) Marine mammals remain stationary during activity
2) Currently, recovery between intermittent sounds is not considered regardless of time between sounds (i.e., all sounds within the accumulation period are counted)

Suggested (Default*) Weighting Factor Adjustments (WFA), If Input Value is Unknown for Broadband Source:

Source	WFA	Example Supporting Sources
Seismic	1 kHz	Breitzke et al. 2008; Tashmukhambetov et al. 2008; Tolstoy et al. 2009
Impact pile driving	2 kHz	Blackwell 2005; Reinhall and Dahl 2011
Vibratory pile driving	2.5 kHz	Blackwell 2005; Dahl et al. 2015
Drilling	2 kHz	Greene 1987; Blackwell et al. 2004; Blackwell and Greene 2006

* NMFS acknowledges default WFAs are likely conservative

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*
Phocid pinnipeds (PW): true seals
Otariid pinnipeds (OW): sea lions and fur seals

Literature Cited

Blackwell, S.B. 2005. Underwater Measurements of Pile Driving Sounds during the Port MacKenzie Dock Modifications, 13-16 August 2004. Juneau, Alaska: Federal Highway Administra

Blackwell, S.B., C.R. Greene, Jr., and W.J. Richardson. 2004. Drilling and operational sounds from an oil production island in the ice-covered Beaufort Sea. Journal of the Acoustical Society of America 116: 3199-3211

Blackwell, S.B., and C.R. Green, Jr. 2006. Sounds from an oil production island in the Beaufort Sea in summer: Characteristics and contribution of vess Journal of the Acoustical Society of America 119: 182-196

Breitzke, M., O. Boebel, S. El Naggar, W. Jokat, and B. Werner. 2008 Broad-band calibration of marine seismic sources used by R/V Polarstern for academic resea in polar regions. Geophysical Journal International 174: 505-524

Dahl, P.H., D.R. Dall'Osto, and D.M. Farrell. 2015. The underwater sound field from vibratory pile driving. Journal of the Acoustical Society of America 137: 3544–35

Madsen, P.T. 2005. Marine mammals and noise: Problems with root mean square sound pressure levels for transients. Journal of the Acoustical Society of America 117:3952–3

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Reinhall, P.G., and P.H. Dahl. 2011. Underwater Mach wave radiation from impact pile driving: Theory and observation. Journal of the Acoustical Society of America 130: 1209–1

Sivle, L.D., P.H. Kvadsheim, and M.A. Ainslie. 2014. Potential for population-level disturbance by active sonar in herring. ICES Journal of Marine Science 72: 558-5

Tashmukhambetov, A.M., G.E. Ioup, J.W. Ioup, N.A. Sidorovskaia, and J.J. Newcomb. 2008. Three-dimensional seismic array characterization study: Experiment modeling. Journal of the Acoustical Society of America 123:4094–4108

Tolstoy, M., J. Diebold, L. Doermann, S. Nooner, S.C. Webb, D.R. Bohnenstiehl, T.J. Crone, and R.C. Holmes. 2009. Broadband calibration of the R/V Marcus Langseth four-string seismic sources. Geochemistry Geophysics Geosystems 10: 1-1

Urick, R.J. 1983. Principles of Underwater Sound. New York, New York: McGraw-Hill Book Compar

Technical questions or suggestion on User Spreadsheet: Please contact Amy Scholik-Schlomer (amy.scholik@noaa.gov)

UPDATES (will be posted when change results in the need to recalculate an isopleth; other non-substantive changes may be made periodically but will not result in a version number change)

Original Version	Updated Version	Change	Date posted
1.0	1.1	Sheet A, error with formula for phocid pinnipe	Aug. 22, 2016
1.1	2.0	Corresponds to 2.0 version of Revised Technical Guidance (2018). Added sheet specific to vibratory pile driving ar explosives* and added capabilities to calculate pea sound pressure level isopleths for impulsive source	2018
		*Explosive sheets are being further evaluated if appropriate.	

