ATLANTIC SHORES
offshore wind

Atlantic Shores Offshore Wind Bight, LLC
1 Dock 72 Way, Floor 7
Brooklyn, NY 11205

April 20, 2023

Jolie Harrison, Division Chief
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, Maryland 20910

[submitted via email to: carter.esch@noaa.gov and kelsey.potluck@noaa.gov]

Subject: Incidental Harassment Authorization to Allow the Non-Lethal Take of Marine Mammals Incidental to Site Characterization Surveys of the Atlantic Shores Offshore Wind Bight Lease Area (OCS-A 0541) Revision 2 (Original submission date March 20, 2023)

Dear Ms. Harrison:

Atlantic Shores Offshore Wind Bight, LLC (Atlantic Shores) is requesting an incidental harassment authorization (IHA), pursuant to section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA) (16 U.S. Code § 1371(a)(5)(D)) and 50 Code of Federal Regulations (C.F.R.) § 216.107 (New IHA Request). This request would allow for the incidental Level B harassment of small numbers of marine mammals during site characterization surveys, including high-resolution geophysical (HRG) sources[1], off the coasts of New Jersey and New York, within and in proximity to the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS)-A 0541 (Lease Area) and export cable route (ECR) area. Atlantic Shores is currently conducting marine site characterization surveys under a National Marine Fisheries Service (NMFS)-issued IHA covering the period from August 10, 2022 through August 9, 2023.

Atlantic Shores requests an IHA to perform the same site characterization surveys within the same survey areas as previously authorized by NMFS. Per email correspondence and a virtual meeting with National Oceanic and Atmospheric Administration (NOAA) Fisheries Office of Protected Resources (OPR) staff (personal comm. with Kelsey Potlock and Carter Esch on February 3, 2023), this request initiates an abbreviated notice for a new IHA from your agency, instead of a renewal of the current IHA. A New IHA Request was determined to be appropriate due to the recent availability of updated marine mammal density estimates for the survey areas as published by Roberts et al. in June 2022. This data serves as the basis for revised calculations of potential takes by Level B harassment from the operation of certain HRG sound sources. In addition to the incorporation of new density data, the New IHA Request includes updated population estimates published in the *Draft U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2022* (Hayes et al. 2023).

All proposed activities under this request are identical to those presented in the application for the issued IHA (the Original Application; Attachment 1), which was originally filed April 2022 and updated May 2022. Table 1 provides a summary of activities and a demonstration of no changes between the Original Application and this New IHA Request, as well as references to relevant information from the Original Application.

[1] Geotechnical activities will take a similar approach to geophysical activities; however geotechnical activities will not result in the take of marine mammals.

Table 1. Summary of Changes in New Application and Pertinent Information from the Original Application

Original Application Section	Summary of Changes and Location of Pertinent Information from Original Application
1. Description of Specified Activity	There are no changes to Section 1.1. Additionally, no changes have been made to the types of equipment or HRG survey activities discussed in Section 1.2 of the Original Application. However, Table 1-2 of the Original Application has been re-organized based on feedback received on previous IHA Applications from NOAA Fisheries. The reorganization provides clearer justifications regarding the use of the SIG ELC 820 as a proxy for the Dura Spark and separates the Innomar equipment into its own equipment category. These changes can be found in Table 2 below.
2. Dates, Duration, and Specified Geographic Region	No change. Please note that Table 2-1 of the Original Application provides a summary of the number of days survey activities will take place within the Survey Areas (pg. 6)
3. Species and Numbers of Marine Mammals	Table 3-1 has been updated (see Table 3 of this New IHA Request) to reflect population estimates as reported in the 2022 Draft Stock Assessment Reports (Hayes et al. 2023).
4. Affected Species Status and Distribution	Updated population estimates are presented in Table 3 of this New IHA Request and to reflect the *Draft U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2022* (Hayes et al. 2023). Notable population estimates were updated for the following species: North Atlantic right whale *(Eubalaena glacialis)*.
5. Type of Incidental Take Authorization	No change.
6. Take Estimates for Marine Mammals	There are no changes to Section 6.1 and 6.2 of the Original Application. Section 6.3 of the Original Application has been updated to account for newly published Roberts et al. (2022) data. That information is provided in the following sections and in Table 4 of this New IHA Request. Note that Table 6-1 of the Original Application provides a summary of the maximum distances to Level B Thresholds for each equipment type (pg. 29) and Table 6-2 provides additional survey specifications and calculated ZOI (pg. 31). No changes have been made to Tables 6-1 or 6-2. Also, no changes have been made to Table 6-3 which reports the average group sizes used for adjusting take.
7. Anticipated Impact of the Activity	No change.
8. Anticipated Impacts on Subsistence Uses	No change.
9. Anticipated Impacts on Habitat	No change.
10. Anticipated Effects of Habitat Impacts on Marine Mammals	No change.
11. Mitigation Measures to Protect Marine Mammals and Their Habitat	No change. Atlantic Shores will follow the same mitigation measures provided in Sections 11-13, which includes applicable measures from NOAA Fisheries Greater Atlantic Regional Office's (GARFO) programmatic consultation.
12. Mitigation Measures to Protect Subsistence Uses – Arctic Plan of Cooperation	No change. Atlantic Shores will follow the same mitigation measures provided in Sections 11-13, which includes applicable measures from NOAA Fisheries Greater Atlantic Regional Office's (GARFO) programmatic consultation.
13. Monitoring and Reporting	No change. Atlantic Shores will follow the same mitigation measures provided in Sections 11-13, which includes applicable measures from

Original Application Section	Summary of Changes and Location of Pertinent Information from Original Application
	NOAA Fisheries Greater Atlantic Regional Office's (GARFO) programmatic consultation.
14. Suggested Means of Coordination	No change.
15. List of Preparers	No change.
16. References	Two citations have been added, one to account for the Draft U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2022 (Hayes et al. 2023) and the other for the updated marine mammal density models (Roberts et al., 2022). These have been added to this New IHA Request.
Appendix A. Manufacturer Specifications	No change.
Appendix B. Distances to Acoustic Thresholds Corresponding to Level B Harassment for High Resolution Geophysical Sources	No change.
Appendix C. Marine Mammal Seasonal Densities	The density values from the Original Application have been updated to account for updates to the Roberts et al. (2022) marine mammal density model updates. Table 6 of this New IHA Request provides the updated density tables.

Updates to Section 1 – Description of Specified Activities

Information provided in the Original Application regarding equipment, survey area (total of 1,375,710 acres), and activities (e.g., types of surveys, vessel operation frequency[2], number of survey days[2]) will remain the same. The information provided in Table 2 is consistent with the information provided in Table 1-2 of the Original Application; however, Table 2 presents a re-organization of the information related to the Dura Spark and Innomar equipment based on feedback received on previous IHA applications from NOAA Fisheries. Table 2 of this New IHA Request supersedes Table 1-2 of the Original Application.

Table 2. Representative Equipment Specifications with Operating Frequencies Below 180 kHz

HRG Survey Equipment (Sub-Bottom Profiler)	Representative Equipment Type	Operating Frequencies Ranges (kHz)	Operational Source Level Ranges (dB_{RMS})	Beamwidth Ranges (degree)	Typical Pulse Durations RMS_{90} (millisec)	Pulse Repetition Rate (Hz)
Sparker	Applied Acoustics Dura-Spark 240	0.01 to 1.9[a]	203[a]	180	3.4[a]	2
	Geo Marine Geo-Source	0.2 to 5[b]	195[b]	180	7.2[b]	0.41
CHIRP	Edgetech 2000-DSS	2 to 16[b]	195[c]	24[d]	6.3	10
	Edgetech 216	2 to 16	179[e]	17, 20, or 24	10	10
	Edgetech 424	4 to 24[f]	180[f]	71[f]	4	2
	Edgetech 512i	0.7 to 12[f]	179[f]	80[f]	9	8
	Pangeosubsea Sub-Bottom ImagerTM	4 to 12.5[d]	190[d,g]	120[d]	4.5	44

[2] As stated in the Original Application, at any one time, up to three vessels could be operating within the survey areas. Each vessel operating would count as a single survey day. For example, if two vessels are operating concurrently, that would be considered two survey days.

HRG Survey Equipment (Sub-Bottom Profiler)	Representative Equipment Type	Operating Frequencies Ranges (kHz)	Operational Source Level Ranges (dB_{RMS})	Beamwidth Ranges (degree)	Typical Pulse Durations RMS_{90} (millisec)	Pulse Repetition Rate (Hz)
INNOMAR	INNOMAR SES-2000 Medium-100 Parametric [h]	85 to 115[d]	241[i]	2[d]	2	40
	INNOMAR deep - 36 Parametric [h]	30 to 42	245	1.5	0.15 to 5	40

Notes:
[a] The operational source level for the Dura-Spark 240 is assigned based on the value closest to the field operational history of the Dura Spark 240 [operating between 500 – 600 J] found in Table 10 in Crocker and Fratantonio (2016), which reports a 203 dBRMS for 500 J source setting and 400 tips. Because Crocker and Fratantonio (2016) did not provide other source levels for the Dura-Spark 240 near the known operational range, the SIG ELC 820 @750 J at 5m depth assuming an omnidirectional beam width was considered as a proxy or comparison to the Dura Spark 240. The corresponding 203 dBRMS level is considered a realistic and conservative value that aligns with the history of operations of the Dura-Spark 240 over three years of survey by Atlantic Shores.
[b] Operational information provided by Atlantic Shores. Geo Marine Survey System operating at 400J.
[c] Gene Andella (Edgetech), personal conversation with JASCO Applied Sciences, 2019-07-29.
[d] Manufacturer specifications and/or correspondence with manufacturer.
[e] Considered EdgeTech Chirp as a proxy source for levels as the Chirp512i has similar operation settings as the Chirp 2000-DSS tow vehicle. See Table 18 in Crocker and Fratantonio (2016) for source levels for 100% power and 2-12 kHz.
[f] Values from Crocker and Fratantonio (2016) for 100% power and comparable bandwidth.
[g] For frequency of 4 kHz.
[h] Based on personal communication with Benjamin Laws, NOAA Fisheries (2022b), NOAA Fisheries does not expect take from these parametric sub-bottom profilers due to their lower frequencies and extremely narrow beamwidth. Therefore, these sources were not considered in calculating the maximum r value for the ZOI calculation.
[i] The specification sheet indicates a peak source level of 247 dB re 1 µPa m (Jens Wunderlich, Innomar, personal communication, 7-18-2019). The average difference between the peak SPL source levels for sub-bottom profilers measured by Crocker and Fratantonio (2016) was 6 dB. Therefore, the estimated SPL source level is 241 dB re 1 µPa m.

Updates to Section 3 - Species and Numbers of Marine Mammals

Table 3 provides updated population estimates that are presented in Table 3-1 of the Original Application and supersedes Table 3-1 of the Original Application. These values have been updated to reflect populations estimates reported in the *Draft U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2022* (Hayes et al. 2023). Population estimates were only updated for the North Atlantic right whale *(Eubalaena glacialis)*.

Table 3. Marine Mammals Known to Occur in the Mid-Atlantic

Common Name	Scientific Name	ESA and MMPA Status	Relative Occurrence in the Region	Estimated Population	Stock	Hearing Range
Toothed Whales (Odontoceti)						
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	N/A	Uncommon	93,233	W. North Atlantic	Mid
Atlantic spotted dolphin	*Stenella frontalis*	N/A	Uncommon	39,921	W. North Atlantic	Mid
Bottlenose dolphin	*Tursiops truncatus*	N/A	Uncommon	62,851	W. North Atlantic, Offshore	Mid

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Table 3. Marine Mammals Known to Occur in the Mid-Atlantic

Common Name	Scientific Name	ESA and MMPA Status	Relative Occurrence in the Region	Estimated Population	Stock	Hearing Range
		Strategic [a]	Common	6,639	W. North Atlantic, Northern Migratory Coastal	Mid
Pan-tropical spotted dolphin	*Stenella attenuata*	N/A	Rare	6,593	W. North Atlantic	Mid
Risso's dolphin	*Grampus griseus*	N/A	Common	35,215	W. North Atlantic	Mid
Short beaked common dolphin	*Delphinus delphis*	N/A	Common	172,974	W. North Atlantic	Mid
Striped dolphin	*Stenella coeruleoalba*	N/A	Rare[b]	67,036	W. North Atlantic	Mid
White-beaked dolphin	*Lagenorhynchus albirostris*	N/A	Rare	536,016	W. North Atlantic	Mid
Harbor porpoise	*Phocoena phocoena*	N/A	Uncommon	95,543	Gulf of Maine/Bay of Fundy	High
Killer whale	*Orcinus orca*	N/A	Rare	Unknown	W. North Atlantic	Mid
False killer whale	*Pseudorca crassidens*	N/A	Rare	1,791	W. North Atlantic	Mid
Long-finned pilot whale	*Globicephala melas*	N/A	Common	39,215	W. North Atlantic	Mid
Short-finned pilot whale	*Globicephala macrorhynchus*	N/A	Rare[c]	28,924	W. North Atlantic	Mid
Sperm whale	*Physeter macrocephalus*	Endangered	Uncommon[d]	4,349	North Atlantic	Mid
Pygmy sperm whale	*Kogia breviceps*	N/A	Rare[b]	7,750 [e]	W. North Atlantic	High
Dwarf sperm whale	*Kogia sima*	N/A	Rare	7,750 [e]	W. North Atlantic	High
Cuvier's beaked whale	*Ziphius cavirostris*	N/A	Rare	5,744	W. North Atlantic	Mid
Blainville's beaked whale	*Mesoplodon densirostris*	N/A	Rare	10,107 [f]	W. North Atlantic	Mid
Gervais' beaked whale	*Mesoplodon europaeus*	N/A	Rare	10,107 [f]	W. North Atlantic	Mid
True's beaked whale	*Mesoplodon mirus*	N/A	Rare	10,107 [f]	W. North Atlantic	Mid
Sowerby's beaked whale	*Mesoplodon bidens*	N/A	Rare	10,107 [f]	W. North Atlantic	Mid

Table 3. Marine Mammals Known to Occur in the Mid-Atlantic

Common Name	Scientific Name	ESA and MMPA Status	Relative Occurrence in the Region	Estimated Population	Stock	Hearing Range
Baleen Whales (Mysticeti)						
Minke whale	*Balaenoptera acutorostrata*	N/A	Regular	21,968	Canadian East Coast	Low
Blue whale[d]	*Balaenoptera musculus*	Endangered	Uncommon	Unknown	W. North Atlantic	Low
Fin whale	*Balaenoptera physalus*	Endangered	Regular	6,802	W. North Atlantic	Low
Humpback whale	*Megaptera novaeangliae*	N/A	Common	1,396	Gulf of Maine	Low
North Atlantic right whale	*Eubalaena glacialis*	Endangered	Regular	338	W. North Atlantic	Low
Sei whale	*Balaenoptera borealis*	Endangered	Uncommon[d]	6,292	Nova Scotia	Low
Earless Seals (Phocidae)						
Gray seals	*Halichoerus grypus*	N/A	Regular	27,300	W. North Atlantic	-
Harbor seals	*Phoca vitulina*	N/A	Regular	61,336	W. North Atlantic	-
Hooded seals	*Cystophora cristata*	N/A	Rare	Unknown	W. North Atlantic	-
Harp seal	*Phoca groenlandica*	N/A	Rare	7.6 million	W. North Atlantic	-

Notes:

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) which is declining and likely to be listed as threatened under the ESA; or 3) which is listed as threatened or endangered under the ESA or as depleted under the MMPA (http://www.ncseonline.org/nle/crsreports/biodiversity/biodv-11.cfm).

b. The 2016 Revised Environmental Assessment for *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York,* describes striped dolphin and pygmy sperm whale as common and uncommon, respectively, in the NY Bight. However, based on more recent marine mammal density modeling published by Roberts et.al (2020), these species are not expected to occur in the Survey Area.

c. Short-finned pilot whale was identified as occurring year-round on the shelf break according to the *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York*. Given that the Survey Area is not located on the shelf break, their occurrence in the area of the Survey Area is expected to be rare.

d. Based on the *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York Revised Environmental Assessment*, sperm and sei whales presence was identified as rare off the coast of New York. However, based on density modeling published by Roberts et al. (2020), their presence is possible.

e. This estimate may include both the dwarf and pygmy sperm whales.

f. This estimate includes Gervais' and Blainville's beaked whales and undifferentiated *Mesoplodon* spp. beaked whales. Sources: Hayes et al. 2023 (draft); Hayes et al. 2021; Hayes et al. 2018a, 2018b; Hayes et al. 2017; Waring et al. 2010, 2011, 2013, 2015; RI Ocean SAMP 2011; Kenney and Vigness-Raposa 2009; NOAA Fisheries 2016, 2018; Pace 2021; BOEM 2016, Roberts et.al 2020.

Updates to Section 6 – Take Estimates for Marine Mammals

Take calculations have been updated to account for new marine mammal density models published by Roberts et al. (2022) in June 2022. The survey areas, number of survey days, and equipment have not changed from the information presented in the Original Application. The list of species for which Atlantic Shores is requesting take has also not changed. Therefore, changes in take numbers of marine mammals reflected in Table 4 are a result of updated density modeling published by Roberts et al. (2022) and the updates to the North Atlantic right whale *(Eubalaena galicialis)* stock in the *Draft U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2022* (Hayes et al. 2023). Table 4 of this New IHA Request supersedes Table 6-4 of the Original Application. The strategy for calculating take and adjusting take based on group sizes, habitat requirements, and Protected Species Observer (PSO) reports remains as discussed in Section 6.3 of the Original Application.

Table 4. Total Estimated Level B Harassment Take Numbers

Species	Lease Area		ECR Survey Area		Total Estimated Takes	
	Maximum Seasonal Density[a] (No./100km^2)	Calculated Take (No.)	Maximum seasonal Density[a] (No./100km^2)	Calculated Take (No.)	Adjusted Take Authorization	Percent of Population (%)
North Atlantic Right Whale	0.09	3	0.07	2	5	1.30
Humpback Whale	0.14	4	0.11	4	16[d]	1.0
Fin Whale	0.18	5	0.14	4	9	0.13
Sei Whale	0.06	2	0.06	2	4	0.05
Minke Whale	0.80	23	0.80	23	46	0.21
Sperm Whale	0.02	0.7[e]	0.02	0.4[e]	2	0.05
Long-finned Pilot Whale[b]	0.15	5	0.08	3	20[f]	0.05
Bottlenose dolphin (Offshore stock)	3.09	87	3.28	92	179	0.28
Short-beaked Common Dolphin	12.7	357	8.24	231	588	0.34
Atlantic white-sided Dolphin	1.21	34	1.00	29	63	0.07
Atlantic Spotted Dolphin	1.07	30	0.41	12	100[f]	0.25
Risso's Dolphin	0.13	4	0.10	3	30[f]	0.09
Harbor Porpoise	5.0	141	4.97	140	281	0.29
Harbor Seal[c]	6.09	171	7.22	203	374	0.61
Gray Seal[c]	6.09	171	7.22	203	374	1.37

[a] Cetacean density values from Duke University (Roberts et al. 2022).

[b] Pilot whale density models from Duke University (Roberts et al. 2022) represent pilot whales as a 'guild' rather than by species. However, since the Survey Area is only expected to contain long-finned pilot whales, it is assumed that pilot whale densities modeled by Roberts et al. (2016a, 2016b, 2017) in the Survey Area only reflect the presence of long-finned pilot whales. Therefore, densities for long-finned pilot whales were not apportioned based on population size.

[c] Pinniped density models from Duke University (Roberts et al. 2022) represent 'seals' as a guild rather than by species. In order to calculate density and take of gray and harbor seals, density of each species was calculated based on a 50/50 split between the two pinniped species.

[d] Per NOAA Fisheries recommendation according to recent findings that humpback whales were the most commonly sighted species in the New York Bight, the number of modeled exposures (4) is multiplied by an average whale size of 2 for a total of 8 estimated takes. (https://www.tandfonline.com/doi/full/10.1080/17451000.2021.1967993)

[e] Where calculated takes for a species in a given survey area were less than 1 individual (i.e., sei and sperm whales), the number was rounded up to 1 take in each survey area to yield conservative take estimates.

[f] The number of authorized takes (Level B harassment only) for these species has been increased from the calculated take to consider mean group size. Source for long-finned pilot whale estimate is NOAA's Species Directory (NOAA 2022a). Source for Atlantic spotted dolphin group size estimate is Jefferson et al. (2008). A previously issued IHA for Atlantic Shores for a survey area adjacent to the proposed Survey Area increased the number of takes to 100 Atlantic spotted dolphins. Therefore, Atlantic Shores will increase the take of Atlantic spotted dolphin to 100. Source for Risso's dolphin group size estimate is NOAA Species Directory (NOAA 2022a).

Table 5. Comparison in Takes Between Original Application and New IHA Request

Species	Issued Take (August 10, 2022 – August 9, 2023) Using Previous Iterations of Roberts et al. Data	Take to Date from August 10th 2022 to February 28th 2023	Revised Take Estimates for New IHA Request Based on Roberts et al. (2022) Data
North Atlantic Right Whale	24	0	5
Humpback Whale	8[d]	0	16[d]
Fin Whale	16	0	9
Sei Whale	2	0	4
Minke Whale	8	0	46
Sperm Whale	3	0	2
Long-finned Pilot Whale[b]	20[f]	0	20[f]
Bottlenose dolphin (Offshore stock)	232	3	179
Short-beaked Common Dolphin	911	232	588
Atlantic white-sided Dolphin	108	0	63
Atlantic Spotted Dolphin	100[f]	0	100[f]
Risso's Dolphin	30[f]	0	30[f]
Harbor Porpoise	357	0	281
Harbor Seal[c]	182	0	374
Gray Seal[c]	82	0	374

Updated Section 16 – References

The following references have been added to those presented in Section 16.

Hayes S.A., E. Josephson, K. Maze-Foley, P.E. Rosel, and J. Wallace (eds.). 2023. Draft U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2021. Available at: https://repository.library.noaa.gov/view/noaa/45014.

Roberts J.J., T.M. Yack, PN Halpin. 2022. Density Model for the U.S. East Coast, Version 9, 2022-06-20. Prepared for Naval Facilities Engineering Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, NC

Updated Appendix C – Marine Mammal Seasonal Densities

Table 6 supersedes the marine mammal seasonal densities presented in Appendix C of the Original Application (Tables C-1 and C-2). Table 6 includes updated marine mammal density modeling data published by Roberts et al. (2022) in June of 2022.

Table 6. Marine Mammal Seasonal Densities (No./100 km^2)[a]

Species	Lease Area				ECR Survey Area			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
North Atlantic Right Whale	**0.0887**	0.0768	0.0036	0.0095	**0.0686**	0.0600	0.0029	0.0071
Humpback Whale	0.0638	**0.1401**	0.0854	0.0764	0.0780	**0.1132**	0.0722	0.0699
Fin Whale	0.1654	**0.1819**	0.1674	0.0553	**0.1409**	0.1304	0.1149	0.0398
Sei Whale	0.0164	**0.0584**	0.0059	0.0147	0.0220	**0.0593**	0.0050	0.0168
Minke Whale	0.0508	**0.8003**	0.3408	0.0893	0.0510	**0.8075**	0.2874	0.0647
Sperm Whale	0.0102	0.0043	**0.0249**	0.0060	0.0058	0.0040	**0.0151**	0.0031
Long-finned Pilot Whale	**0.1520**				**0.0836**			
Bottlenose dolphin (Offshore)	1.5303	1.2819	**3.0985**	2.8902	1.4614	1.2373	**3.2788**	2.9396
Short-beaked Common Dolphin	**12.7158**	6.9340	7.3662	6.5769	**8.2423**	4.2605	3.7811	5.0525
Atlantic white-sided Dolphin	0.9259	**1.2136**	0.6941	0.7416	0.7240	**1.0075**	0.5009	0.6672
Atlantic Spotted Dolphin	0.0254	0.0784	0.5866	**1.0707**	0.0113	0.0241	0.1645	**0.4122**
Risso's Dolphin	**0.1294**	0.0914	0.0455	0.0672	**0.1027**	0.0528	0.0218	0.0458
Harbor Porpoise	**5.0248**	4.9811	0.2031	0.1338	4.5724	**4.9744**	0.2400	0.1333
Gray Seal	**6.0877**	4.7560	0.0528	0.4062	7.0568	**7.2233**	0.1908	0.7574
Harbor Seal	**6.0877**	4.7560	0.0528	0.4062	7.0568	**7.2233**	0.1908	0.7574

[a] Bold density values represent highest seasonal density. Those values were used when calculating marine mammal take.

Respectfully submitted,

DocuSigned by:
Jennifer Daniels
E091265696FE4DB...

Jennifer Daniels

Development Director

Atlantic Shores Offshore Wind

cc: Kelsey Potluck, NOAA

ATLANTIC SHORES offshore wind

Atlantic Shores Bight LLC

Request for an Incidental Harassment Authorization to Allow the Non-Lethal Take of Marine Mammals Incidental to Site Characterization Surveys of the Atlantic Shores Lease Area (OCS-A 0541)

Submitted to NOAA National Marine Fisheries Service
April 2022

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Acronyms and Abbreviations

Atlantic Shores	Atlantic Shores Bight, LLC
BOEM	Bureau of Ocean Energy Management
CeTAP	Cetacean and Turtles Assessment Program
C.F.R.	Code of Federal Regulations
CPT	cone penetration test
dB	decibel
DMA	Dynamic Management Area
ECR	Export Cable Route
ESA	Endangered Species Act
ft	feet/foot
HFC	high-frequency cetaceans
HRG	high-resolution geophysical
Hz	hertz
IHA	Incidental Harassment Authorization
km	kilometer
km^2	square kilometer
km/h	kilometer per hour
kHz	kilohertz
knot	nautical mile per hour
LFC	low-frequency cetaceans
m	meter
MFC	mid-frequency cetaceans
mi	mile
μPa	microPascal
MMPA	Marine Mammal Protection Act
nm	nautical mile
NARW	North Atlantic Right Whale
NOAA (Fisheries)	National Oceanic and Atmospheric Administration, (National Marine Fisheries Service)
OCS	Outer Continental Shelf
OPW	Otariid pinnipeds in water
PPW	Phocid pinnipeds in water
Project	Atlantic Shores Offshore Wind Project
PSO	Protected Species Observer
PTS	permanent threshold shift
r	maximum radial distance
RMS	root mean square
SEL	sound exposure level
SEL_{cum}	cumulative SEL
SL	sound level
SMA	Seasonal Management Area
ZOI	zone of influence

1. Description of Specified Activity

Atlantic Shores Bight, LLC (Atlantic Shores), a 50/50 joint venture between EDF-RE Offshore Development, LLC and Shell New Energies US LLC, is seeking an Incidental Harassment Authorization (IHA) for a future offshore wind development project (Project) pursuant to section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA) (16 U.S. Code § 1371(a)(5)(D)) and 50 Code of Federal Regulations (C.F.R.) § 216.107. The IHA requests the incidental take of marine mammals by Level B harassment resulting from site characterization surveys, including high-resolution geophysical (HRG) sources operating at frequencies less than 180 kilohertz (kHz), off the coasts of New Jersey and New York and in the area of the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS)-A 0541 (Lease Area). Site characterization surveys will take place in two areas including the Lease Area (also referred to as the Lease Survey Area for the purposes of this application) and an Export Cable Route (ECR) Survey Area, collectively referred to as the Survey Area and depicted on Figures 1-1 and 4-1[1]. Atlantic Shores intends to conduct HRG and geotechnical survey campaigns within each of the identified survey areas over a period of up to 12 months. Survey activities are proposed to initiate no earlier than August 2022.

The regulations set forth in Section 101(a)(5) of the MMPA and 50 C.F.R. § 216 Subpart I allow for the incidental taking of marine mammals by a specific activity if the take by such activity is found to have a negligible impact on the species or stock(s) of marine mammals and will not result in an unmitigable adverse impact on the availability of the marine mammal species or stock(s) for certain subsistence uses. In order for the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (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), or to make a finding that incidental take is unlikely to occur, a written request must be submitted to NOAA Fisheries' Office of Protected Resources. Such a request is detailed in the following sections.

Atlantic Shores proposes to conduct HRG and geotechnical surveys within the approximately 1,375,710-acre Survey Area. The Survey Area is located approximately 11 nautical miles (nm; 12 miles [mi]; 20 kilometers [km]) off the coast of New Jersey and New York and extends out to a maximum distance of approximately 40 nm (46 mi); 74 km)[2]. As depicted in Figure 1-1, the Survey Area generally spans from Sandy Hook Bay to Ocean City, New Jersey.

[1] No nearshore surveys are proposed as part of this application. Any potential nearshore activities were authorized under a separate IHA application issued in April 2022 for Atlantic Shores Offshore Wind.
[2] 1 nautical mile = 1.1508 miles; 1 mile = 1.609 kilometers

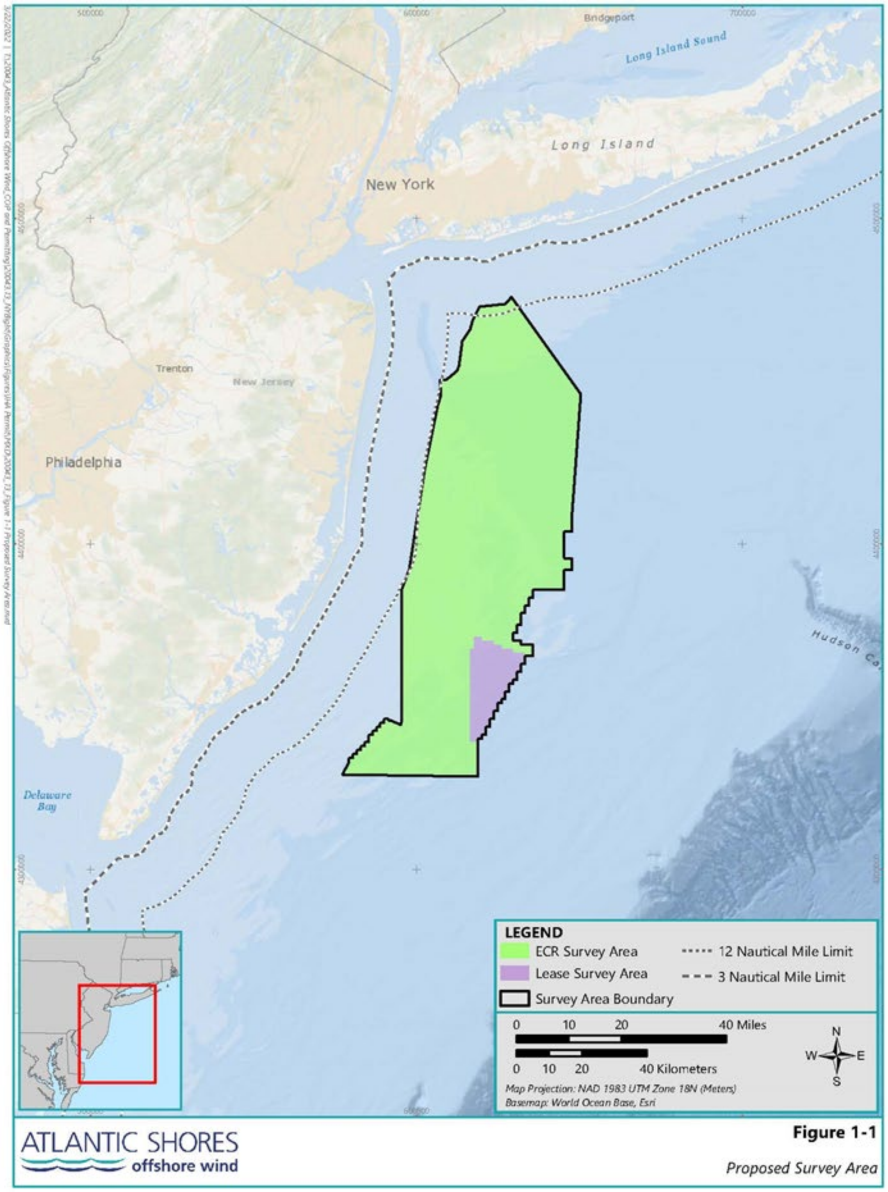

Figure 1-1 Proposed Survey Areas for Future Offshore Wind Development of Lease OCS-A-0541

The purpose of the HRG and geotechnical surveys is to:

- Support the site characterization, siting, and engineering design of offshore Project facilities including wind turbine generators, offshore substation(s), and submarine cables within the Lease Survey Area and ECR Survey Area; and
- Collect the data necessary to support Project review requirements associated with 30 C.F.R. § 585 and the National Environmental Policy Act.

NOAA Fisheries has indicated, through past IHA decisions, that geotechnical surveys do not result in acoustic impacts to marine mammals. Based on these decisions, it is unlikely that the geotechnical surveys to be conducted by Atlantic Shores (e.g., sample boreholes, deep cone penetration tests (CPTs), and shallow CPTs) will result in Level A or B harassment. Therefore, geotechnical survey activities are not discussed in further detail in this application request.

1.1 Acoustic Thresholds and Regulatory Criteria

NOAA Fisheries has advised that sound-producing survey equipment operating below 180 kHz has the potential to cause both Level A and/or Level B acoustic harassment to marine mammals (pers comm. Benjamin Laws, NOAA Fisheries 2021). Under the MMPA, Level A Harassment is statutorily defined as any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild. Level B harassment is defined as 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. The actionable sound pressure levels are not identified in the statute.

Under recent NOAA Fisheries (2018a) guidance, Level A harassment is said to occur as a result of exposure to high noise levels and the onset of permanent hearing sensitivity loss, known as a permanent threshold shift (PTS). NOAA Fisheries has defined PTS for five distinct marine mammal hearing groups: Low-frequency cetaceans (LFC) (i.e., baleen whales), Mid-frequency cetaceans (MFC) (i.e., dolphins, toothed whales, beaked whales, bottlenose whales), High-frequency cetaceans (HFC) (i.e., true porpoises, Kogia spp., river dolphins, *cephalorhynchid*, *Lagenorhynchus cruciger* and *L. australis*), Phocid pinnipeds in water (PPW) (i.e., true seals), and Otariid pinnipeds in water (OPW) (i.e., sea lions and fur seals). PTS levels for each of these hearing groups for both impulsive and non-impulsive noise are defined in Table 1-1.

Table 1-1 M-Weighted PTS Criteria and Functional Hearing Range for Maine Mammals (NOAA Fisheries 2016, 2018)

Functional Hearing Group	PTS Onset Impulsive	PTS Onset Non Impulsive	Functional Hearing Range
LFC	219 dB_{peak} and 183 dB SEL_{cum}	199 dB SEL_{cum}	7 Hz to 35 kHz
MFC	230 dB_{peak} and 185 dB SEL_{cum}	198 dB SEL_{cum}	150 Hz to 160 kHz
HFC	202 dB_{peak} and 155 dB SEL_{cum}	173 dB SEL_{cum}	275 Hz to 160 kHz
PPW	218 dB_{peak} and 185 dB SEL_{cum}	201 dB SEL_{cum}	50 Hz to 86 kHz
OPW	232 dB_{peak} and 203 dB SEL_{cum}	219 dB SEL_{cum}	60 Hz to 39 kHz

Notes:
dB – decibel
dB_{peak} – peak decibel
Hz – hertz
kHz – kilohertz
SEL – sound exposure level
SEL_{cum} – cumulative SEL

NOAA Fisheries has defined the threshold level for Level B harassment at 120 dB_{RMS} re 1 microPascal (μPa) for continuous noise and 160 dB_{RMS} re 1 μPa for impulsive and intermittent noise.

The following section provides specific information regarding the HRG survey activities proposed by Atlantic Shores and includes information on the types of activities and associated equipment to be deployed, how the equipment will interact with the surrounding physical and biological environment, and which activity may result in the potential taking of marine mammals per NOAA Fisheries' established thresholds for Level A and B harassment.

1.2 HRG Survey Activities

The HRG survey activities that have been proposed in each of the identified Survey Area will include the following:

- Depth sounding (multibeam depth sounder and single beam echosounder) to determine water depths and general bottom topography (currently estimated to range from approximately 16 feet (ft) (5 meters [m] to 131 ft [40 m] in depth);
- Magnetic intensity measurements (gradiometer) for detecting local variations in regional magnetic field from geological strata and potential ferrous objects on and below the bottom;
- Seafloor imaging (side scan sonar survey) for seabed sediment classification purposes, to identify natural and man-made acoustic targets resting on the bottom as well as any anomalous features;
- Shallow penetration sub-bottom profiler (pinger/chirp) to map the near surface stratigraphy (top 0 ft to 16 ft [0 m to 5 m] soils below seabed); and,
- Medium penetration sub-bottom profiler (chirps/parametric profilers/sparkers) to map deeper subsurface stratigraphy as needed (soils down to 246 ft [75 m] to 328 ft [100 m] below seabed). Based upon three years of previous survey experience (i.e., 2019 – 2021 surveys), Atlantic Shores anticipates that it will operate the Applied Acoustics Dura-Spark and/or the GeoMarine Geo-Source to map deeper stratigraphy in the survey areas.
- Grab sampling to validate seabed classification using typical sample sizes between 0.1 m^2 and 0.2 m^2.