Category	Representative HRG Equipment	Operating Frequencies (kHz)	RMS Source Level[a] (dB re 1µPA m)	Peak Source Level[a] (dB re 1µPA m)	Primary beamwidth (degrees)	Pulse Duration (ms)	Pulse Repetition (Hz)
Subsea Positioning / USBL	Kongsberg HiPAP 501/502 USBL	21 - 31	190	207	Omni	2	0.5-2
	iXblue, IxSea GAPS Beacon System	8–16	188	194[c]	Omni	10	1
	Sonardyne Ranger 2 and Mini Ranger 2 USBL HPT 3000/5/7000	19–34	200	206	Omni	5	1
MBES	Reson Seabat T20P multibeam echosounder[b]	200 - 400	221[d]	227[d]	90	0.253	
	Reson 7111	100	224[e]	228[e]	6	1.35	
	Kongsberg EM2040Quad[b]	200-400					
	R2 Sonic 2026	170-450	191	221	1	1.115	
	R2 Sonic 2024[b]	200- 700					
SSS	Klein 3900 SSS[b]	445-900	220[f]	226[f]	1.8	0.1	
SBP	EdgeTech DW106	1 to 6	194	197	Omni	66	8
	EdgeTech 424	4 to 20	180[g]	186[g]	122	4.8	
	Innomar, SES-2000 compact	85–115	232[h]	238	4	40	1
	Innomar, SES-2000 Light & Light Plus	85–115	232[h]	238	4	40	1
	Innomar, SES-2000 Standard & Standard Plus	85–115	234[h]	240	1-3.5	60	1.5
	Innomar, SES-2000 Smart	90–110	229[h]	235	5	40	0.5
	Innomar, SES-2000 Medium-70	60-80	240[h]	246	3	40	5
	Teledyne Benthos Chirp III - TTV 170	2 to 7	219[h]	225[h]	100	60	15
Obstacle Avoidance Sonar ROV	Coda Octopus 3D[b]	240-300					20

Pulse Duration (ms)	Pulse Repetition (Hz)
0.002	2
0.01	1
0.005	1
0.000253	
0.00135	1
0.001115	0.016667
0.0001	
0.066	0.125
0.0048	0.125
0.04	1
0.04	1
0.06	0.66667
0.04	2
0.04	0.2
0.06	0.06667

[a] Source levels reported by manufacture

[b] Operating frequencies are above all relevant marine mammal hearing thresholds, so are not assessed I this IHA

[c] The equipment specification sheets indicates a SPL_{RMS} level of 188 dB re 1 µPA. The average difference between peak and SPL_{RMS} USBL measured by Crocker and Fratantonio (2016) was 6 dB. Therefore the estimated peak source level is 194 dB re 1 µPA.

[d] The source levels are based from the Crocker and Frantantonio (2016) Table 25 for a frequency setting of 300 kHz.

[e] The source levels are based from the Crocker and Frantantonio (2016) Table 24 for a source setting of 230 dB.

[f] The source levels are based from the Crocker and Frantantonio (2016) Table 30 for a frequency setting of 445 kHz.

[g] The source levels are based from the Crocker and Frantantonio (2016) Table 16 for a 100% power setting.

[h] The peak source level is based on the manufacturing specifications. The average difference between the peak and SPL_{RMS} for SBP's measured by Crocker and Frantantonio (2016) was 6 dB. Therefore, 6 dB was subtracted from the peak source level to determine the SPL_{RMS} level.

Table 6-3. HRG Equipment - Distances to Regulatory Level B Thresholds

HRG Survey Equipment	Source Level (SL_{RMS})	Lateral Distance (m) to Level B thresholds used in take analysis
	(dB re 1µPa)	
Kongsberg HiPAP 501/502 USBL	190	31.25
iXblue, IxSea GAPS Beacon System	188	25.00
Sonardyne Ranger 2 and Mini Ranger 2 USBL HPT 3000/5/7000	200	97
Reson Seabat T20P multibeam echosounder	221	N/A
Reson 7111	224	2.20
Kongsberg EM2040Quad	0	N/A
R2 Sonic 2026	191	0.26
R2 Sonic 2024	0	N/A
Klein 3900 SSS	0	N/A
EdgeTech DW106	194	50.00
EdgeTech 424	180	8.75
Innomar, SES-2000 compact	232	1.47
Innomar, SES-2000 Light & Light Plus	232	1.47
Innomar, SES-2000 Standard & Standard Plus	234	1.28
Innomar, SES-2000 Smart	229	1.83
Innomar, SES-2000 Medium-70	240	1.10
Teledyne Benthos Chirp III - TTV 170	219	50.05
Coda Octopus 3D	0	N/A

N/A = Operating frequencies are above all relevant marine mammal hearing thresholds and outside standard underwater test equipment measurement ranges.