The HRG survey equipment to be used in the identified Survey Area will be similar to the HRG survey equipment used to support previous Atlantic Shores surveys and other offshore wind development projects along the Atlantic Coast that have been previously approved by both NOAA Fisheries and BOEM. HRG survey activities such as grab sampling may result in bottom disturbance from activities; however, impacts would be temporary and localized and considered negligible given the scale of the activity. These negligible impacts are unlikely to affect marine mammal species, their habitat, or prey (see Sections 9 and 10).

The HRG survey activities will be supported by vessels of sufficient size to accomplish the survey goals in the Survey Area. Survey equipment will be deployed from multiple vessels during site characterization surveys. Up to three geophysical vessels could be operating at any one time across the Survey Area.

Atlantic Shores has evaluated a range of possible HRG survey equipment that would be necessary to support seabed assessments across the Survey Area during the specified timeframe associated with the proposed activities. This evaluation has been based on both the technical and regulatory requirements for project development as well as the type of survey equipment that has been recently deployed in support of offshore wind projects along the Atlantic Coast. The categories of representative HRG survey equipment with operating frequencies <180 kHz that are anticipated for use are presented in Table 1-2. This equipment will either be mounted to or towed behind the survey vessel at a typical survey speed of approximately 3.5 knots (6.5 km) per hour.

Operational parameters presented in Table 1-2 were obtained from the following sources: Crocker and Fratantonio (2016); manufacturer specifications; personal communication with manufacturers; agency correspondence; and Atlantic Shores. The operational source level, frequency, and beamwidth were used in the NOAA Fisheries Level B spreadsheet tool for calculating the distance to the Level B threshold (see Section 6.0, Table 6-1). Manufacturer specifications are included in Appendix A.

Table 1-2 Representative Equipment Specifications with Operating Frequencies Below 180 kHz

HRG Survey Equipment (Sub Bottom Profiler)	Representative Equipment Type	Operating Frequencies Ranges (kHz)	Operational Source Level (dB_{RMS})	Beamwidth Ranges (degree)	Typical Pulse Durations RMS_{90} (millisec)	Pulse Repetition Rate (Hz)
Sparker	Applied Acoustics Dura-Spark 240	0.01 to 1.9[a]	203[a]	180	3.4[a]	2
	Geo Marine Geo-Source	0.2 to 5[b]	195[b]	180	7.2[b]	0.41
CHIRP	Edgetech 2000-DSS	2 to 16[b]	195[c]	24[d]	6.3	10
	Edgetech 216	2 to 16	179[e]	17, 20, or 24	10	10
	Edgetech 424	4 to 24[f]	180[f]	71[f]	4	2
	Edgetech 512i	0.7 to 12[f]	179[f]	80[f]	9	8
	Pangeosubsea Sub-Bottom Imager™	4 to 12.5[d]	190[d,g]	120[d]	4.5	44
	INNOMAR SES-2000 Medium-100 Parametric [h]	85 to 115[d]	241[i]	2[d]	2	40
	INNOMAR deep -36 Parametric [h]	30 to 42	245	1.5	0.15 to 5	40

Notes:

[a] The operational source level for the Dura-Spark 240 is assigned based on the value closest to the field operational history of the Dura-Spark 240 [operating between 500 – 600 J] found in Table 10 in Crocker and Fratantonio (2016), which reports a 203 dB_{RMS} for 500 J source setting and 400 tips. Because Crocker and Fratantonio (2016) did not provide other source levels for the Dura-Spark 240 near the known operational range, the SIG ELC 820 @750 J at 5m depth assuming an omnidirectional beam width was considered as a proxy or comparison to the Dura-Spark 240. The corresponding 203 dB_{RMS} level is considered a realistic and conservative value that aligns with the history of operations of the Dura-Spark 240 over three years of survey by Atlantic Shores.

[b] Operational information provided by Atlantic Shores. Geo Marine Survey System operating at 400J.

[c] Gene Andella (Edgetech), personal conversation with JASCO Applied Sciences, 2019-07-29.

[d] Manufacturer specifications and/or correspondence with manufacturer.

[e] Considered EdgeTech Chirp as a proxy source for levels as the Chirp512i has similar operation settings as the Chirp 2000-DSS tow vehicle. See Table 18 in Crocker and Fratantonio (2016) for source levels for 100% power and 2-12 kHz.

[f] Values from Crocker and Fratantonio (2016) for 100% power and comparable bandwidth.

[g] For frequency of 4 kHz

[h] Based on personal communication with Benjamin Laws, NOAA GARFO (2021), NOAA Fisheries does not expect take from these parametric sub-bottom profilers due to their lower frequencies and extremely narrow beamwidth. Therefore, these sources were not considered in calculating the maximum r value for the ZOI calculation.

[i] The specification sheet indicates a peak source level of 247 dB re 1 μPa m (Jens Wunderlich, Innomar, personal communication, 7-18-2019). The average difference between the peak SPL source levels for sub-bottom profilers measured by Crocker and Fratantonio (2016) was 6 dB. We therefore estimate the SPL source level is 241 dB re 1 μPa m.

Previous Atlantic Shores survey experience with the Applied Acoustics Dura-Spark indicates that the necessary electrical input of this sparker is approximately 500 - 600 J. Only in seafloor areas where very dense substrates are encountered would a higher level of electrical input be used, which has not been the case thus far. For the purposes of estimating Level B Harassment takes from sparker operation, Atlantic Shores consulted NOAA Fisheries staff, published IHAs, NOAA GARFO (2021) and Crocker and Fratantonio (2016) to identify a source level value that considers the use of the Applied Acoustics Dura-Spark that is not overly conservative. Crocker and Fratantonio (2016) reports for the Applied Acoustics Dura-Spark a source level of 203 dB_{RMS} for 500 J electrical input using 400 tips. The SIG ELC 820 was selected as a comparison to the Applied Acoustics Dura-Spark. As indicated in Table 1-2, the maximum reported [RMS] source level of 203 dB re 1µPa@1m for the SIG ELC 820 operating at 750 J at a depth of 5 meters provides another point of reference from the Crocker and Fratantonio (2016) report.

Some of the equipment expected to be operated during certain survey activities are not considered impactful to marine mammals and were not included in Table 1-2. These include single beam depth echosounders which are not believed to result in take of marine mammals; gradiometers which generate no acoustic output and do not pose risk of take to marine mammals; and side scan sonar and multibeam echosounders operated at frequencies above 180 kHz which are outside the general hearing range of most marine mammals (pers comm. Benjamin Laws, NOAA GARFO 2021; CSA Ocean Sciences Inc 2021; NOAA Fisheries 2018). Of the HRG survey equipment expected to be operated during the survey campaign, only the sparkers and non-impulsive, nonparametric sub-bottom profilers generate the sound with characteristics that have the potential to result in the non-lethal take of exposed marine mammals.

Due to the implementation of mitigation and monitoring measures, as detailed in Section 11, in combination with the behavior of marine mammal species (i.e., their transient nature and their ability to move away from the source of potential harassment), it is unlikely that these pieces of equipment will result in the Level A harassment of marine mammals. This conclusion has been supported by both BOEM and NOAA Fisheries through published literature and agency communications from past Atlantic Shores IHA applications. Given the discrete frequency bands and small area of sound propagation emitted from HRG equipment, BOEM has concluded that injury to marine mammals (i.e., Level A harassment) is not expected as sound diminishes rapidly from the equipment (BOEM, 2018). NOAA Fisheries has also confirmed that Level A harassment is not expected with the use of mitigation measures and advised Atlantic Shores not to calculate Level A take in IHA applications for HRG surveys (pers comm. Benjamin Laws, NOAA GARFO 2021). Therefore, Level A take calculations have not been performed and Level A take has not been requested for any marine mammal species. Atlantic Shores is only requesting authorization for the incidental take of small numbers of marine mammals within each of the Survey Area by Level B harassment. Estimates of Level B take are further detailed in Section 6.

2. Dates, Duration, and Specified Geographic Region

Atlantic Shores is proposing to conduct HRG surveys within the Survey Area, which consists of the Lease Survey Area and ECR Survey Area (see Figure 1-1). HRG surveys will begin August 2022. Survey activities may include up to 3 geophysical vessels operating simultaneously in different areas. The estimated duration of survey activities is provided in Table 2-1. This estimate accounts for weather downtime and assumes activities could occur at any time in a 24-hr day for a period of up to 12 months.

Table 2-1 Estimated Duration of Survey Activities in Proposed HRG Survey Segments

Survey Segment	Total Duration (Vessel Days)
Lease Survey Area (OCS-A 0541)	180
ECR Survey Area	180

3. Species and Numbers of Marine Mammals

The *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York Revised Environmental Assessment* (BOEM 2016) reports 31 species of marine mammals (whales, dolphins, porpoise, and seals) in the New York Bight that are protected by the MMPA, five of which are listed under the Endangered Species Act (ESA) and may be present, at least seasonally, in the Survey Area (see Table 3-1). The status and distribution of these species are discussed in detail in Section 4.

Table 3-1 Marine Mammals Known to Occur in the Marine Waters of the New York Bight

Common Name	Scientific Name	ESA and MMPA Status	Relative Occurrence in the Region	Estimated Population	Stock	Hearing Range
Toothed Whales (Odontoceti)						
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	N/A	Common	93,233	W. North Atlantic	Mid
Atlantic spotted dolphin	*Stenella frontalis*	N/A	Uncommon	39,921	W. North Atlantic	Mid
Bottlenose dolphin	*Tursiops truncatus*	N/A	Uncommon	62,851	W. North Atlantic, Offshore	Mid
		Strategic [a]	Common	6,639	W. North Atlantic, Northern Migratory Coastal	Mid
Pan-tropical spotted dolphin	*Stenella attenuata*	N/A	Rare	6,593	W. North Atlantic	Mid
Risso's dolphin	*Grampus griseus*	N/A	Common	35,215	W. North Atlantic	Mid
Short beaked common dolphin	*Delphinus delphis*	N/A	Common	172,974	W. North Atlantic	Mid
Striped dolphin	*Stenella coeruleoalba*	N/A	Rare[b]	67,036	W. North Atlantic	Mid
White-beaked dolphin	*Lagenorhynchus albirostris*	N/A	Rare	536,016	W. North Atlantic	Mid
Harbor porpoise	*Phocoena phocoena*	N/A	Common	95,543	Gulf of Maine/Bay of Fundy	High
Killer whale	*Orcinus orca*	N/A	Rare	Unknown	W. North Atlantic	Mid
False killer whale	*Pseudorca crassidens*	N/A	Rare	1,791	W. North Atlantic	Mid
Long-finned pilot whale	*Globicephala melas*	N/A	Common	39,215	W. North Atlantic	Mid
Short-finned pilot whale	*Globicephala macrorhynchus*	N/A	Rare	28,924	W. North Atlantic	Mid

Table 3-1 Marine Mammals Known to Occur in the Marine Waters of the New York Bight

Common Name	Scientific Name	ESA and MMPA Status	Relative Occurrence in the Region	Estimated Population	Stock	Hearing Range
Sperm whale	*Physeter macrocephalus*	Endangered	Uncommon[c]	4,349	North Atlantic	Mid
Pygmy sperm whale	*Kogia breviceps*	N/A	Rare[b]	7,750 [e]	W. North Atlantic	High
Dwarf sperm whale	*Kogia sima*	N/A	Rare	7,750 [e]	W. North Atlantic	High
Cuvier's beaked whale	*Ziphius cavirostris*	N/A	Rare	5,744	W. North Atlantic	Mid
Blainville's beaked whale	*Mesoplodon densirostris*	N/A	Rare	10,107 [f]	W. North Atlantic	Mid
Gervais' beaked whale	*Mesoplodon europaeus*	N/A	Rare	10,107 [f]	W. North Atlantic	Mid
True's beaked whale	*Mesoplodon mirus*	N/A	Rare	10,107 [f]	W. North Atlantic	Mid
Sowerby's beaked whale	*Mesoplodon bidens*	N/A	Rare	10,107 [f]	W. North Atlantic	Mid
Baleen Whales (Mysticeti)						
Minke whale	*Balaenoptera acutorostrata*	N/A	Regular	21,968	Canadian East Coast	Low
Blue whale	*Balaenoptera musculus*	Endangered	Rare	Unknown	W. North Atlantic	Low
Fin whale	*Balaenoptera physalus*	Endangered	Common	6,802	W. North Atlantic	Low
Humpback whale	*Megaptera novaeangliae*	N/A	Common	1,396	Gulf of Maine	Low
North Atlantic right whale	*Eubalaena glacialis*	Endangered	Regular	368	W. North Atlantic	Low
Sei whale	*Balaenoptera borealis*	Endangered	Uncommon [d]	6,292	Nova Scotia	Low
Earless Seals (Phocidae)						
Gray seals	*Halichoerus grypus*	N/A	Regular	27,300	W. North Atlantic	-
Harbor seals	*Phoca vitulina*	N/A	Regular	61,336	W. North Atlantic	-
Hooded seals	*Cystophora cristata*	N/A	Rare	Unknown	W. North Atlantic	-
Harp seal	*Phoca groenlandica*	N/A	Rare	7.6 million	W. North Atlantic	-

Table 3-1 Marine Mammals Known to Occur in the Marine Waters of the New York Bight

Common Name	Scientific Name	ESA and MMPA Status	Relative Occurrence in the Region	Estimated Population	Stock	Hearing Range

Notes:

a 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) which is declining and likely to be listed as threatened under the ESA; or 3) which is listed as threatened or endangered under the ESA or as depleted under the MMPA (http://www.ncseonline.org/nle/crsreports/biodiversity/biodv-11.cfm).

b. The 2016 Revised Environmental Assessment for *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York,* describes striped dolphin and pygmy sperm whale as common and uncommon, respectively, in the NY Bight. However, based on more recent marine mammal density modeling published by Roberts et.al (2020), these species are not expected to occur in the Survey Area.

c. Short-finned pilot whale was identified as occurring year-round on the shelf break according to the *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York*. Given that the Survey Area is not located on the shelf break, their occurrence in the area of the Survey Area is expected to be rare.

d. Based on the *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York Revised Environmental Assessment*, sperm and sei whales presence was identified as rare off the coast of New York. However based on density modeling published by Roberts et al. (2020), their presence is possible.

e. This estimate may include both the dwarf and pygmy sperm whales.

f. This estimate includes Gervais' and Blainville's beaked whales and undifferentiated *Mesoplodon* spp. beaked whales.

Sources: Hayes et al. 2021; Hayes et al. 2018a, 2018b; Hayes et al. 2017; Waring et al. 2010, 2011, 2013, 2015; RI Ocean SAMP 2011; Kenney and Vigness-Raposa 2009; NOAA Fisheries 2016, 2018; Pace 2021; BOEM 2016, Roberts et.al 2020

4. Affected Species Status and Distribution

The 31 marine mammal species identified in Table 3-1 are protected by the MMPA, and some are also listed under the ESA. The five ESA-listed marine mammal species that could occur in waters of the New York Bight are the sperm whale, North Atlantic right whale (NARW), fin whale, blue whale, and sei whale. The humpback whale, which may occur year-round, was delisted as an endangered species. These large whale species are generally migratory and typically do not spend extended periods of time in a localized area. The waters off the coast of New York are primarily used as areas where animals occur seasonally to feed, or as habitat during seasonal movements between the more northward feeding areas and southern hemisphere breeding grounds typically used by some of the large whale species (though some winter breeding areas exist further offshore vs. in the southerly latitudes) (BOEM 2016). Presence of mid-sized whale species and other large baleen whales in the Survey Area will vary with prey availability and other habitat factors. The North Atlantic right whale (NARW) has the greatest potential to occur within the Survey Area; however, sperm, fin, and humpback whales can also occur.

The following subsections provide additional information on the distribution, habitat use, abundance, and the existing threats to marine mammals with regular, common, and uncommon presence around the Survey Area. Species with regular, common, and uncommon presence around the Survey Area include the sperm whale, long-finned pilot whale, harbor porpoise, bottlenose dolphin, short-beaked common dolphin, Atlantic white-sided dolphin, Atlantic spotted dolphin, Risso's dolphin, NARW, fin whale, sei whale, humpback whale, minke whale, harbor seal, and gray seal. Of the 31 species included in Table 3-1, 15 species with the greatest potential of occurrence in the Survey Area were selected for further analysis and evaluated for potential take in this Application. The 15 species included in the take analysis are described below.

4.1 Toothed Whales (Odontonceti)

4.1.1 Sperm Whale (Physeter macrocephalus) – Endangered

Sperm whales are the largest of the toothed whales and characterized by their large, bulbous heads. Adults can achieve 15 tons (females) to 45 tons (males). They mainly reside in deep-water habitats on the OCS, along the shelf edge, and in mid-ocean regions (NOAA Fisheries 2010). However, this species has also been observed in relatively high numbers in shallow continental shelf areas off the coast of southern New England (Scott and Sadove 1997). Sperm whale vocalizations include directional clicks, from less than 100 Hz to 30 kHz with most of the clicks is in the 5 to 25 kHz range. Sperm whales use echolocation and produce repeated patterns of clicks or codas, which are used to attract females, compete for mates, display aggression, and maintain group cohesion (Wahlberg 2002). Foraging sperm whales make regularly spaced clicks interrupted by “creaks” and very rapid clicking for locating and capturing prey (Wahlberg 2002; Richardson et al. 1995).

Distribution

Sperm whale migratory patterns are not well-defined, and no obvious migration patterns have been observed in certain tropical and temperate areas. However, general trends suggest that most populations move poleward during summer (Waring et al. 2015). Within U.S. Atlantic EEZ waters, sperm whales appear to exhibit seasonal movement patterns (CeTAP 1982, Scott and Sadove 1997). During winter, sperm whales are concentrated to the east and north of Cape Hatteras. This distribution shifts northward in spring, when sperm whales are most abundant in the central portion of the Mid-Atlantic Bight to the southern region of Georges Bank. In summer, this distribution continues to move northward, including the area east and north of Georges Bank and the continental shelf to the Mid-Atlantic region. In fall, sperm whales are most abundant on the continental shelf to the south of New England and remain abundant along the continental shelf edge in the Mid-Atlantic Bight.