Table 6.2 Maximum Distances (meters) to Level A Regulatory Thresolds by Equipment Category

HRG System	Representative HRG Equipment	Marine Mammal Group PTS Onset				
		LF cetaceans	MF cetaceans	HF cetaceans	Phocid pinnipeds	Otariid pinnipeds
		199 dB SEL_{cum}	198 dB SEL_{cum}	173 dB SEL_{cum}	201 dB SEL_{cum}	219 dB SEL_{cum}
Subsea Positioning / USBL	Kongsberg HiPAP 501/502 USBL	0.0	0.0	0.1	0.0	0.0
	iXblue, IxSea GAPS Beacon System	0.0	0.0	0.3	0.0	0.0
	Sonardyne Ranger 2 and Mini Ranger 2 USBL HPT 3000/5/7000	0.0	0.0	3.8	0.0	0.0
MBES	Reson Seabat T20P multibeam echosounder[b]	N/A	N/A	N/A	N/A	N/A
	Reson 7111	0.0	0.3	152.6	0.0	0.0
	Kongsberg EM2040Quad[b]	N/A	N/A	N/A	N/A	N/A
	R2 Sonic 2026	0.0	0.0	14.4	0.0	0.0
	R2 Sonic 2024[b]	N/A	N/A	N/A	N/A	N/A
SSS	Klein 3900 SSS[b]	N/A	N/A	N/A	N/A	N/A
SBP	EdgeTech DW106	0.3	0.1	7.7	0.2	0.0
	EdgeTech 424	0.0	0.0	0.2	0.0	0.0
	Innomar, SES-2000 compact	0.3	78.4	34397.1	1.1	0
	Innomar, SES-2000 Light & Light Plus	0.3	78.4	34397.1	1.1	0
	Innomar, SES-2000 Standard & Standard Plus	1.0	279.7	122659.8	4.0	0.0
	Innomar, SES-2000 Smart	0.1	18.0	8114.5	0.2	0.0
	Innomar, SES-2000 Medium-70	33.1	3685.3	1400756.7	115.9	1.0
	Teledyne Benthos Chirp III - TTV 170	138.0	1.8	113.2	54.0	1.1
Obstacle Avoidance Sonar ROV	Coda Octopus 3D[b]	N/A	N/A	N/A	N/A	N/A

N/A indicates the HRG source emit frequency is outside of given marine mammal hearing range.

HRG Propagation Modeling Based on the October 2019 Guidelines

HRG System	HRG Equipment	Source Level SPLrms	Slant Distance of Threshold Distance (m)	Vertical Depth of Threshold (m)	Distance w/Beamwidth Adjusment (m)	Maximum Water Depth in Lease Area	Frequency (kHz)	Beamwidth (degrees)	Beamwidth (radians)	Absorption Coefficient	Transmission Loss	SPLrms at referenced Distance
Subsea Positioning / USBL	Kongsberg HiPAP 501/502 USBL	190	31.25	1.91429E-15	**31.25**	42.0	21	180	3.14	3.6	30.0	160.0
	iXblue, IxSea GAPS Beacon System	188	25	1.53144E-15	**25.00**	42.0	8	180	3.14	0.6	28.0	160.0
	Sonardyne Ranger 2 and Mini Ranger 2 USBL HPT 3000/5/7000	200	97	5.94197E-15	**97.00**	42.0	19	180	3.14	3.0	40.0	160.0
MBES	Reson 7111	224	370	369.4929279	**2.20**	42.0	100	6	0.10	34.3	64.0	160.0
	R2 Sonic 2026	191	29.9	29.8988615	**0.26**	42.0	170	1	0.02	50.3	31.0	160.0
SBP	EdgeTech DW106	194	50	3.06287E-15	**50.00**	42.0	1	180	3.14	0.0	34.0	160.0
	EdgeTech 424	180	10	4.848096202	**8.75**	42.0	4	122	2.13	0.1	20.0	160.0
	Innomar, SES-2000 compact	232	572	571.6515531	**1.47**	42.0	85	4	0.07	29.5	72.0	160.0
	Innomar, SES-2000 Light & Light Plus	232	572	571.6515531	**1.47**	42.0	85	4	0.07	29.5	72.0	160.0
	Innomar, SES-2000 Standard & Standard Plus	234	617	616.7122255	**1.28**	42.0	85	3.5	0.06	29.5	74.0	160.0
	Innomar, SES-2000 Smart	229	489	488.5345804	**1.83**	42.0	90	5	0.09	31.2	69.0	160.0
	Innomar, SES-2000 Medium-70	240	1000	999.657325	**1.10**	42.0	60	3	0.05	20.0	80.0	160.0
	Teledyne Benthos Chirp III - TTV 170	219	890	572.0809726	**50.05**	42.0	2	100	1.75	0.0	59.0	160.0

Table 7-9. HRG Equipment - Distances to Regulatory Level B Thresholds

HRG Survey Equipment	Source Level (SL_{RMS}) (dB re 1µPa)	Lateral Distance (m) to Level B thresholds used in take analysis
Kongsberg HiPAP 501/502 USBL	190	31.3
iXblue, IxSea GAPS Beacon System	188	25.0
Sonardyne Ranger 2 and Mini Ranger 2 USBL HPT 3000/5/7000	200	97.0
Reson Seabat T20P multibeam echosounder	221	N/A
Reson 7111	224	2.2
Kongsberg EM2040Quad		N/A
R2 Sonic 2026	191	0.26
R2 Sonic 2024		N/A
Klein 3900 SSS		N/A
EdgeTech DW106	194	50.00
EdgeTech 424	180	8.75
Innomar, SES-2000 compact	232	1.47
Innomar, SES-2000 Light & Light Plus	232	1.47
Innomar, SES-2000 Standard & Standard Plus	234	1.28
Innomar, SES-2000 Smart	229	1.83
Innomar, SES-2000 Medium-70	240	1.10
Teledyne Benthos Chirp III - TTV 170	219	50.05
Coda Octopus 3D		N/A

N/A = Operating frequencies are above all relevant marine mammal hearing thresholds and outside standard underwater test equipment measurement ranges.

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY

	User Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	Kongsberg HiPAP 501/502 USBL

Please include any assumptions

PROJECT CONTACT	Tetra Tech Inc

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)[¥]	21	source-specific WFA

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directl However, they must provide additional support and documentation supporting this modificatic

*** BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)**

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD[‡] USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	190
Source Velocity (meters/second)	2.045
Pulse Duration (seconds)	0.002
1/Repetition rate^ (seconds)	2
Duty Cycle	0.00
Source Factor	1E+16

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent

^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	0.0	0.0	0.1	0.0	0.0

D2: ALTERNATIVE METHOD[†] (SINGLE PING/PULSE EQUIVALENT)

Source Level (Single Ping/Pulse SEL)	
Source Velocity (meters/second)	
1/Repetition rate^ (seconds)	
Source Factor	#DIV/0!

†Methodology assumes propagation of 20 log R; Activity duration (time) independent

^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet toc

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	-6.80	-0.24	-1.04	-2.75	-4.01

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY	
	User Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	iXblue, IxSea GAPS Beacon System

Please include any assumptions

PROJECT CONTACT	Tetra Tech Inc

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)[¥]	16	source-specific WFA

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directl However, they must provide additional support and documentation supporting this modificatic

* BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD[‡] USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	188
Source Velocity (meters/second)	2.045
Pulse Duration (seconds)	0.01
1/Repetition rate^ (seconds)	1
Duty Cycle	0.01
Source Factor	6.30957E+16

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	0.0	0.0	0.3	0.0	0.0

D2: ALTERNATIVE METHOD[†] (SINGLE PING/PULSE EQUIVALENT)

Source Level (Single Ping/Pulse SEL)	
Source Velocity (meters/second)	
1/Repetition rate^ (seconds)	
Source Factor	#DIV/0!

†Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet toc

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	-4.53	-0.82	-2.24	-1.49	-2.37

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY

	User Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	Sonardyne Ranger 2 and Mini Ranger 2 USBL HPT 3000/5/7000

Please include any assumptions

PROJECT CONTACT	Tetra Tech Inc

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)[¥]	34	source-specific WFA

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directl
However, they must provide additional support and documentation supporting this modificatic

*** BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)**

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD[‡] USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	200
Source Velocity (meters/second)	2.045
Pulse Duration (seconds)	0.005
1/Repetition rate^ (seconds)	1
Duty Cycle	0.01
Source Factor	5E+17

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	0.0	0.0	3.8	0.0	0.0

D2: ALTERNATIVE METHOD[†] (SINGLE PING/PULSE EQUIVALENT)

Source Level (Single Ping/Pulse SEL)	
Source Velocity (meters/second)	
1/Repetition rate^ (seconds)	
Source Factor	#DIV/0!

†Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet toc

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	**-12.34**	**-0.04**	**-0.06**	**-6.44**	**-8.46**

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY

(green)	**User Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	Sonardyne Ranger 2 and Mini Ranger 2 USBL HPT 3000/5/7000

Please include any assumptions

PROJECT CONTACT	Tetra Tech Inc

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)¥	100	source-specific WFA

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directl However, they must provide additional support and documentation supporting this modificatic

*** BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)**

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD‡ USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	224
Source Velocity (meters/second)	2.045
Pulse Duration (seconds)	0.00135
1/Repetition rate^ (seconds)	1
Duty Cycle	0.00
Source Factor	3.39105E+19

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent

^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	0.0	0.3	152.6	0.0	0.0

D2: ALTERNATIVE METHOD† (SINGLE PING/PULSE EQUIVALENT)

Source Level (Single Ping/Pulse SEL)	
Source Velocity (meters/second)	
1/Repetition rate^ (seconds)	
Source Factor	#DIV/0!

†Methodology assumes propagation of 20 log R; Activity duration (time) independent

^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet toc

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	-29.03	-4.09	-2.33	-20.92	-23.97

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a\,[1+(f/f_2)^2]^b}\right\}$$

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY	
	User Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	R2Sonics 2026
Please include any assumptions	
PROJECT CONTACT	Tetra Tech Inc

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)[¥]	170	source-specific WFA

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directl However, they must provide additional support and documentation supporting this modificatic

* BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD‡ USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	191
Source Velocity (meters/second)	2.045
Pulse Duration (seconds)	0.01115
1/Repetition rate^ (seconds)	0.016667
Duty Cycle	0.67
Source Factor	8.42204E+18

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent

^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**0.0**	**0.0**	**14.4**	**0.0**	**0.0**

D2: ALTERNATIVE METHOD† (SINGLE PING/PULSE EQUIVALENT)

Source Level (Single Ping/Pulse SEL)	
Source Velocity (meters/second)	
1/Repetition rate^ (seconds)	
Source Factor	#DIV/0!

†Methodology assumes propagation of 20 log R; Activity duration (time) independent

^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet toc

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	**-38.05**	**-9.42**	**-6.55**	**-29.65**	**-32.85**

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY

	User Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	EdgeTech DW106

Please include any assumptions

PROJECT CONTACT	Tetra Tech Inc

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)[¥]	6	source-specific WFA

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directl
However, they must provide additional support and documentation supporting this modificatic

*** BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)**

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD[‡] USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	194
Source Velocity (meters/second)	2.045
Pulse Duration (seconds)	0.066
1/Repetition rate^ (seconds)	0.125
Duty Cycle	0.53
Source Factor	1.32628E+19

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	0.2	0.1	7.7	0.2	0.0

D2: ALTERNATIVE METHOD[†] (SINGLE PING/PULSE EQUIVALENT)

Source Level (Single Ping/Pulse SEL)	
Source Velocity (meters/second)	
1/Repetition rate^ (seconds)	
Source Factor	#DIV/0!

†Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet toc

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	-0.70	-6.80	-11.24	-0.01	-0.06

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY

	User Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	EdgeTech 424

Please include any assumptions

PROJECT CONTACT	Tetra Tech Inc

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)[¥]	20	source-specific WFA

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directl However, they must provide additional support and documentation supporting this modificatic

*** BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)**

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD[‡] USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	180
Source Velocity (meters/second)	2.045
Pulse Duration (seconds)	0.0048
1/Repetition rate^ (seconds)	0.125
Duty Cycle	0.04
Source Factor	3.84E+16

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent

^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	0.0	0.0	0.2	0.0	0.0

D2: ALTERNATIVE METHOD[†] (SINGLE PING/PULSE EQUIVALENT)

Source Level (Single Ping/Pulse SEL)	
Source Velocity (meters/second)	
1/Repetition rate^ (seconds)	
Source Factor	#DIV/0!