According to the Ocean Wind Power Ecological Baseline Studies conducted for the New Jersey Department of Environmental Protection (NJDEP) by Geo-Marine (2010) no sperm whale sightings were made; however, approximately nine individuals were observed offshore of New Jersey near the OCS during shipboard surveys in summer 2011 (Palka 2012). There is substantial information on sperm whale occurrence offshore of New Jersey, but they are exclusively near the OCS (CETAP 1982; Waring et al. 2007) and are unlikely to be present within the Survey Area. Due to the rare occurrence of sperm whales within New Jersey waters, the Endangered and Nongame Species Program (NJ ENSP) recommends that the species should be removed from the New Jersey list of species (Bowers-Altman and NJ Division of Fish and Wildlife 2009).

Abundance

Though there is currently no reliable estimate of total sperm whale abundance in the entire western North Atlantic, the most recent and best available population estimate for the U.S. Atlantic EEZ is 4,349 (Hayes et al. 2021).

Status

Sperm whales are listed as endangered under the ESA and NJDEP, and the North Atlantic stock is considered strategic by NOAA Fisheries under the MMPA.

4.1.2 Long-Finned Pilot Whale (*Globicephala melas*) – Non-Strategic

Long-fin pilot whales have bulbous heads, are dark gray, brown, or black in color, and can reach approximately 24 ft (7.3 m) in length (NOAA Fisheries 2022a). These whales form large, relatively stable aggregations that appear to be maternally determined (American Cetacean Society 2022). Long-fin pilot whales feed primarily on squid but also eat small to medium-sized fish and octopus when available (NOAA Fisheries 2022a). Occurrence of the long-finned pilot whale is considered common in the Survey Area.

Pilot whales are acoustic mid-frequency specialists with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Pilot whales echolocate and produce tonal calls. The primary tonal calls of the long-finned pilot whale range from 1 to 8 kHz with a mean duration of about one second. The calls can be varied with seven categories identified (level, falling, rising, up-down, down-up, waver, and multi-hump) and are likely associated with specific social activities (Vester et al. 2014).

<u>Distribution</u>

Within the U.S. Atlantic EEZ, long-finned pilot whales are categorized into Western North Atlantic stocks. In U.S. Atlantic waters, pilot whales are distributed principally along the continental shelf edge off the northeastern U.S. coast in winter and early spring (CETAP 1982, Payne and Heinemann 1993, Abend and Smith 1999, Hamazaki 2002). In late spring, pilot whales move onto Georges Bank, into the Gulf of Maine, and into more northern waters, where they remain through late fall (CeTAP 1982, Payne and Heinemann 1993). Long-finned pilot whales have occasionally been observed stranded as far south as South Carolina (Hayes et al. 2017). The latitudinal range of the species therefore remains uncertain. However, south of Cape Hatteras, most pilot whale sightings are expected to be short-finned pilot whales, while north of approximately 42° N, most pilot whale sightings are expected to be long-finned pilot whales (Hayes et al. 2019).

Long-finned pilot whales have been known to occur offshore of New Jersey (Abend and Smith 1999, Tyler 2008, Hayes et al. 2017). It is likely that the species can be found along the shelf break between New Jersey and Georges Bank, however, there is limited information on the spatial and temporal distribution of long-finned pilot whales near the Survey Area (Hayes et al. 2017). For instance, pilot whales were not detected during the Geo-Marine (2010) study. The limited information of pilot whale presence within the Survey Area is likely based on the habitat preference and overall distribution of pilot whales (Hayes et al. 2017). Further, the consensus from the NJ ENSP determined that pilot whales are primarily pelagic and have a rare presence in New Jersey waters (Bowers-Altman and NJ Division of Fish and Wildlife 2009).

<u>Abundance</u>

The best available estimate for long-finned pilot whale abundance is 39,215 whales as of surveys conducted through 2016 (Lawson and Gosselin 2018, Hayes et al. 2021). Estimates of population trend or net productivity rates have not been calculated for long-finned pilot whales as abundance estimates remain highly uncertain due to long survey intervals. From 2013 to 2017, total annual observed fishery-related mortality or serious injury was 21 whales (Hayes et al. 2020). In addition, to direct human-induced mortality, mass strandings of long-finned whales have occurred throughout their range. Between 2013 and 2017, 16 long-finned pilot whales were found stranded between Maine and Florida (Hayes et al. 2020).

<u>Status</u>

The long-finned pilot whale species is not listed as threatened or endangered under the ESA or the NJ ENSP, and the Western North Atlantic stock is not considered strategic under the MMPA.

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

The harbor porpoise is abundant throughout the coastal waters of the Northern hemisphere and the only porpoise species found in the Atlantic Ocean. This species is the smallest cetacean, with a blunt, short-beaked head, dark gray back, and white underside (NOAA Fisheries 2022a). Harbor porpoises reach a maximum length of 6 ft (1.8 m) and feed on a wide variety of small fish and cephalopods (Reeves and Read 2003, Kenney and Vigness-Raposa 2010). Most harbor porpoise groups are small, usually between five and six individuals, although they aggregate into large groups for feeding or migration (Jefferson et al. 2008). Harbor porpoises are considered high-frequency cetaceans. The dominant component of harbor porpoise echolocation signals are narrowband, high-frequency clicks within 130 to 142 kHz (Villadsgaard et al. 2007).

<u>Distribution</u>

The harbor porpoise occupies both coastal and deep waters from off the coast of North Carolina to Greenland. They are commonly found in bays, estuaries, harbors, and fjords less than 656 ft (200 m) deep (NOAA Fisheries 2022a). Hayes et al. (2019) report that harbor porpoises are generally concentrated along the continental shelf within the northern Gulf of Maine and southern Bay of Fundy region during summer (July to September). During fall (October to December) and spring (April to June), they are more widely dispersed from New Jersey to Maine. In winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina with lower densities found in waters off New York to New Brunswick, Canada (Hayes et al. 2019). There are four distinct populations of harbor porpoise in the western Atlantic: Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland (Hayes et al. 2019). Harbor porpoises observed within the U.S. Atlantic EEZ are considered part of the Gulf of Maine/Bay of Fundy stock.

Harbor porpoises are a frequently sighted cetacean offshore of New Jersey (Geo-Marine 2010). During the Geo-Marine (2010) study, 51 harbor porpoise sightings were documented approximately 0.8 to 19.8 nm (1.5 to 36.6 km) from shore (mean = 10.5 nm/19.5 km). These sightings were primarily during winter months (February to March). It is therefore likely that this marine mammal will be present within the Survey Area.

<u>Abundance</u>

According to data collected in 2016 by Northeast Fisheries Science Center (NEFSC) and DFO, the best abundance estimate for harbor porpoises is 95,543 individuals (Hayes et al. 2021). The total annual estimated human-caused mortality and serious injury is 217 harbor porpoises per year based on fisheries observer data (Hayes et al. 2020).

<u>Status</u>

Harbor porpoises are not listed as threatened or endangered under the ESA or designated as a strategic stock under the MMPA.

4.1.4 Bottlenose Dolphin (*Tursiops truncatus*) –Western North Atlantic Offshore Stock – Non-Strategic

Bottlenose dolphins are one of the most well-known and widely distributed species of marine mammals. There are multiple genetically distinct bottlenose dolphin stocks present in the Mid-Atlantic including the Western North Atlantic Offshore stock and Northern Migratory Coastal stock (Mead and Potter 1995). Given the location of the Survey Area, only the Western North Atlantic Offshore Stock is expected to potentially occur in the Survey Area. Therefore, the Western North Atlantic Northern Migratory Coastal Stock will not be discussed in this application for IHA.

These dolphins reach 7 ft to 13 ft (2 m to 4 m) in length and are light gray to black in color (NOAA Fisheries 2022a). Bottlenose dolphins are commonly found in groups of two to 15 individuals, though aggregations in the hundreds are occasionally observed (NOAA Fisheries 2022a). They are considered generalist feeders and consume a wide variety of organisms, including fish, squid, shrimp, and other crustaceans (Jefferson et al. 2008). Bottlenose dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Bottlenose dolphin vocalization frequencies range from 3.4 to 130 kHz (DoN 2008).

Distribution

The Western North Atlantic Offshore stock inhabits the outer continental slope and shelf edge regions from Georges Bank to the Florida Keys (Hayes et al. 2017). Sightings of this stock of bottlenose dolphin occur from Cape Hatteras to the eastern end of Georges Bank (Kenney 1990). Off the coast of New Jersey, bottlenose dolphins can occur throughout the year and were the most frequently detected species in an ecological baseline survey conducted in coastal New Jersey waters (Geo-Marine 2010, BOEM 2012). Seasonal movements north along the coast occur during the warmer months, are likely directed by the presence of prey (Hayes et al. 2018b). Targeted prey species vary by area, season, and stock; however, sciaenid fishes, such as Atlantic croaker, weakfish, and squid, are common (NOAA 2022a). The Northeast Fisheries Science Center (NEFSC) observed bottlenose dolphins during the AMAPPS surveys (NEFSC and SEFSC 2011a, 2011b, 2012, 2014a, 2014b, 2015, 2016, 2018, 2019).

Bottlenose dolphins were the most frequently observed species during the Geo-Marine (2010) study period. A total of 319 bottlenose dolphins with group sizes averaging at 15.3 animals were detected offshore of New Jersey (Geo-Marine 2010). Several other monitoring efforts recorded sightings of this species during geophysical surveys in the potential windfarm sites (including the Survey Area) southeast of Atlantic City (Geo-Marine 2009a, 2009b). Bottlenose dolphins have been present annually near and offshore of New Jersey; with greater sightings during spring and summer months (Geo-Marine 2010).

Abundance

The best available population estimate for the offshore stock is at 62,851 individuals (Hayes et al. 2021). Current population estimates indicate there is no significant trend in abundance for the stock. Total annual human-caused mortality is unknown for the offshore stock and total annual fisheries mortality and serious injury is estimated as 28 individuals for the offshore stock (from 2013 to 2017) (Hayes et al. 2018b, 2020).

Status

The offshore stock of bottlenose dolphin is not listed as threatened or endangered under the ESA or designated as a strategic stock under the MMPA (Hayes et al. 2018b).

4.1.5 Short-Beaked Common Dolphin (*Delphinus delphis*) – Non-Strategic

Short-beaked common dolphins (Delphinus delphis) are one of the most widely distributed cetaceans and occur in temperate, tropical, and subtropical regions (Jefferson et al. 2008). Short-beaked common dolphins can reach 9 ft (2.7 m) in length and have a distinct color pattern with a white ventral patch, yellow or tan flank, and dark gray dorsal "cape" (NOAA Fisheries 2022a). This species feeds on schooling fish and squid found near the surface at night (NOAA Fisheries 2022a). Short-beaked common dolphins are in the mid-frequency functional hearing group. Their vocalizations range from 300 Hz to 44 kHz (Southall et al. 2007).

Distribution

Short-beaked common dolphins within the U.S. Atlantic EEZ belong to the Western North Atlantic stock, generally occurring from Cape Hatteras to the Scotian Shelf (Hayes et al. 2018b). Short-beaked common dolphins are a highly seasonal, migratory species. Within the U.S. Atlantic EEZ, this species is distributed along the continental shelf and is associated with Gulf Stream features (CeTAP 1982, Selzer and Payne 1988, Hamazaki 2002, Hayes et al. 2019). Short-beaked common dolphins occur from Cape Hatteras northeast to Georges Bank (35° to 42°N) during mid-January to May and move as far north as the Scotian Shelf from mid-summer to fall (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs when water temperatures exceed 51.8°Fahrenheit (11°Celsius) (Sergeant et al. 1970, Gowans and Whitehead 1995). Breeding usually takes place between June and September, with females estimated to have a calving interval of two to three years (Hayes et al. 2019).

There have been numerous sightings of short-beaked common dolphins throughout the New Jersey coastline (Ulmer 1981, Hamazaki 2002). Generally, this species has been documented 20 nm (>37 km) near the shelf break within the months of February, May, and July, however, they have been sighted throughout the year (Geo-Marine 2010). Short-beaked common dolphins are most common at the surface and are regularly observed in large groups consisting of hundreds of animals (NOAA Fisheries 2022a). Multiple strandings of the short-beaked common dolphins have occurred within the New Jersey coasts across multiple seasons (NOAA Fisheries 2022b). Geo-Marine (2010) recorded a total of 32 short-short beaked common dolphin sightings off the coast of New Jersey. The observed species were documented in waters ranging from 33 ft to 102 ft (10 m to 21 m) (Geo-Marine 2010). Approximately 26% of the shipboard sightings were calves during the Geo-Marine (2010) study.

Abundance

The best abundance estimate for the western north Atlantic stock of common dolphins is 172,974 individuals (Hayes et al. 2021). Average annual estimated human-caused mortality and serious injury between 2015 to 2019 was 390.49 animals (Hayes et al. 2021).

Status

Short-beaked common dolphins are not listed as threatened or endangered under the ESA or designated as a strategic stock under the MMPA.

4.1.6 Atlantic White-Sided Dolphin (*Lagenorhynchus acutus*) – Non-Strategic

Atlantic white-sided dolphins are common in temperate waters of the western North Atlantic. They have a distinctive yellowish-tan patch near their fluke and white patches below the dorsal fin and ventral sides, on both sides of their long, slender bodies. These dolphins grow up to 9 ft (2.7 m) in length and weigh between

400 and 500 pounds as adults. Like other dolphins, Atlantic white-sided dolphins communicate vocally and non-vocally through signals. They produce burst-pulse sounds and echolocation clicks and whistles (Popper 1980).

Distribution

Atlantic white-sided dolphins observed off the U.S. Atlantic coast are part of the Western North Atlantic Stock (Hayes et al. 2019). This stock inhabits waters from central West Greenland to North Carolina (about 35°N), primarily in continental shelf waters to the 328 ft (100 m) depth contour (Doksæter et al. 2008). Sighting data indicate seasonal shifts in distribution (Northridge et al. 1997). From January to May, low numbers of Atlantic white-sided dolphins are found from Georges Bank to Jeffreys Ledge (off New Hampshire). From June through September, large numbers of Atlantic white-sided dolphins are found from Georges Bank to the lower Bay of Fundy. From October to December, they occur at intermediate densities from southern Georges Bank to the southern Gulf of Maine (Payne and Heinemann 1990). No critical habitat areas are designated for the Atlantic white-sided dolphin.

No Atlantic white-sided dolphins were observed in the Geo-Marine (2010) study. This suggests that Atlantic white-sided dolphins occur infrequently in the Survey Area and surrounding areas. The NJ ENSP noted that there is little information on the sightings of this species and that more information is needed to accurately assess the abundance of Atlantic white-sided dolphins within State waters (see CETAP 1982, Selzer and Payne 1988, Waring et al. 2007, Bowers-Altman and NJ Division of Fish and Wildlife 2009). A shallow water (~188 ft [36 m]) marine mammal survey off of New Jersey found no presence of Atlantic white-sided dolphin across each season (Kenney et al. 1985: p. 91), which further implies that it is unlikely for this species to be present within the Survey Area. Although regional surveys found very limited presence of this species near the Survey Area, data adapted from Roberts et al. (2016b; 2017; 2018) via the MDAT (Curtice et al. 2019) indicate abundance in this region increases in the spring.

Abundance

Roberts et al. (2016a, 2018) habitat-based density models provide an abundance estimate of 37,180 Atlantic white-sided dolphins within the U.S. Atlantic EEZ. There are insufficient data to determine seasonal abundance estimates of Atlantic white-sided dolphins off the U.S. Atlantic coast or their status within the U.S. Atlantic EEZ. The best available abundance estimate for the Western North Atlantic stock of Atlantic white-sided dolphins is 93,233 individuals, which is derived from data collected during a summer survey in 2011 (Hayes et al. 2021).

Status

The Atlantic white-sided dolphin is not listed as threatened or endangered under the ESA or NJ ENSP, and the Western North Atlantic stock of Atlantic white-sided dolphins is not classified as strategic under the MMPA.

4.1.7 Atlantic Spotted Dolphin (*Stenella frontalis*) – Non-Strategic

Atlantic spotted dolphins have a robust body with a curved, tall dorsal fin and moderately long beaks (NOAA Fisheries 2022a). This species can range in length from 5 to 7.5 feet long and weigh between 220 and 315 pounds (NOAA Fisheries 2022a). There are two species of spotted dolphin in the Atlantic Ocean, the Atlantic spotted dolphin (*Stenella frontalis*) and the pantropical spotted dolphin (*S. attenuata*) (Perrin et al. 1987). In addition, two forms of the Atlantic spotted dolphin exist: one that is large and heavily spotted and usually inhabits the continental shelf, and one that is smaller in size with less spots (Fulling et al. 2003; Mullin and Fulling 2003, 2004; Viricel and Rosel 2014). The Atlantic spotted dolphin diet consists of a wide variety of fish and squid, as well as benthic invertebrates (Herzing 1997). Its hearing is in the mid-frequency range (Southall et al. 2007).

Distribution

The western north Atlantic stock of the Atlantic spotted dolphin can be found from southern New England to the Gulf of Mexico and Venezuela (NOAA Fisheries 2022a). Though the waters off the coast of New Jersey are located within the distributional range of the Atlantic spotted dolphin, the species was not included in the Geo-marine (2010) study. The Atlantic spotted dolphin prefers tropical to warm temperate waters along the continental shelf 33 ft to 650 ft (10 m to 200 m) deep to slope waters greater than 1,640 ft (500 m) deep. It has been suggested that the species may move inshore seasonally during the spring, but data to support this theory are limited (Caldwell and Caldwell 1966; Fritts et al. 1983).

Abundance

The best population estimate for the Atlantic spotted dolphin is approximately 39,921 individuals (Hayes et al. 2021). Population levels of the Atlantic spotted dolphin are influenced by fishery interactions (particularly long-line fisheries) and strandings (NOAA Fisheries 2022b). From 2013 to 2017, no fishery-related mortality or serious injury was reported, however 21 strandings were reported along the coastline from North Carolina to Florida (NOAA Fisheries 2022b).

Status

Atlantic spotted dolphin are not listed as threatened or endangered under the ESA or designated as a strategic stock under the MMPA.

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

Risso's dolphins occur worldwide in both tropical and temperate waters (Jefferson et al. 2008, Jefferson et al. 2014). This species of dolphin attains a body length of approximately 9 ft to 13 ft (2.6 m to 4 m) (NOAA Fisheries 2022a), a narrow tailstock, and a whitish or gray body. Risso's dolphins form groups ranging from 10 to 30 individuals (NOAA Fisheries 2022a). They feed primarily on squid as well as fish, such as anchovies, krill, and other cephalopods (NOAA Fisheries 2022a). Risso's dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations range from 400 Hz to 65 kHz (DoN 2008).

Distribution

Risso's dolphins within the U.S. Atlantic EEZ are part of the Western North Atlantic stock. The Western North Atlantic stock of Risso's dolphins inhabits waters from Florida to eastern Newfoundland (Leatherwood et al. 1976, Baird and Stacey 1991). During spring, summer, and fall, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank (CeTAP 1982, Payne et al. 1984). In winter, the distribution extends outward into oceanic waters (Payne et al. 1984) within the Mid-Atlantic Bight, however, little is known about movement and migration patterns and they are infrequently observed in shelf waters. The stock may contain multiple demographically independent populations that should themselves be considered stocks because the current stock spans multiple eco-regions (Spalding et al. 2007).

There is limited data regarding Risso's dolphins offshore of New Jersey. Increased strandings of this species were recorded from 2003 to 2004 on New York, New Jersey, and Delaware coasts (DiGiovanni et al. 2005). Other than strandings, this species has been primarily documented on the shelf break off of New Jersey (DiGiovanni et al. 2005). There were no Risso's dolphins documented during the Geo-Marine (2010) study. However, one Risso's dolphin observation was recorded during Atlantic Shores 2020 geophysical campaign in the vicinity of the Survey Area.

Abundance

The best abundance estimate for Risso's dolphins is 35,215 individuals, calculated from surveys conducted by Northeast Fisheries Science Center (NEFSC) and Department of Fisheries and Oceans Canada (DFO) (Hayes et al. 2021). Estimates of population trend or net productivity rates have not been calculated for Risso's dolphins. Annual average estimated human-caused mortality or serious injury from 2013 to 2017 was 54 dolphins, most of which was likely due to interactions with fisheries (Hayes et al. 2020).

Status

Risso's dolphins are not listed as threatened or endangered under the ESA or designated as a strategic stock under the MMPA.

4.2 Baleen Whales (Mysticeti)

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

North Atlantic right whales (NARW) are among the most endangered of all marine mammal species in the Atlantic Ocean. The average adult NARW can grow to approximately 50 ft (15 m) in length, while calves are typically 14 ft (4 m) at birth (NOAA Fisheries 2022a). Members of this species have stocky, black bodies with no dorsal fin, and bumpy, coarse patches of skin on their heads called callosities. NARWs feed mostly on zooplankton and copepods belonging to the *Calanus* and *Pseudocalanus* genera (Hayes et al. 2019). They are slow-moving grazers that feed on dense concentrations of prey at or below the water's surface, as well as at depth (NOAA Fisheries 2022a). Female whales become sexually mature at about age ten and carry a single calf during a year-long gestation period every six to ten years. The life span of NARW is estimated at 70 years, based on the estimated age of found deceased right whales and other closely related species (NOAA Fisheries 2022a).

NARWs are low-frequency cetaceans that vocalize using several distinctive call types, most of which have peak acoustic energy below 500 Hz. Most vocalizations do not go above 4 kHz (Matthews et al. 2014). One typical right whale vocalization is the "up call": a short sweep that rises from roughly 50 to 440 Hz over a period of two seconds. These up calls are characteristic of the NARW and are used by research and monitoring programs to determine species presence. A characteristic "gunshot" call is believed to be produced by male NARWs. These pulses can have sound levels of 174 to 192 dB re 1 μPa with frequency range from 50 to 2,000 Hz (Parks et al. 2005, Parks and Tyack 2005). Other tonal calls range from 20 to 1,000 Hz and have sound levels between 137 and 162 dB re 1 μPa.

Distribution

NARWs in U.S. waters belong to the Western Stock. This stock ranges primarily from calving grounds in coastal waters of the southeastern U.S. to feeding grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence (Hayes et al. 2019). Surveys indicate that there are seven areas where NARWs congregate seasonally: the coastal waters of the southeastern U.S., the Great South Channel, Jordan Basin, Georges Basin along the northeastern edge of Georges Bank, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Roseway Basin on the Scotian Shelf (Hayes et al. 2018b). NOAA Fisheries has designated two critical habitat areas for the NARW under the ESA: The Gulf of Maine/Georges Bank region, and the southeast calving grounds from North Carolina to Florida. Two additional critical habitat areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified in Canada's final recovery strategy for the NARW (Brown et al. 2009). Davis et al. (2017) recently pooled together detections from a large number of passive acoustic devices and documented broad-scale use of much more of the Atlantic Seaboard than previously believed. Further, there has been an apparent shift in habitat use patterns (Davis et al. 2017), which includes an increased use of Cape Cod Bay (Mayo et al. 2018) and decreased use of the Great South Channel. Movements within and between habitats are extensive (Hayes et al. 2019), and there is a high interannual variability in NARW use of some habitats (Pendleton et al. 2009).

The NARW is a migratory species that travels from high-latitude feeding waters to low-latitude calving and breeding grounds, though this species has been observed feeding in winter in the Mid-Atlantic region and has been recorded off the coast of New Jersey in all months of the year (Whitt et al. 2013). Figure 4-1 illustrates the NARW migration corridor with respect to the Survey Area. NARWs are mainly present in the Survey Area in winter, with another smaller peak in spring, ranging elsewhere for their main feeding and breeding/calving activities (Geo-Marine 2010). NARW typically occupy coastal and shelf waters within 56 mi (90 km) of the shoreline; however, they have been observed as far as 87 mi (140 km) offshore. These whales undertake a seasonal migration from their northeast feeding grounds (generally spring, summer, and fall habitats) south along the eastern U.S. coast to their calving grounds in the waters of the southeastern U.S. (Kenney and Vigness-Raposa 2010). The Survey Area is located within the NARW migration Biologically Important Area (BIA). NARWs are usually observed in groups of less than 12 individuals, and most often as single individuals or pairs. Larger groups may be observed in feeding or breeding areas (Jefferson et al. 2008). Migrating NARWs have been detected acoustically in the New York Bight from February to May and then again in August through December (Biedron et al. 2009).

Historically, there have been several documented sightings of NARW off the coast of New Jersey and surrounding waters (CETAP 1982, Knowlton and Kraus 2001, Biedron et al. 2009). These waters are important migratory routes for NARW as this species travels between feeding areas and breeding/calving grounds off the southeastern U.S. (NOAA Fisheries 2022a).. Satellite-monitored radio tags on a NARW cow and calf documented the migratory route of this pair from the Bay of Fundy to New Jersey and back during a six-week period (Knowlton et al. 2002). A few NARW sightings were documented east of the south of the Lease Survey Area near the Delaware Bay in October, December, May, and July (Knowlton et al. 2002). Other visual recordings of NARW were found in New Jersey waters during the spring and fall seasons (CETAP 1982). An entanglement mortality event of a NARW was recorded off the coast of New Jersey in October (Knowlton et al. 2002). It is has been noted, however, that NARW sightings in several traditional feeding habitats has been declining, causing speculation that a shift in NARW habitat usage may be occurring (Pettis et al. 2017).

Geo-Marine (2010) observed NARWs offshore of New Jersey during all seasons; except for summer. Three sightings of this species were documented in November, December, and January (Geo-Marine 2010). NARWs exhibit notable seasonal variability, with maximum occurrence in winter (December to February) and minimum occurrence in spring and summer. These sightings were likely to be migrant movements towards breeding and calving grounds located north and south of the Lease Survey Area (Winn et al. 1986, Cole et al. 2009). NARWs detected in the Geo-Marine (2010) study area off the coast of New Jersey were seen as single animals or pairs. These sightings occurred within water depths from 56 ft to 85 ft (17 m to 26 m) with distances from shore ranging from 10.7 nm to 17.2 nm (19.9 km to 31.9 km). A January 2009 sighting documented two adult males offshore of Barnegat Light in the northernmost portion of the Geo-Marine (2010) study area. In May 2008, a cow-calf pair were documented in waters (56 ft [17 m] isobath) southeast of Atlantic City (Geo-Marine 2010; M. Zani, New England Aquarium, pers. comm. 6 January 2020).

Abundance

The population of the western Atlantic NARW stock has been in decline since 2011, with a minimum population estimate of 368 as of 2019 (Hayes et al. 2021). Population growth rates remain low (2.5%), as average calves born per year between 1990 to 2017 was 16 and ranged from one to thirty-nine per year. In more recent years, female production has fallen, likely a result of lower female survival rate. The most significant causes of anthropogenic mortality to NARW include incidental fishery entanglement, which takes six right whales per year, and vessel strikes, which take two whales per year (Hayes et al. 2021). 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 NARW (see Figure 4-1). From 2013 to 2017, 28 records of mortality or serious injury involved entanglement or fishery interactions.

Status

The NARW was listed as a Federally endangered species in 1970 and remains critically endangered throughout its range. In addition to its endangered status, the high rate of annual human-related mortality classifies NARW as a strategic stock under the MMPA. An unusual mortality event (UME) was established for NARWs in June 2017. Thirty documented deaths and 8 seriously injured free-swimming whales have been document as of 2019 (NOAA Fisheries 2022c).

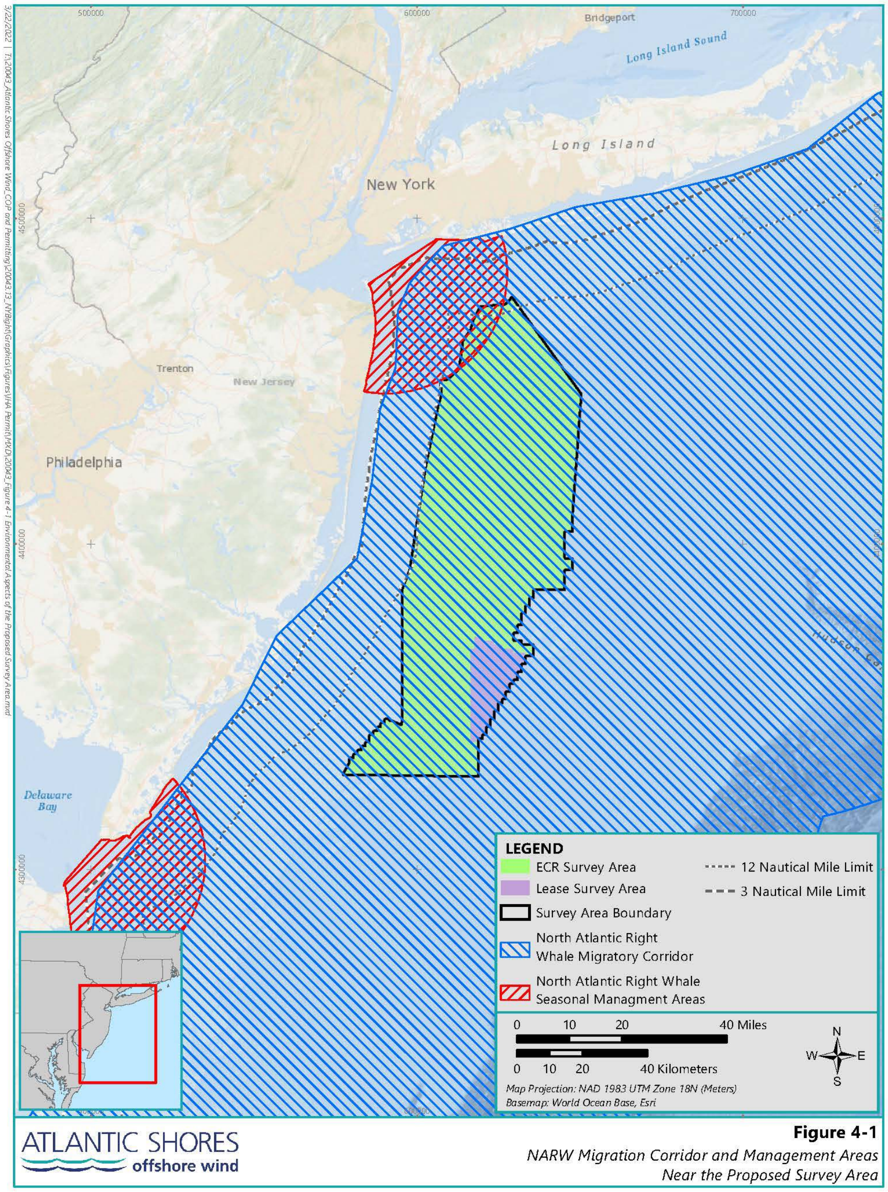

Figure 4-1 NARW Migration Corridor and Management Areas Near the Future Offshore Wind Development of Lease OCS-A-0541

4.2.2 Fin Whale (*Balaenoptera physalus*) – Endangered

Fin whales are the second largest species of baleen whale that occur in the northern hemisphere, with a maximum length of about 75 ft (22.8 m) (NOAA Fisheries 2022a). These whales have a sleek, streamlined body with a V-shaped head that makes them fast swimmers. Fin whales have a distinctive coloration pattern: the dorsal and lateral sides of their bodies are black or dark brownish-gray while the ventral surface is white. The lower jaw is dark on the left side and white on the right side. Fin whales feed on krill (*Euphausiacea*), small schooling fish (e.g., herring [*Clupea harengus*], capelin [*Mallotus villosus*], sand lance [*Ammodytidae* spp.]), and squid (*Teuthida* spp.) by lunging into schools of prey with their mouths open (Kenney and Vigness-Raposa 2010). Fin whales are low-frequency cetaceans producing short duration down sweep calls between 15 and 30 hertz (Hz), typically termed “20-Hz pulses”, as well as other signals up to 1 kilohertz (kHz) (Southall et al. 2019). The sound level (SL) of fin whale vocalizations can reach 186 decibels (dB) re 1 μPa, making them one of the most powerful biological sounds in the ocean (Charif et al. 2002).

Distribution

Fin whales found offshore U.S. Atlantic, Nova Scotia, and the southeastern coast of Newfoundland are believed to constitute a single stock under the present International Whaling Commission (IWC) management scheme (Donovan 1991), which has been named the Western North Atlantic stock. The current understanding of stock boundaries, however, remains uncertain (Hayes et al. 2019). The range of fin whales in the western North Atlantic extends from the Gulf of Mexico and Caribbean Sea to the southeastern coast of Newfoundland. Fin whales are common in waters of the U.S. Atlantic Exclusive Economic Zone (EEZ), principally from Cape Hatteras northward. There is evidence that fin whales are present year-round throughout much of the U.S. EEZ north of 35° N, but the density of individuals in any one area changes seasonally (NOAA Fisheries 2022a, Hayes et al. 2019). Fin whales are the most commonly observed large whales in continental shelf waters from the Mid-Atlantic coast of the U.S. to Nova Scotia (Sergeant 1977, Sutcliffe and Brodie 1977, CeTAP 1982, Hain et al. 1992), and were the most common baleen whale species detected in an ecological baseline survey conducted in coastal New Jersey waters, which surveyed an area that encompassed 97% of the New Jersey Wind Energy Area (Geo-Marine 2010, BOEM 2012). Fin whales are the dominant large cetacean species during all seasons from Cape Hatteras to Nova Scotia, having the largest standing stock, the largest food requirements, and, therefore, the largest influence on ecosystem processes of any baleen whale species (Hain et al. 1992, Kenney et al. 1997).

Fin whales have a high multi-seasonal relative abundance in U.S. Mid-Atlantic waters, and surrounding areas. During the Geo-Marine (2010) survey, most of the sightings were observed during winter and summer. Within the study area, group size ranged from one to four animals with a mean distance from shore of 20 km and a mean water depth of 21.5 m (Geo-Marine 2010). One calf was observed with an adult fin whale in the area (Geo-Marine 2010). There were mixed aggregations of feeding humpbacks during fin whale sightings, and with the presence of known prey species, it is possible that fin whales use this area to feed (Geo-Marine 2010). Acoustic data also indicate that this species is present in the area in all seasons (CETAP 1982). Fin whales were the most common marine mammal species detected acoustically during the study (Geo-Marine 2010).

While fin whales typically feed in the Gulf of Maine and the waters surrounding New England, their mating and calving (and general wintering) areas are largely unknown (Hain et al. 1992, Hayes et al. 2019). Acoustic detections of fin whale singers augment and confirm these visual sighting conclusions for males. Recordings from Massachusetts Bay, New York Bight, and deep-ocean areas have detected some level of fin whale singing from September through June (Watkins et al. 1987, Clark and Gagnon 2002, Morano et al. 2012). These acoustic observations from both coastal and deep-ocean regions support the conclusion that male fin whales are broadly distributed throughout the western North Atlantic for most of the year (Hayes et al. 2019). It is likely that fin whales occurring within the U.S. Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions; however, the popular notion that entire fin whale populations make distinct annual migrations like some other mysticetes has questionable support (Hayes et al. 2019). Based on an analysis of neonate stranding data, Hain et al. (1992) suggest that calving occurs during October to January in latitudes of the U.S. Mid-Atlantic region.

Low-frequency vocalizing fin whale pulses were detected in the northern and eastern range of the study area where shelf waters are typically deeper (Geo-Marine 2010). Fin whales were acoustically detected on 281 days from March 2008 to October 2009 and documented in every month of acoustic recording indicating a lack of seasonal trends (Geo-Marine 2010). As the detection range for fin whale vocalizations is more than 108 nautical miles (nm) (200 km), detected signals may have originated from areas far outside of the study area; however, the acoustic presence suggest that this species can be found regularly along the New Jersey outer continental shelf (Geo-Marine 2010).

Abundance

The best available abundance estimate for the western North Atlantic fin whale stock in U.S. waters from NOAA Fisheries stock assessments is 6,802 individuals (Hayes et al. 2021). Current and maximum net productivity rates and population trends are unknown for this stock due to relatively imprecise abundance estimates and variable survey design (Hayes et al. 2020). From 2013 to 2017, the minimum human-caused mortality rate was approximately two whales per year, caused by incidental fishery interactions and vessel collisions; however, this estimate is biased low due to haphazard detections of carcasses (Hayes et al. 2020). Potential biological removal (PBR) for fin whales was calculated based on the most recent SAR (Hayes et al. 2021), while the most recent density data from Roberts et al. (2018) were used to calculate the number of animals potentially exposed to threshold levels of sound.

Status

The fin whale is Federally listed under the United States Endangered Species Act (ESA) as an endangered marine mammal and are designated as a strategic stock under the Marine Mammal Protection Act (MMPA) due to their endangered status under the ESA, uncertain human-caused mortality, and incomplete survey coverage of the stock's defined range.