†Methodology assumes propagation of 20 log R; Activity duration (time) independent

^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet toc

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	-6.35	-0.31	-1.22	-2.48	-3.68

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY

(green)	**User Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	Innomar, SES-2000 compact / Light

Please include any assumptions

PROJECT CONTACT	Tetra Tech Inc

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)¥	85	source-specific WFA

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directl
However, they must provide additional support and documentation supporting this modificatic

*** BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)**

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD‡ USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	232
Source Velocity (meters/second)	2.045
Pulse Duration (seconds)	0.04
1/Repetition rate^ (seconds)	1
Duty Cycle	0.04
Source Factor	6.33957E+21

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	0.3	78.4	34,397.1	1.1	0.0

D2: ALTERNATIVE METHOD† (SINGLE PING/PULSE EQUIVALENT)

Source Level (Single Ping/Pulse SEL)	
Source Velocity (meters/second)	
1/Repetition rate^ (seconds)	
Source Factor	#DIV/0!

†Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet toc

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	-26.32	-2.94	-1.52	-18.36	-21.34

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY

(green)	**User Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	Innomar, SES-2000 Standard & Standard Plus

Please include any assumptions

PROJECT CONTACT	Tetra Tech Inc

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)[¥]	85	source-specific WFA

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directl
However, they must provide additional support and documentation supporting this modificatic

*** BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)**

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD‡ USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	234
Source Velocity (meters/second)	2.045
Pulse Duration (seconds)	0.06
1/Repetition rate^ (seconds)	0.66667
Duty Cycle	0.09
Source Factor	2.26069E+22

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	1.0	279.7	122,659.8	4.0	0.0

D2: ALTERNATIVE METHOD† (SINGLE PING/PULSE EQUIVALENT)

Source Level (Single Ping/Pulse SEL)	
Source Velocity (meters/second)	
1/Repetition rate^ (seconds)	
Source Factor	#DIV/0!

†Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet toc

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	-26.32	-2.94	-1.52	-18.36	-21.34

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY

(green)	**User Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	Innomar, SES-2000 Smart

Please include any assumptions

PROJECT CONTACT	Tetra Tech Inc

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)[¥]	90	source-specific WFA

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directl However, they must provide additional support and documentation supporting this modificatic

*** BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)**

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD‡ USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	229
Source Velocity (meters/second)	2.045
Pulse Duration (seconds)	0.04
1/Repetition rate^ (seconds)	2
Duty Cycle	0.02
Source Factor	1.58866E+21

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	0.1	18.0	8,114.5	0.2	0.0

D2: ALTERNATIVE METHOD† (SINGLE PING/PULSE EQUIVALENT)

Source Level (Single Ping/Pulse SEL)	
Source Velocity (meters/second)	
1/Repetition rate^ (seconds)	
Source Factor	#DIV/0!

†Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet toc

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	-27.27	-3.32	-1.78	-19.25	-22.26

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY

(green)	**User Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	Innomar, SES-2000 Medium-70

Please include any assumptions

PROJECT CONTACT	Tetra Tech Inc

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)¥	60	source-specific WFA

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directl
However, they must provide additional support and documentation supporting this modificatic

*** BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)**

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD‡ USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	240
Source Velocity (meters/second)	2.045
Pulse Duration (seconds)	0.04
1/Repetition rate^ (seconds)	0.2
Duty Cycle	0.20
Source Factor	2E+23

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	33.1	3,685.3	1,400,756.7	115.9	1.0

D2: ALTERNATIVE METHOD† (SINGLE PING/PULSE EQUIVALENT)

Source Level (Single Ping/Pulse SEL)	
Source Velocity (meters/second)	
1/Repetition rate^ (seconds)	
Source Factor	#DIV/0!

†Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet toc

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	-20.68	-1.21	-0.41	-13.23	-15.96

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a\,[1+(f/f_2)^2]^b}\right\}$$

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY

(green)	**User Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	Teledyne Benthos Chirp III - TTV 170

Please include any assumptions

PROJECT CONTACT	Tetra Tech Inc

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)[¥]	2	source-specific WFA

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directl
However, they must provide additional support and documentation supporting this modificatic

* BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD[‡] USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	219
Source Velocity (meters/second)	2.045
Pulse Duration (seconds)	0.06
1/Repetition rate^ (seconds)	0.06667
Duty Cycle	0.90
Source Factor	7.1486E+21

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**138.0**	**1.8**	**113.2**	**54.0**	**1.1**

D2: ALTERNATIVE METHOD[†] (SINGLE PING/PULSE EQUIVALENT)

Source Level (Single Ping/Pulse SEL)	
Source Velocity (meters/second)	
1/Repetition rate^ (seconds)	
Source Factor	#DIV/0!