4.2.3 Sei Whale (*Balaenoptera borealis*) – Endangered

Sei whales can reach lengths of about 39 ft to 59 ft (12 m to 18 m) (NOAA Fisheries 2022a). This species has a long, sleek body that is dark bluish-gray to black in color and pale underneath (NOAA Fisheries 2022a). Their diet is comprised primarily of plankton including krill and copepods, schooling fish, and cephalopods. Sei whales generally travel in small groups (two to five individuals), but larger groups are observed on feeding grounds (NOAA Fisheries 2022a).

Sei whales, like all baleen whales, are categorized as low-frequency cetaceans. There are limited confirmed sei whale vocalizations; however, studies indicate that this species produces several, mainly low-frequency (less than 1,000 Hz) vocalizations. Calls attributed to sei whales include pulse trains up to 3 kHz, broadband "growl" and "whoosh" sounds between 100 and 600 Hz, tonal calls and upsweeps between 200 and 600 Hz, and down sweeps between 34 and 100 Hz (McDonald et al. 2005, Rankin and Barlow 2007, Baumgartner et al. 2008).

Distribution

The stock that occurs within the U.S. Atlantic EEZ is the Nova Scotia stock, which ranges along the continental shelf waters of the northeastern U.S. to Newfoundland (Hayes et al. 2017). Sei whales are relatively widespread. Sighting data suggest sei whale distribution is largely centered in the waters of New England and eastern Canada (Roberts et al. 2016a, Hayes et al. 2017). There appears to be a strong seasonal component to sei whale distribution, and they are most abundant in adjacent waters near the continental shelf from winter to spring (Roberts et al. 2016a). This general offshore pattern of sei whale distribution is disrupted during episodic incursions into more shallow and inshore waters (Hayes et al. 2017). In years of reduced predation on copepods by other predators, and thus greater abundance of this prey source, sei whales are reported in more inshore locations, such as the Great South Channel (1987 and 1989) and Stellwagen Bank (1986) areas (Payne and Heinemann 1990, Waring et al. 2016). An influx of sei whales into the southern Gulf of Maine occurred in summer 1986 (Schilling et al. 1992). Such episodes, often punctuated by years or even decades of absence from an area, have been reported for sei whales from various places worldwide.

There has been little detection of sei whales within New Jersey and surrounding waters (Kenney et al. 1985, Geo-Marine 2010). According to the NJ ENSP, there have been no sightings of this species documented within State waters. On the shelf offshore of New Jersey, sei whales have been detected in spring. Approximately 200 sei whale vocalizations were detected in mid-September 2006 (Newhall et al. 2009); however, it is unlikely that the sei whale will be present farther nearshore inshore by the Survey Area.

Abundance

The best available abundance estimate for the Nova Scotia stock of sei whales from NOAA Fisheries stock assessments is 6,292 individuals (Hayes et al. 2021). This estimate is considered an underestimate because the full known range of the stock was not surveyed, the estimate did not include availability-bias correction for submerged animals, and there was uncertainty regarding population structure (Hayes et al. 2017).

Status

Sei whales are listed as endangered under the ESA and NJ ENSP and the Nova Scotia stock is considered strategic by NOAA Fisheries under the MMPA. The minimum population size is 3,098. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.10 because the sei whale is listed as endangered under the ESA. PBR for the Nova Scotia stock of the sei whale is 0.5. For the period 2009 through 2014, the minimum annual rate of human-caused mortality and serious injury to sei whales was 0.8 (Hayes et al. 2017). No critical habitat areas are designated for the sei whale under the ESA. A BIA for feeding for sei whales occurs north of Survey Area in the Gulf of Maine from May through November (LaBrecque et al. 2015).

4.2.4 Humpback Whale (*Megaptera novaeangliae*) – Non-Strategic for Gulf of Maine Stock/West Indies Distinct Population Segment

Humpback whale body coloration is primarily dark gray, but individuals have a variable amount of white on their pectoral fins, belly, and flukes. These distinct coloration patterns are used by scientists to identify individuals. This baleen whale species feeds on small prey often found in large concentrations, including krill and fish such as herring and sand lance (Kenney and Vigness-Raposa 2010). Humpback whales use unique behaviors, including lunge feeding, bubble nets, bubble clouds, and flicking of their flukes and fins, to herd and capture prey (NOAA Fisheries 1991). Humpback whale females are larger than males and can reach lengths of up to 59 ft (18 m) (NOAA Fisheries 2022a) and reach sexual maturity between the ages four and ten with females producing a single calf every two to three years.

Humpback whales are low-frequency cetaceans but have one of the most varied vocal repertoires of the baleen whales. Male humpbacks will arrange vocalizations into a complex, repetitive sequence to produce a characteristic “song”. Songs are variable but typically occupy frequency bands between 300 and 3,000 Hz and last upwards of 10 minutes. Songs are predominately produced while on breeding grounds; however, they have been recorded on feeding grounds throughout the year (Clark and Clapham 2004, Vu et al. 2012). Typical feeding calls are centered at 500 Hz with some other calls and songs reaching 20 kHz. Common humpback calls also contain series of grunts between 25 and 1,900 Hz as well as strong, low-frequency pulses (with sound levels up to 176 dB re 1 μPa) between 25 and 90 Hz (Clark and Clapham 2004, Vu et al. 2012).

Distribution

Humpback whales are a cosmopolitan species and widely distributed in the Western Atlantic. Most humpback whales that inhabit the waters within the U.S. Atlantic EEZ belong to the Gulf of Maine stock, formerly called the Western North Atlantic Stock. Humpback whales in the Gulf of Maine stock typically feed in the waters between the Gulf of Maine and Newfoundland during spring, summer, and fall, but they have been observed feeding in other areas, such as off the coast of New York (Sieswerda et al. 2015). Humpback whales from most feeding areas, including the Gulf of Maine, migrate to the West Indies (including the Antilles, Dominican Republic, Virgin Islands, and Puerto Rico) in winter, where they mate and calve their young (Katona and Beard 1990, Palsbøll et al. 1997). There have been several wintertime humpback sightings in coastal waters of the eastern U.S., including 46 sightings of humpbacks in the New York-New Jersey Harbor Estuary documented between 2011 and 2016 (Brown et al. 2017). However, not all humpback whales from the Gulf of Maine stock migrate to the West Indies every winter because significant numbers of animals are observed in mid- and high-latitude regions at this time (Swingle et al. 1993).

Humpback whales are known to occur regularly throughout the Mid-Atlantic Bight, including New Jersey waters (Geo-Marine 2010). The occurrence of this population is strongly seasonal with most observations occurring during the spring and fall, with a peak from April to June (Geo-Marine 2010, Curtice et al. 2019). There have also been documented strandings from the New Jersey coast (Barco et al. 2002). Geo-Marine (2010) observed humpback whales during all seasons including seven observations in the winter. Group size tended to be single animals or pairs with a mean distance from shore of 11.4 mi (18.4 km) and a mean depth of 67 ft (20.5 m) (Geo-Marine 2010). Acoustic data indicate that this species may be present within the surrounding areas year-round, with the highest rates of acoustic detections in adjacent waters in winter and spring (Kraus et al. 2016). Acoustic detections do not differentiate between individuals, so detections on multiple days could be the same or different individuals. Humpback whales have previously been observed feeding off the coast of New Jersey with juveniles exhibiting feeding behavior just south of the study area near the mouth of the Chesapeake Bay (Swingle et al. 2006). There was one instance of observed lunge-feeding on effort within the study area (Geo-Marine 2010). Additionally, a cow-calf pair was seen once north of the study area boundary suggesting that the nearshore waters off of New Jersey may provide important feeding and nursery habitats for humpback whales (Geo-Marine 2010).

Abundance

The Gulf of Maine humpback whale stock consists of approximately 1,396 whales and is characterized by a positive trend in abundance with a maximum annual production rate estimate of 6.5% (Barlow and Clapham 1997, Hayes et al. 2021). The most significant anthropogenic causes of mortality to humpback whales remain incidental fishery entanglements, responsible for roughly eight whale mortalities, and vessel collisions, responsible for four mortalities both on average annually from 2013 to 2017 (Hayes et al. 2020).

Status

The humpback whale was listed under the ESA as endangered throughout its range until 2016 when NOAA Fisheries revised the listing and defined 14 distinct population segments (DPS) based on breeding populations. Under the final determination, the three DPSs that occur in U.S. waters are listed as threatened or endangered (81 FR 62259, September 8, 2016).

The Gulf of Maine stock is not considered depleted because it does not coincide with any ESA-listed DPS. The detected level of U.S. fishery-caused mortality and serious injury, derived from the available records, which is surely biased low, does not exceed the calculated PBR and, therefore, this is not a strategic stock (if the recovery factor is set at 0.5) (Hayes et al. 2019) under the MMPA. Humpback whales in the western North Atlantic have been experiencing a UME since January 2016 that appears to be related to a larger than usual number of vessel collisions (NOAA Fisheries 2022d). In total, 76 mortalities were documented through July 25, 2018, as part of this event (NOAA Fisheries 2022d). A biologically important area (BIA) for humpback whales for feeding from March to December has been designated in the Gulf of Maine, Stellwagen Bank, and the Great South Channel; all of which are north of the Survey Area (LaBrecque et al. 2015).

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

Minke whales are a small baleen whale species reaching 33 ft (10 m) in length (NOAA Fisheries 2022a). This species has a dark gray-to-black back and a white ventral surface (NOAA Fisheries 2022a). Its diet is comprised primarily of crustaceans, schooling fish, and copepods. Minke whales generally travel in small groups (one to three individuals), but larger groups have been observed on feeding grounds (NOAA Fisheries 2022a). Like other baleen whales, minke whales use low-frequency sounds to communicate with one another and to locate prey. They are believed to make mechanical sound calls and a variety of grunts, moans, and belches (Gedamke 2004).

Distribution

This species has a cosmopolitan distribution in temperate, tropical, and high latitude waters (Hayes et al. 2018b). Common and widely distributed within the U.S. Atlantic EEZ, these whales are the third most abundant great whale (any of the larger marine mammals of the order Cetacea) within the U.S. Atlantic EEZ (CeTAP 1982). Until better information is available, minke whales within the U.S. Atlantic EEZ are considered part of the Canadian East Coast stock, which inhabits the area from the western half of the Davis Strait (45°W) to the Gulf of Mexico. It is uncertain if separate sub-stocks exist within the Canadian East Coast stock. Like many of the other pelagic baleen whales, minke whales conduct seasonal migrations between high latitude summer feeding waters and low latitude winter breeding and calving grounds. Acoustic monitoring surveys indicate minke whales leave wintering grounds for their northern migrations from March through April and move south once again in mid-October through November (Risch et al. 2014).

Although primarily documented near the continental shelf offshore of New Jersey (Mead 1975, Potter 1979, Rowlett 1980, Potter 1984, Winn et al. 1985, DoN 2005), minke whales have been sighted nearshore at water depths of 36 ft (11 m) (Geo-Marine 2010). Acoustic recordings of minke whales have been detected north of the Lease Survey Area within the New York Bight during the fall (August to December) and winter

(February to May) (Biedron et al. 2009). A juvenile minke whale was sighted north of the Lease Survey Area near the New York Harbor in April, 2007 (Hamazaki 2002). The expected occurrence of minke whales near the Survey Area are likely due to the availability of prey species, such as capelin, herring, mackerel, and sand lance in this region (Kenney et al. 1985, Horwood 1989). Based on habitat information and predictive habitat models, Hamazaki (2002) determined that minke whales are likely to occur in nearshore waters off New Jersey.

Minke whales are most common off New Jersey in coastal waters in the spring and early summer as they move north to feeding ground in New England and fall as they migrate south (Geo-Marine 2010). Geo-Marine (2010) observed four minke whales near the Survey Area and surrounding waters during winter and spring. This species demonstrated a distinct seasonal habitat usage pattern that was consistent throughout the study. The two winter sightings were recorded in February, northeast of Barnegat Light whereas the two spring sightings were recorded in June, southeast of Sea Isle City. Minke whale sightings off the coast of New Jersey were within water depths of 36 ft to 79 ft (11 m to 24 m) and temperatures ranging from 5.4 to 11.5°C (47°F) (Geo-Marine 2010).

Minke whale recordings have resulted in some of the most variable and unique vocalizations of any marine mammal. Common calls for minke whales found in the North Atlantic include repetitive, low-frequency (100 to 500 Hz) pulse trains that may consist of either grunt-like pulses or thump-like pulses. The thumps are very short duration (50 to 70 milliseconds [ms]) with peak energy between 100 and 200 Hz. The grunts are slightly longer in duration (165 to 320 ms) with most energy between 80 and 140 Hz. In addition, minke whales will repeat a six-to-14-minute pattern of 40 to 60 second pulse trains over several hours (Risch et al. 2013). Minke whales produce a unique sound called the "boing", which consists of a short pulse at 1.3 kHz followed by an undulating tonal call around 1.4 kHz. This call was widely recorded but unidentified for many years and had scientists widely speculating as to its source (Rankin and Barlow 2005).

Abundance

The best available abundance estimate for the Canadian East Coast minke whale stock is 21,968 individuals (Hayes et al. 2021). Current population trends and net productivity rates of minke whales in this region are currently unknown. The average annual minimum human-caused mortality is estimated to be eight whales per year, with seven deaths caused by entanglement in fishing gear and one death caused by vessel strikes between 2013 and 2017 (Hayes et al. 2020).

Status

Minke whales are not listed as threatened or endangered under the ESA or designated as a strategic stock under the MMPA.

4.3 Earless Seals (Phocidae)

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

Adult harbor seals are not sexually dimorphic and both males and females are light gray to dark brown in color and typically reach 4.9 ft (1.5 m) and 220 pounds in size with a 35-year lifespan (NOAA Fisheries 2022a). Harbor seals forage in both shallow coastal waters and deeper offshore waters, diving to target prey within the water column or on the seafloor (Tollit et al. 1997). Primary food sources vary with seasonal abundances of fish and crustaceans in the north and Mid-Atlantic coastal region, with the most numerous prey species including sandlance, silver hake, Atlantic Herring, and redfish (NOAA Fisheries 2022a).

Male harbor seals produce underwater vocalizations during mating season to attract females and defend territories. These calls are comprised of "growls" or "roars" with peak energy at 200 Hz (Sabinsky et al. 2017). Captive studies have shown that harbor seals have good (greater than 50%) sound detection thresholds between 0.1 and 80 kHz, with primary sound detection between 0.5 and 40 kHz (Kastelein et al. 2009).

Distribution

Harbor seals are found throughout coastal waters of the Atlantic Ocean and adjoining seas above 30° N and is the most abundant pinniped within the U.S. Atlantic EEZ (Hayes et al. 2019). Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Richardson and Rough 1993) and occur seasonally from southern New England to New Jersey coasts between September and late May (Schneider and Payne 1983, Barlas 1999, Schroeder 2000). The western North Atlantic stock may occupy southern waters of the Mid-Atlantic Bight during seasonal migrations from the Bay of Fundy in the late autumn and winter (NOAA Fisheries 2022b; Palka et al. 2017). In addition to coastal waters, harbor seals utilize terrestrial habitat as haul-out sites throughout the year, but primarily during the pupping and molting periods, which occur from late spring to late summer in the northern portion of their range.

There are three major haul-out sites along the New Jersey coast, located in Great Bay, Sandy Hook, and Barnegay Inlet (CWFNJ 2015). In the western North Atlantic, they are distributed from eastern Canada to southern New England and New York, and occasionally as far south as the Carolinas (Payne and Selzer 1989). A general southward movement from the Bay of Fundy to southern New England occurs in fall and early winter (Rosenfeld et al. 1988, Whitman and Payne 1990, Barlas 1999). A northward movement from southern New England to Maine and eastern Canada takes place prior to the pupping season, which occurs from mid-May through June along the Maine coast (Richardson 1976, Wilson 1978, Whitman and Payne 1990, Kenney 1994). Geo-Marine (2010) observed one harbor seal offshore of New Jersey during their survey effort.

Abundance

The best current abundance estimate for harbor seals is 61,336 individuals (CV = 0.08), estimated using aerial photographs from haul-out sites along the coast of Maine in 2012 (Waring et al. 2015, Hayes et al. 2021). Annual average estimated human-caused mortality and serious injury to harbor seals (from 2015 to 2019) is estimated to be 339 seals per year (Hayes et al. 2021), with death due to fisheries interactions accounting for most of the mortality events. Harbor seal mortality through bycatch is highest in the Northeast Sink Gillnet fishery between Boston, Massachusetts, and Maine. Increased abundance of seals in the northeast region has also been documented during aerial and boat surveys of overwintering haul-out sites from the Maine/New Hampshire border to eastern Long Island and New Jersey (Payne and Selzer 1989, Rough 1995, Barlas 1999, Hoover et al. 1999, Slocum et al. 1999, deHart 2002).

Status

The Western North Atlantic Stock of harbor seals is not considered strategic under the MMPA (Hayes et al. 2020).

4.3.2 Gray Seal (*Halichoerus grypus*) – Non-Strategic

Gray seals are large, reaching 7 ft to 10 ft (2 m to 3 m) in length, and have a silver-gray coat with scattered dark spots (NOAA Fisheries 2022a). These seals are generally gregarious and live in loose colonies while breeding (Jefferson et al. 2008). Though they spend most of their time in coastal waters, gray seals can dive to depths of 984 ft (300 m) and frequently forage on the OCS (Lesage and Hammill 2001, Jefferson et al. 2008). These opportunistic feeders primarily consume fish, crustaceans, squid, and octopus (Bonner 1971, Reeves 1992, Jefferson et al. 2008). They often co-occur with harbor seals because their habitat and feeding preferences overlap (NOAA Fisheries 2022a). Gray seals, as with all pinnipeds, are assigned to functional hearing groups based on the medium (air or water) through which they are detecting the sounds, for an estimated auditory bandwidth of 75 Hz to 75 kHz (Southall et al. 2007). Vocalizations range from 100 Hz to 3 kHz (DoN 2008).

<u>Distribution</u>

Gray seals are the second most common pinniped along the U.S. Atlantic coast (Jefferson et al. 2008). This species inhabits temperate and sub-arctic waters and lives on remote, exposed islands, shoals, and unstable sandbars (Jefferson et al. 2008). Gray seals range from Canada to New Jersey; however, stranding records as far south as Cape Hatteras (Gilbert et al. 2005) have been recorded. The eastern Canadian population of gray seals ranges from New Jersey to Labrador and is centered at Sable Island, Nova Scotia (Davies 1957, Mansfield 1966, Richardson and Rough 1993, Lesage and Hammill 2001). There are three breeding concentrations in eastern Canada: Sable Island, Gulf of St. Lawrence, and along the east coast of Nova Scotia (Lavigueur and Hammill 1993). In U.S. waters, gray seals primarily pup at four established colonies: Muskeget and Monomoy islands in Massachusetts, and Green and Seal Islands in Maine. Since 2010, pupping has also been observed at Noman's Island in Massachusetts and Wooden Ball and Matinicus Rock in Maine (Hayes et al. 2019). Although white-coated pups have stranded on eastern Long Island beaches in New York, no pupping colonies have been detected in that region. Following the breeding season, gray seals may spend several weeks ashore in late spring and early summer while undergoing a yearly molt.

The gray seal is primarily found in coastal waters and forages in OCS regions (Lesage and Hammill 2001). For this reason, studies such as the Geo-Marine (2010) did not observe gray seals offshore of New Jersey. However, the Marine Mammal Stranding Center (2020) documented 25 gray seal strandings in 2019. Other reported sightings of gray seal in waters off of New Jersey were found as bycatch in gillnets (Hatch and Orphanides 2017, Orphanides 2019). Gray seals are less likely than harbor seals to occur around the Survey Area (Hayes et al. 2019).

<u>Abundance</u>

The gray seal is found on both sides of the North Atlantic, with three major populations: Northeast Atlantic, Northwest Atlantic, and Baltic Sea (Haug et al. 2013). The Western North Atlantic stock is equivalent to the Northwest Atlantic population, and ranges from New Jersey to Labrador (Mansfield 1966, Scott et al. 1990, Katona et al. 1993, Lesage and Hammill 2001). In U.S. waters alone, Hayes et al. (2021) estimated an abundance of 27,300. PBR (1,458) for gray seals was calculated based on the most recent SAR (Hayes et al. 2021).

<u>Status</u>

Gray seals are not listed as threatened or endangered under the ESA or the NJDEP, and they are not considered strategic under the MMPA.

5. Type of Incidental Take Authorization Requested

Atlantic Shores is seeking an IHA for a future offshore wind development project (Project) pursuant to section 101(a)(5)(D) of the MMPA (16 U.S. Code § 1371(a)(5)(D)) and 50 C.F.R. § 216.107. Atlantic Shores is requesting authorization for incidental take by Level B harassment of small numbers of marine mammals resulting from the operation of HRG equipment within each of the identified survey areas. The request is based on the following:

- The projected HRG survey activities as described in Section 1;
- The projected survey schedule as described in Section 2;
- The evaluation of the "maximum" acoustic footprint associated with the range of potential sound-producing equipment available on the market that could be deployed within the Survey Area; and
- The mitigation and monitoring measures proposed in Section 11.

6. Take Estimates for Marine Mammals

To determine the type of take that could result from the operation of the HRG survey equipment operating below 180 kHz throughout the survey period, Atlantic Shores followed the interim recommendations provided by NOAA Fisheries (2020) and the NOAA Fisheries HRG Level B Impact Distance Calculation spreadsheet (pers comm. Benjamin Laws, NOAA GARFO 2021) to estimate the maximum horizontal distance to the Level B marine mammal acoustic harassment threshold for impulsive noise (160 $dB_{RMS90\%}$ re 1 μPa) based on equipment source specifications. Results of this assessment are provided in Table 6-1 and Appendix B.

Table 6-1 Maximum Distances to Level B 160 $dB_{RMS90\%}$ Threshold by Equipment Type Operating Below 180 kHz

HRG Survey Equipment (Sub Bottom Profiler)	Representative Equipment Type	Operating Frequencies Ranges (kHz)	Operational Source Level Ranges (dB_{RMS})	Beamwidth Ranges (degree)	Distance to Level B Threshold (m)
Sparker	Applied Acoustics Dura-Spark 240	0.01 – 1.9	203	180	141
	Geo Marine Survey System 2D SUHRS	0.2 to 5	195	180	56
CHIRP	Edgetech 2000-DSS	2 to 16	195	24	56
	Edgetech 216	2 to 16	179	17, 20, or 24	9
	Edgetech 424	4 to 24	180	71	10
	Edgetech 512i	0.7 to 12	179	80	9
	Pangeosubsea Sub-Bottom Imager™	4 to 12.5	190	120	32

As evidenced in Table 6-1, the maximum distance to the Level B harassment threshold is 463 ft (141 m) and results from use of the Applied Acoustics Dura-Spark sparker equipment. This distance was used as the "r" input in calculating the zone of influence (ZOI), which in turn is used to calculate estimated takes of marine mammals (see Section 6). It is unlikely that the sound source (sparker) resulting in the maximum possible impact as presented in Table 6-1 will be used over the entire duration of the 12-month survey period in the identified Survey Area. As such, the assessment included herein is based on conservative assumptions and provides a cautious approach to predicting active survey operations and their potential impact on marine mammal species.

Atlantic Shores seeks authorization for potential take of small numbers of marine mammals by Level B harassment in the specified areas where the proposed activities will occur (Figure 1-1). Anticipated impacts to marine mammals from the proposed survey activities will be associated with noise propagation from the use of specific HRG survey equipment deployed to meet the goals of the survey campaigns conducted over the 12-month period. The following sections present Atlantic Shores' basis for estimating take and associated request for take related to planned HRG surveys.

6.1 Basis for Estimating Numbers of Marine Mammals that Might be Taken by Harassment

As stated in Section 1, Atlantic Shores proposes to conduct a range of HRG surveys over a 12-month period in the Survey Area (Figure 1-1). To provide flexibility in the design, selection, and execution of the survey campaign (including choice of equipment) and to maximize protection of marine mammals from survey activities, Atlantic Shores used the following conservative (i.e., maximum or upper-end) parameters to estimate the potential for take:

- Maximum number of days of survey that could occur over a 12-month period in each of the identified survey areas;
- Maximum distance each vessel could travel per 24-hour period in each of the identified survey areas;
- Maximum ensonified area (ZOI) from the equipment listed in Table 6-1; and
- Maximum average marine mammal densities for any given season that a survey could occur.

The following sections provide additional details on how each of these parameters have been applied to calculate the maximum ZOI associated with the planned survey activities in each survey area, along with estimates and associated requests for take.

6.2 Calculation of Maximum ZOI

The ZOI is the maximum ensonified area around the sound source over a 24-hour period. The following formula for a mobile source was used to calculate the ZOI:

$$\textit{Mobile Source ZOI} = (\textit{Distance/day} \times 2r) + \pi r^2$$

Where:

Distance/day = the maximum distance a survey vessel could travel in a 24-hour period;

r = the maximum radial distance from a given sound source to the NOAA Level A or Level B harassment thresholds.

For the purpose of the Atlantic Shores HRG surveys, the total *distance/day* has been estimated to be approximately 34.2 mi (55.0 km) in the Survey Area (Table 6-2). This estimated distance per day has taken into consideration not only the line-kilometers per day achieved during Atlantic Shores' surveys to date, but also data inputs from previous offshore wind and oil and gas surveys performed by members of the Atlantic Shores Geoscience Teams.

To calculate a conservative ZOI, Atlantic Shores applied the maximum radial distance (*"r")* for any category and type of HRG survey equipment considered in its assessment to the mobile source ZOI calculation. Following the methods in the interim recommendations provided by NOAA Fisheries (2020) and the results from the NOAA Fisheries HRG Level B Impact Distance Calculation spreadsheet, the maximum calculated distance to the Level B harassment threshold for any category and type of HRG survey equipment that could be operated is the sparker at 462.6 ft (141 m; Table 6-2 and Appendix B). As such, the ZOI for the sparker was applied as the maximum assumption.

Results of the maximum mobile source ZOI calculations are provided in Table 6-2.

Table 6-2 HRG Survey Area Distances and Maximum ZOIs

Survey Area	Number of Active Survey Days	Survey distances per day (km)	Maximum Radial Distance (r) (m)	Calculated ZOI per day (km^2)	Total Annual Ensonified Area (km^2)
Lease Area	180	55	141	15.57	2,802.6
ECR Survey Area	180				2,802.6

It should be noted that the maximum ZOI calculation for mobile sources results in a conservative ZOI because:

- it uses the sparker, which produces the largest Level B ZOI, as the basis for the take estimates and assumes it is operational for 100% of the survey effort[3],
- and, that this ZOI is a representation of the maximum extent of the ensonified area around a sound source over a 24-hour period.

6.3 Estimate of Numbers of Marine Mammals that Might be Taken by Harassment

Estimates of take are computed according to the following formula:

$$\text{Estimated Take} = D \times ZOI \times (d).$$

Where:

D = average highest marine mammal species density (number per km^2)
ZOI = maximum ensonified area (as calculated in Section 6.0 and summarized in Table 6-2)
d = number of survey days (as summarized in Table 6-2)

The data used as the basis for estimating species density "*D*" for the Survey Area were 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 (1992-2019) and was prepared in a collaboration between Duke University, Northeast Regional Planning Body, University of North Carolina Wilmington, the Virginia Aquarium and Marine Science Center, and NOAA (Roberts et al. 2016a; Curtice et al. 2018). To determine seasonal densities of marine mammal species in each of the survey areas, density data from Roberts et al. (2016b, 2017, 2018, 2020) were mapped within the boundary of each

[3] Though take estimates account for operation of the sparker during all survey campaigns, Atlantic Shores and their contractor reports that it is more likely that the sparker will only be used during 80% of survey campaigns. Thus, using the sparker to calculate take estimates for the entirety of surveying provides conservative take values.

survey area using geographic information systems (GIS). For each survey area, the densities, as reported by Roberts et al. (2016b, 2017, 2018, 2020), were averaged by season (spring [March - May], summer [June - August], fall [September - November], and winter [December - February]). To support the most conservative estimates of take over a 12-month period, Atlantic Shores applied the maximum average seasonal density values for each marine mammal species to the calculation. The seasonal densities by Survey Area are provided in Appendix C. Maximum average densities used to support the calculations of take are presented in bold. Table 6-4 provides a summary of total take inclusive of the entire Survey Area. It should be noted that calculations do not consider whether a single animal is exposed multiple times or whether each exposure is a different animal. Therefore, the numbers summarized in Table 6-4 are the maximum estimates for animals that may be harassed during the HRG surveys (i.e., Atlantic Shores assumes that each exposure event is a different animal).

For bottlenose dolphin densities, Roberts et al. (2016b, 2017, 2018) does not differentiate by individual stock. Therefore, densities and takes were only analyzed for the offshore stock. For pinnipeds, density data from Roberts et al (2016b, 2017, 2018), which was modeled for a guild of pinnipeds rather than on a species-specific level, was apportioned for gray and harbor seals based on total population size.

While Level B harassment take is unlikely due to the required mitigation measures (e.g., shutdown/power-down if an animal enters the Level B harassment isopleths), requested take estimates were adjusted for some species to account for typical group size. Table 6-3 provides the mean group size for Risso’s dolphin, Atlantic spotted dolphin, and long-finned pilot whale. Increasing takes based on group size provides conservative take estimates by ensuring the number of takes authorized is at least equal to the average group size.

Table 6-3 Average Group Size Used for Adjusting Takes

Species	Average Group Size	Source
Risso’s Dolphin	30	NOAA Fisheries 2022a, 2022e
Atlantic Spotted Dolphin	100	Jefferson et.al (2008), NOAA Fisheries 2022e
Long-finned Pilot Whale	20	NOAA Fisheries 2022a, 2022e

While Table 6-4 provides estimates of take over the entire survey schedule, not all HRG equipment will be in operation for the entire duration. Yet, to provide maximum operational flexibility, this analysis assumes that the sound source that could result in the largest Level B ZOI (sparker) would be used for the entire duration and in all locations. However, it should be noted that, based on past experience by Atlantic Shores, the sparker is estimated to be used only 80% of the time during the surveys. The remaining 20% of survey time will use other equipment that result in a smaller Level B ZOI. Because the equipment resulting in the maximum-case ZOI would not be used during all survey campaigns in each survey area, the calculated take represents a conservative number. In addition, as noted in Section 11.8, for delphinoid cetaceans, HRG survey equipment can continue operating if the individuals voluntarily approach the vessel (e.g., to bow ride) when the sound sources are at full operating power. Therefore, the determination of “voluntary” approach will effectively reduce the numbers and percent population affected for delphinoid cetaceans, below estimated values.

Table 6-4. Total Maximum Average Seasonal Density Marine Mammal Density and Total Estimated Level B Harassment Take Numbers

Species	Lease Area		ECR Survey Area		Total Estimated Takes	
	Maximum Seasonal Density[a] (No./100 km²)	Calculated Take (No.)	Maximum Seasonal Density[a] (No./100 km²)	Calculated Take (No.)	Adjusted Take Authorization (No.)	Percent of Population
North Atlantic right whale	0.386	11	0.475	13	**24**	**6.560**
Humpback whale	0.068	2	0.058	2	**8[d]**	**0.573**
Fin whale	0.295	9	0.216	7	**16**	**0.193**
Sei whale	0.012	0.3[e]	0.013	0.4[e]	**2**	**0.032**
Minke whale	0.168	5	0.112	3	**8**	**0.036**
Sperm whale	0.030	0.9[e]	0.042	2	**3**	**0.069**
Long-finned pilot whale [b]	0.354	10	0.256	8	**20[f]**	**0.051**
Bottlenose dolphin (Offshore stock)	5.011	141	3.231	91	**232**	**0.369**
Short beaked common dolphin	19.246	539	13.251	372	**911**	**0.527**
Atlantic white-sided dolphin	2.213	62	1.611	46	**108**	**0.116**
Atlantic spotted dolphin	0.062	2	0.036	1	**100[f]**	**0.250**
Risso's dolphin	0.089	3	0.038	2	**30[f]**	**0.084**
Harbor porpoise	6.657	187	6.059	170	**357**	**0.373**
Harbor seal [c]	2.446	69	4.001	113	**182**	**0.297**
Gray seal [c]	1.099	31	1.798	51	**82**	**0.300**

Notes:

[a] Cetacean density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020).

[b] Pilot whale density models from Duke University (Roberts et al. 2016a, 2016b, 2017) represent pilot whales as a 'guild' rather than by species. However, since the Survey Area is only expected to contain long-finned pilot whales, it is assumed that pilot whale densities modeled by Roberts et al. (2016a, 2016b, 2017) in the Survey Area only reflect the presence of long-finned pilot whales. Therefore, densities for long-finned pilot whales were not apportioned based on population size.

[c] Pinniped density models from Duke University (Roberts et al. 2016b, 2017, 2018) represent 'seals' as a guild rather than by species. In order to calculate density and take of gray and harbor seals, density of each species was apportioned based on total population size of each species.

[d] Per NOAA Fisheries recommendation according to recent findings that humpback whales were the most commonly sighted species in the New York Bight, the number of modeled exposures (4) is multiplied by an average whale size of 2 for a total of 8 estimated takes. (https://www.tandfonline.com/doi/full/10.1080/17451000.2021.1967993)

[e] Where calculated takes for a species in a given survey area were less than 1 individual (i.e., sei and sperm whales), the number was rounded up to 1 take in each survey area to yield conservative take estimates.

[f] The number of authorized takes (Level B harassment only) for these species has been increased from the calculated take to consider mean group size. Source for long-finned pilot whale estimate is NOAA's Species Directory (NOAA 2022a). Source for Atlantic spotted dolphin group size estimate is Jefferson et al. (2008). A previously issued IHA for Atlantic Shores for a survey area adjacent to the proposed Survey Area increased the number of takes to 100 Atlantic spotted dolphins. Therefore, Atlantic Shores will increase the take of Atlantic spotted dolphin to 100. Source for Risso's dolphin group size estimate is NOAA Species Directory (NOAA 2022a).

7. Anticipated Impact of the Activity

Marine mammals use sound, either by actively producing or passively listening to sounds, for basic life functions such as communication, navigation, foraging, detecting predators, and maintaining social networks. Toothed whales (odontocetes) are known to produce echolocation sounds to image their surroundings and find prey. Additionally, marine mammals passively listen to sounds to learn about their environment by gathering information from other marine mammal species, prey species, and physical phenomena such as wind, waves, rain, and seismic activity (Richardson et al. 1995).

Marine mammals exposed to anthropogenic sound may experience impacts ranging in severity from minor disturbance to non-auditory injury (Southall et al. 2007). The severity of any noise-induced effect on marine mammals depends on the characteristics of received sounds (i.e., received level, frequency band, duration, rise time, duty cycle), the distance the sound travels and the biological context within which it occurs (Ellison et al. 2012, Ellison et al. 2016, Ellison et al. 2018). Impacts most likely to occur from HRG surveys are masking of sound and behavioral disturbance (URI 2021a). Masking effects have the largest impacts on low-frequency communicating mammals like baleen whales (NOAA 2021a). NOAA Fisheries has indicated any effects of masking from sub-bottom profiler equipment on ESA-listed whales (e.g., NARW, fin whale, sei whale, humpback whale) will be insignificant given the directionality of signals for most HRG survey equipment and the mobile nature of marine mammals (NOAA GARFO 2021). Therefore, impacts to masking are not expected to cause population-level impacts. Behavioral disturbances are most likely to occur in the form of displacement. The distance to Level B threshold for proposed HRG equipment (otherwise known as the maximum ensonified area), presented in Table 6-1, is relatively small compared to available habitat of 15 marine mammal species expected to occur in the Survey Area (NOAA 2021a). If displacement of one or more individual marine mammals during HRG survey equipment operation occurs, it would likely be limited to the relatively small area exposed to noise from survey equipment. Most marine mammals avoid sound sources and some species are known for avoiding anthropogenic noise (harbor porpoise). Avoidance or aversion reactions are considered to be of low severity and with no lasting biological consequences (NOAA 2021a; Southall et al. 2007). Since NOAA Fisheries and NOAA Office of Protected Resources have identified impacts from masking and displacement to be insignificant, particularly to sensitive ESA-listed whale species, it can be reasonably assumed that if impacts occur, they would be negligible on a population-level.

Based on the acoustic outputs from surveying work (i.e., non-injurious, Level B harassment), as well as the distribution and density of marine mammals in the Survey Area, impacts to marine mammals are expected to be short-term and minimal. For all species, impacts resulting from sound exposure may affect individuals but have only very low to low risk of impact on marine mammal stocks or populations. The potential impact on the population will depend on the effect on the individual, the size of the species' population and the localized activity. Additionally, protective measures such as vessel strike avoidance procedures and visual monitoring of clearance and shutdown zones will be used to further avoid, minimize or mitigate potential effects. Detailed information regarding protection measures is provided in Section 11 of this Application.