†Methodology assumes propagation of 20 log R; Activity duration (time) independent
^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet toc

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	**-0.01**	**-19.74**	**-26.87**	**-2.08**	**-1.15**

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

WEIGHTING FACTOR ADJUSTMENTS (WFA] **VERSION 2.0, 2018**

Numerical criteria presented in the Technical Guidance consist of both an acoustic threshold and auditory weighting function associated with the SELcum metric. NMFS recognizes that the implementation of marine mammal weighting functions represents a new factor for consideration, which may extend beyond the capabilities of some action proponents. Thus, NMFS has developed simple weighting factor adjustments (WFA) for those who cannot fully apply auditory weighting functions associated with the SELcum metric.

WFAs consider marine mammal auditory weighting functions by focusing on a single frequency. This will typically result in similar, if not identical, predicted exposures for narrowband sounds or higher predicted exposures for broadband sounds, since only one frequency is being considered, compared to exposures associated with the ability to fully incorporate

WFAs have the advantage of allowing everyone to use the same acoustic thresholds and allows for adjustments to be made for each hearing group based on source-specific information.

<u>For Narrowband Sounds</u>: The selection of the appropriate frequency for consideration associated with WFAs is fairly straightforward. WFAs for a narrowband sound would take the weighting function amplitude, for each hearing group, associated with the particular frequency of interest and use it to make an adjustment to better reflect the hearing's group susceptibility to that narrowband sound.

<u>For Broadband Sounds</u>*: The selection of the appropriate frequency for consideration associated with WFAs is more complicated. The selection of WFAs associated with broadband sources is similar to the concept used for to determine the 90% total cumulative energy window (5 to 95%) for consideration of duration associated with the RMS metric and impulsive sounds (Madsen 2005) but considered in the frequency domain, rather than the time domain. This is typically referred to as the 95% frequency contour percentile (Upper frequency below which 95% of total cumulative energy is contained; Charif et al. 2010).

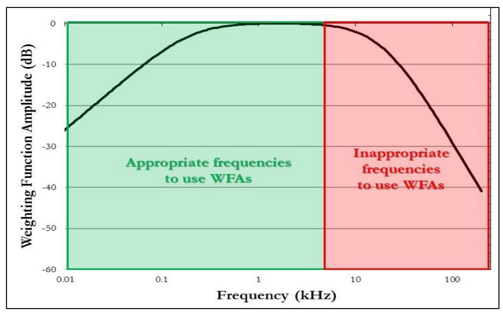
* <u>Special Considerations for Broadband Sounds</u>: Since the intent of WFAs is to broadly account for auditory weighting functions below the 95% frequency contour percentile, it is important that only frequencies on the “left side” of the weighting function be used to make adjustments (i.e., frequencies below those where the weighting function amplitude is zero or below where the function is essentially flat; resulting in every frequency below the WFA always having a more negative amplitude than the chosen WFA) (Figure below). It is inappropriate to use WFAs for frequencies on the “right side” of the weighting function (i.e., frequencies above those where the weighting function amplitude is zero). For a frequency on the “right side” of the weighting function (Table below), any adjustment is inappropriate and WFAs cannot be used (i.e., an action proponent would be advised to not use weighting functions and evaluate its source as essentially unweighted; see “Use” frequencies in Table below, which will result in a weighting function amplitude of 0 dB).

TABLE*

Hearing Group	Applicable Frequencies	Non-Applicable Frequencies*
Low-Frequency Cetaceans (LF)	4.8 kHz and lower	Above 4.8 kHz (Use: 1.7 kHz)
Mid-Frequency Cetaceans (MF)	43 kHz and lower	Above 43 kHz (Use: 28 kHz)
High-Frequency Cetaceans (HF)	59 kHz and lower	Above 59 kHz (Use: 42 kHz)
Phocid Pinnipeds (PW)	11 kHz and lower	Above 11 kHz (Use: 6.2 kHz)
Otariid Pinnipeds (OW)	8.5 kHz and lower	Above 8.5 kHz (Use: 4.9 kHz)

* With non-applicable frequencies, user should input the "use" frequency in the User Spreadsheet, which will result in a weighting function amplitude/adjustment of 0 dB (i.e., unweighted). NOTE: "use" frequency is only appropriate for that particular hearing group. Thus, if unweighted isopleths are required for more than one hearing group, users will need to provide multiple spreadsheets supporting isopleths (i.e., separate spreadsheets for each different WFA used) or override the Adjusment (dB) with 0.

FIGURE



Example weighting function illustrating where the use of weighting function adjustments are (Green: “left side”) and are not (Red: “right side”) appropriate for broadband sources.

E.1: IMPACT PILE DRIVING (STATIONARY SOURCE: Impulsive, Intermittent)

VERSION 2.2: 2020

KEY

(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	Goal Post Installation

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)¥	2	

¥ Broadband: 95% frequency contour percentile (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 73), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: METHOD E.1-1 is PREFERRED method when SEL-based source levels are available (because pulse duration is not required). Only use method E.1-2 if SEL-based

E.1-1: METHOD TO CALCULATE PK AND SEL_{cum} (SINGLE STRIKE EQUIVALENT) **PREFERRED METHOD (pulse duration not needed)**

Unweighted $SEL_{cum\ (at\ measured\ distance)}$ = SEL_{ss} + 10 Log (# strikes)	**210.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	174
Number of strikes per pile	2000
Number of piles per day	2
Transmission loss coefficient	15
Distance of single strike SEL_{ss} ($L_{E,p,\ single\ strike}$) measurement (meters)	10

PK

$L_{p,0\text{-}pk}$ specified at "x" meters (Cell G29)	200
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	215.0

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	**632.1**	**22.5**	**752.9**	**338.3**	**24.6**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**7.4**	**NA**	**NA**

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

E.1: IMPACT PILE DRIVING (STATIONARY SOURCE: Impulsive, Intermittent)

VERSION 2.2: 2020

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	Goal Post Installation

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)[¥]	2	

[¥] Broadband: 95% frequency contour percentile (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 73), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: METHOD E.1-1 is PREFERRED method when SEL-based source levels are available (because pulse duration is not required). Only use method E.1-2 if SEL-based

E.1-1: METHOD TO CALCULATE PK AND SEL_{cum} (SINGLE STRIKE EQUIVALENT) **PREFERRED METHOD (pulse duration not needed)**

Unweighted $SEL_{cum\ (at\ measured\ distance)}$ = SEL_{ss} + 10 Log (# strikes)	**204.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	168
Number of strikes per pile	2000
Number of piles per day	2
Transmission loss coefficient	15
Distance of single strike SEL_{ss} ($L_{E,p,\ single\ strike}$) measurement (meters)	10

PK

$L_{p,0\text{-}pk}$ specified at "x" meters (Cell G29)	194
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	209.0

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	**251.6**	**8.9**	**299.7**	**134.7**	**9.8**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**2.9**	**NA**	**NA**

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

E.1: IMPACT PILE DRIVING (STATIONARY SOURCE: Impulsive, Intermittent)

VERSION 2.2: 2020

KEY

(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Empire Wind
PROJECT/SOURCE INFORMATION	Goal Post Installation

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)¥	2	

¥ Broadband: 95% frequency contour percentile (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 73), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: METHOD E.1-1 is PREFERRED method when SEL-based source levels are available (because pulse duration is not required). Only use method E.1-2 if SEL-based

E.1-1: METHOD TO CALCULATE PK AND SEL_{cum} (SINGLE STRIKE EQUIVALENT) **PREFERRED METHOD (pulse duration not needed)**

Unweighted $SEL_{cum\ (at\ measured\ distance)}$ = SEL_{ss} + 10 Log (# strikes)	**200.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	164
Number of strikes per pile	2000
Number of piles per day	2
Transmission loss coefficient	15
Distance of single strike SEL_{ss} ($L_{E,p,\ single\ strike}$) measurement (meters)	10

PK

$L_{p,0\text{-}pk}$ specified at "x" meters (Cell G29)	190
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	205.0

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	**136.2**	**4.8**	**162.2**	**72.9**	**5.3**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.6**	**NA**	**NA**

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.