To authorize the incidental take of marine mammals, NOAA Fisheries must determine that harassment resulting from proposed activities will have a negligible impact on marine mammal species or stocks. NOAA Fisheries defines negligible impact as "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" (50 C.F.R. § 216.103).

8. Anticipated Impacts on Subsistence Uses

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

9. Anticipated Impacts on Habitat

As summarized in Section 1.2, bottom disturbance associated with the HRG activities will be limited to grab samples to support the validation of seabed classifications obtained from the multibeam echosounder/side scan sonar data. This temporary and localized impact is considered negligible given the scale of the activity and is unlikely to affect marine mammal species, their habitat, or prey.

The temporary and localized impact of the ZOI associated with sound emitted from various HRG equipment in relation to the comparatively vast area of surrounding open ocean, would result in negligible effects to marine mammals. Impacts on prey species are expected to be limited to temporary avoidance of the area around HRG survey activities and short-term changes in behavior. Such impacts are not expected to result in population-level effects on prey species (BOEM 2012). Individuals disturbed by a survey would likely return to normal behavioral patterns after the survey has ceased or after the animal has left the Survey Area. Because of the limited immediate area of ensonification and duration of individual HRG surveys, few fish may be expected in most cases to be present within the survey areas (BOEM 2012).

Impacts on marine mammal habitat from survey activities described in this application are considered negligible.

10. Anticipated Effects of Habitat Impacts on Marine Mammals

No long-term impacts to marine mammal habitat are expected. Marine mammals use sound to navigate, communicate, avoid predators, and find food sources (URI 2021a). Alterations to the soundscape from survey activities could result in masking effects which can interfere with an animal's ability to perceive (i.e., detect, interpret, and/or discriminate) sounds (URI, 2021b). Though surveying could result in masking, impacts would be temporary and localized, limited to the vicinity of the survey activities. Such impacts are not expected to permanently degrade or reduce available habitat for marine mammals. Additionally, though the Survey Area is located within the NARW migratory corridor, the Survey Area occupies a relatively small portion (approximately 2%) of the migratory corridor area identified along the western Atlantic coastline. Due to the relatively small area that will be occupied by localized survey activities, it is expected that NARW will be able to avoid vessels and survey activities without disrupting their typical behavior.

11. Mitigation Measures to Protect Marine Mammals and Their Habitat

The mitigation and monitoring measures presented in this section represent Atlantic Shores' baseline commitment to ensure the protection of marine mammals during HRG survey activities. The mitigation procedures outlined in this section aligns with the minimum requirements set forth in Atlantic Shores' draft Renewable Energy Lease OCS-A 0541 and the NOAA Fisheries Greater Atlantic Regional Office (GARFO) programmatic consultation regarding geophysical and geotechnical surveys along the U.S. Atlantic coast in the three Atlantic Renewable Energy Regions (i.e., 2021 NOAA GARFO Biological Assessment).

Atlantic Shores has committed to following monitoring and mitigation procedures described in the following sections including vessel strike avoidance, seasonal operating requirements, visual monitoring of clearance and shutdown zones, pre-clearance and ramp-up procedures, and shutdown procedures. Additionally, Atlantic Shores will ensure proper spacing between survey vessels that could be operating in proximity to one another, in order to ensure sound sources do not overlap. Atlantic Shores will provide a Protected Species Mitigation and Monitoring Plan to NOAA Fisheries for review and approval prior to the mobilization of survey activities.

11.1 Vessel Strike Avoidance Procedures

Atlantic Shores will implement vessel strike avoidance measures including, but are not limited to, the following, except under circumstances when complying with these requirements would put the safety of the vessel or crew at risk or when the vessel is restricted in its ability to maneuver:

- A Vessel Strike Avoidance Zone(s) will be maintained, as defined as 1,640 ft (500 m) or greater from any sighted ESA-listed whale species or other unidentified large marine mammal.
- All vessel operators and crew will maintain vigilant watch for all marine mammals, and slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any marine mammals. Unless a required PSO is aboard and on duty, then a designated and trained vessel crew member on all vessels associated with survey activities (transiting [i.e., travelling between a port and survey site] or actively surveying) will be assigned as a lookout for marine mammals.
- Maintain Vessel Strike Avoidance Zone(s) around all surface vessels at all times in accordance with the following parameters, at a minimum:
    - If a large whale is identified within 1,640 ft (500 m) of the forward path of any vessel, the vessel operator must steer a course away from the whale at 10 knots (18.5 km/hr) or less until the 1,640 ft (500 m) minimum separation distance has been established. Vessels may also shift to idle if feasible.
- If a large whale is sighted within 656 ft (200 m) of the forward path of a vessel, the vessel operator must reduce speed and shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel’s path and beyond 1,640 ft (500 m). If stationary, the vessel must not engage engines until the large whale has moved beyond 1,640 ft (500 m). All survey vessels, regardless of size, will observe a 10 knot (less than 18.5 km per hour [km/h]) speed restriction in specific areas designated by NOAA Fisheries for the protection of NARWs from vessel strikes including seasonal management areas (SMAs), Right Whale Slow Zones, and dynamic management areas (DMAs), when in effect.
- All vessels greater than or equal to 65 ft (19.8 m) in overall length operating from November 1 through April 30 will operate at speeds of 10 knots or less while transiting to and from the Survey Area.
- All vessels, regardless of size, will reduce vessel speed to 10 knots or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near (within 330 ft [100 m]) of an underway vessel.
- All vessels will, to the maximum extent practicable, attempt to maintain a minimum separation distance of 164 ft (50 m) from all other marine mammals than ESA-listed and large whales, with an

understanding that at times this may not be possible (e.g., for animals that approach the vessel).

- When marine mammals are sighted while a vessel is underway, the vessel will take action as necessary to avoid violating the relevant separation distance (e.g., attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area). Engines will not be engaged until the animals are clear of the area. This will not apply to any vessel towing gear or any vessel that is navigationally constrained.

A survey vessel crew training program will be provided to NOAA Fisheries for review and approval prior to the start of surveys. All vessel crew members will be briefed in the identification of protected species that may occur in the survey area and in regulations and best practices for avoiding vessel collisions. 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 Seasonal Operating Requirements

Throughout all survey operations, Atlantic Shores will monitor NOAA Fisheries NARW reporting systems for the presence of NARW. If NOAA Fisheries should establish Right Whale Slow Zones or DMA in the Survey Area, survey vessels will abide by established restrictions. While the proposed survey activities will occur outside of the established SMA located off Delaware Bay and the ports of New York/New Jersey, a portion of ECR Survey Area does overlap with the Migratory Route and Calving Grounds SMA located off Raritan Bay (i.e., Ports of New York/New Jersey). If surveys in the ECR Survey Area occur within this SMA between November 1 through April 30, Atlantic Shores will ensure compliance with the requisite speed restrictions.

11.3 Maintenance of Shutdown Zones

Atlantic Shores will maintain shutdown zones below during site characterization survey activities using HRG sources in Table 6-1 operating at frequencies below 180 kHz.

- Shutdown Zones - Protected Species Observers (PSOs) will establish and monitor marine mammal Shutdown Zones. Distances to Shutdown Zones will be from acoustic sources operating below 180 kHz, not the distance from the vessel. Shutdown Zones will be as follows:
    - 1,640 ft (500 m) Shutdown Zone for NARW for use of impulsive acoustic sources (e.g., sparkers) and non-impulsive, nonparametric sub-bottom profilers; and
    - 328 ft (100 m) Shutdown Zone for all other marine mammals for use of impulsive acoustic sources (e.g., sparkers), except for as noted in Section 11.8 for delphinids from the genera *Delphinus*, *Lagenorhynchus*, *Stenella*, or *Tursiops* that are visually detected as voluntarily approaching the vessel or towed equipment.

If shutdown is required, a PSO will notify the survey crew immediately. Vessel operators and crews will comply immediately with any call for shutdown. Shutdown will remain in effect until the minimum separation distances (detailed above) between the animal and noise source are re-established.

11.4 Visual Monitoring Program

Visual monitoring from HRG survey vessels of the established monitoring zones will be performed by qualified, NOAA Fisheries–approved Protected Species Observers (PSOs). Qualifications for PSOs will include completion of an approved PSO training course and/or demonstrated experience in the role of independent PSO during an HRG survey. PSO resumes will be provided to NOAA Fisheries for review and approval prior to the start of survey activities. As they will not be using equipment that generate a sound source with the potential to cause Level B harassment take, geotechnical survey activities and vessels will not require PSOs.

Up to six Protected Species Observers (PSOs) will be on board each one of the three survey vessels (i.e., a total of up to 18 PSOs) that will be conducting 24-hour and daylight only survey operations. PSOs will undertake visual and acoustic watches, implement mitigation and conduct data collection and reporting. PSOs will be assigned to duties as follows:

24-Hour Operations Vessels:

- One PSO will be on watch at all times during transit.
- One PSO will be on watch at all times during daylight source operations.
- Two PSO will be on watch at all times during nighttime operations.

12-Hour/Day-light only Operations Vessels:

- One PSO will be on watch at all times during transit.
- One PSO will be on watch at all times during daylight source operations.

These third-party PSOs will conduct marine mammal visual monitoring when specified acoustic sources (impulsive: sparkers; non-impulsive: non-parametric sub-bottom profilers) are operating below 180 kHz in accordance with the following:

- A minimum of one PSO must be on duty looking for listed species when noise-producing equipment operating below 180 kHz is deployed, or the survey vessel is actively transiting during daylight hours (i.e., from 30 minutes prior to sunrise and through 30 minutes following sunset). If an ESA-listed species are observed within the Clearance or Shutdown Zones, those occurrences will be documented. Two PSOs must be on duty during nighttime operations. A PSO schedule showing that the number of PSOs used is sufficient to effectively monitor the affected area for the project (e.g., surveys) and record the required data must be included.
- PSOs will be employed by a third-party observer provider and will have no tasks other than to conduct observational effort, collect data, and communicate with and instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements (including brief alerts regarding maritime hazards). At least one PSO aboard each acoustic source vessel will have a minimum of 90 days at-sea experience working as a PSO during a geophysical survey, with no more than 18 months elapsed since the conclusion of the at-sea experience. This lead PSO will coordinate duty schedules and roles for the PSO team and serve as primary point of contact for the vessel operator. The responsibility of coordinating duty schedules and roles may instead be assigned to a shore-based, third-party monitoring coordinator. To the maximum extent practicable,

the lead PSO will devise the duty schedule such that experienced PSOs are on duty with those PSOs with appropriate training but who have not yet gained relevant experience.

- Non-third-party observers may be approved by NOAA Fisheries on a case-by-case basis for limited, specific duties in support of approved, independent PSOs on smaller vessels with limited crew capacity operating in nearshore waters.
- Visual monitoring will begin no less than 30 minutes prior to initiation of acoustic sources operating below 180 kHz and will continue until 30 minutes after use of these acoustic sources cease.
- PSOs will coordinate to ensure 360-degree visual coverage around the vessel from the most appropriate observation posts or vantage point(s).
- PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least two hours between watches and may conduct a maximum of 12 hours of observation per 24-hour period.
- In cases where multiple vessels are surveying concurrently, any observations of marine mammals will be communicated to PSOs on all active survey vessels.
- PSOs will be equipped with binoculars and will have the ability to estimate distances to marine mammals located in proximity to the vessel and/or Shutdown Zones. Reticulated binoculars will be available to PSOs for use as appropriate based on conditions and visibility to support the siting and monitoring of marine species.
- Position data will be recorded using hand-held or vessel global positioning system (GPS) units for each sighting.
- Atlantic Shores will consult NOAA Fisheries NARW reporting system and Whale Alert throughout survey operations, when practicable, for notifications about the presence of NARWs, and the establishment of Right Whale Slow Zones and DMA. If NOAA Fisheries should establish a DMA in the Lease Area during the survey, the vessels will abide by speed restrictions in the DMA per the lease conditions.
- Visual PSOs will conduct observations in the following circumstances:
  - During good conditions (e.g., daylight hours; Beaufort sea state 3 or less), and no acoustic sources are operating below 180 kHz, for comparison of sighting rates and behavior with and without use of the specified acoustic sources and between acquisition periods (to the maximum extent practicable); and
  - During all daylight hours, when any acoustic sources are active.
- Night-vision equipment (i.e., night-vision goggles and/or infrared technology) will be available for use during nighttime monitoring. Two PSO will be always on watch during nighttime operations. The PSOs on duty will monitor for marine protected species using infrared LED pistol grip spotlight; and Morovision PVS-7 Gen 3 PINNACLE night vision goggles with a thermal acquisition clip-on system, so PSOs can focus observations in any direction.
- Any observations of marine mammals by crew members aboard any vessel associated with the survey will be relayed to the PSO team.
- In cases when clearance has begun in conditions with good visibility, including via the use of night-vision equipment, and the lead PSO has determined that the pre-start clearance zones (as

described in Section 11.6 of this IHA) are clear of marine mammals, survey operations may commence (i.e., no delay is required) despite brief periods of inclement weather and/or loss of daylight. In cases where Shutdown Zones cannot be adequately monitored for ESA-listed species (e.g., low visibility conditions), no equipment operating <180 kHz will be deployed until the Shutdown Zone can be reliably monitored.

- Data on all PSO observations will be recorded based on standard PSO collection requirements. PSOs will use standardized data forms, whether hard copy or electronic.

As part of the monitoring program, PSOs will record all sightings beyond the established Clearance and Shutdown Zones, as far as they can see. This will include dates and locations of survey efforts; time of observation, location and weather; details of the sightings (e.g., species, age classification [if known], numbers, behavior); and details of any observed behavioral disturbances or injury/mortality. In addition, prior to initiation of survey work, all crew members will undergo environmental training, a component of which will focus on the procedures for sighting and protection of marine mammals and sea turtles. A briefing will also be conducted between the survey supervisors and crews, the PSOs, and Atlantic Shores. 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.

11.5 Clearance Zones

PSOs will conduct 30 minutes of clearance observation prior to the initiation of HRG survey operations using impulsive sources operating below 180 kHz. Clearance observations are not required during HRG survey operations using only non-impulsive sources (e.g., USBL and parametric sub-bottom profilers), unless non-parametric sub-bottom profilers are used (e.g., CHIRPs). If a marine mammal is observed entering or within the clearance zones during the pre-start clearance period, relevant acoustic sources will not be initiated until the marine mammal(s) is confirmed by visual observation to have exited the relevant zone, or, until an additional time period has elapsed with no further sighting of the animal (15 minutes for small odontocetes and seals and 30 minutes for all other species). The pre-start clearance requirement includes small delphinids that approach the vessel. If any ESA-listed species is observed within the Clearance Zone during the 30-minute pre-clearance period, the presence of that animal will be recorded, and the 30-minute clock must be paused. If the PSO confirms the animal has exited the zone and headed away from the survey vessel, the 30-minute clock that was paused may resume. The pre-clearance clock will reset to 30 minutes if the animal dives or visual contact is otherwise lost.

Clearance Zones are in effect when HRG surveys are operating impulsive sources operating below 180 kHz. HRG surveys using impulsive sources and non-impulsive, non-parametric sub-bottom profilers will not be initiated if:

- a NARW or other ESA-listed species is observed within a 1,640 ft (500 m) radius of impulsive acoustic sources (e.g., sparkers) and non-impulsive, nonparametric sub-bottom profilers during the pre-start clearance period; or

- any other marine mammals are observed within a 328 ft (100 m) radius of impulsive acoustic sources (e.g., sparkers) and non-impulsive, nonparametric sub-bottom profilers during the pre-start clearance period.

11.6 Ramp-Up Procedures

When technically feasible, acoustic sources operating below 180 kHz will be ramped up at the start or restart of survey activities. Ramp-up must begin with the power of the smallest acoustic equipment at its lowest practical power output. When technically feasible, the power will then be gradually turned up and other acoustic sources added in a way such that the source level would increase gradually. Ramp-up procedures are not required during HRG survey operations using only non-impulsive sources (e.g., USBL and parametric sub-bottom profilers) other than non-parametric sub-bottom profilers (e.g., CHIRPs).

Ramp-up activities will be delayed if a marine mammal(s) enters its respective Clearance Zone. Ramp-up will continue if the animal has been observed exiting its respective Clearance Zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes and seals and 30 minutes for all other marine mammal species).

11.7 Shutdown and Power-Down Procedures

If a marine mammal is observed within or entering the relevant Exclusion Zones as described under Section 11.3 of this IHA while acoustic sources operating below 180 kHz are in use, the acoustic sources will be immediately shut down (except for delphinids from the genera *Delphinus*, *Lagenorhynchus*, *Stenella*, or *Tursiops* as described in more detail below).

Any PSO on duty has the authority to call for shutdown of acoustic sources. When there is certainty regarding the need for mitigation action on the basis of visual detection, the relevant PSO(s) will call for such action immediately. When a shutdown is called for by a PSO, the shutdown will occur and any dispute resolved only following shutdown. Vessel operators will establish and maintain clear lines of communication directly between PSOs on duty and crew controlling the acoustic source(s) to ensure that shutdown commands are conveyed swiftly, while allowing PSOs to maintain watch.

Upon implementation of a shutdown, survey equipment will be reactivated when all marine mammals that triggered the shutdown have been confirmed by visual observation to have exited the relevant Exclusion Zone or an additional time period has elapsed with no further sighting of the animal that triggered the shutdown (15 minutes for small odontocetes (i.e., species comprising the family Phocoenidae and the species comprising the genera *Delphinus*, *Lagenorhynchus*, *Stenella* [*frontalis* only], or *Tursiops*), and seals; 30 minutes for all other marine mammals).

If acoustic sources operating below 180 kHz are shut down for less than 30 minutes for reasons other than marine mammal mitigation (e.g., due to mechanical or electronic failure), the equipment may be re-activated as soon as is practicable at full operational level if PSOs have maintained constant visual observation during the shutdown and no visual detections of marine mammals occurred within the applicable Exclusion Zone during that time. For a shutdown of 30 minutes or longer, or if visual observation was not continued diligently during the pause, pre-start clearance observation will be conducted, as previously described, unless visual observation was continued diligently during the entire pause with no further detections of any marine mammals.

If delphinids from the genera *Delphinus*, *Lagenorhynchus*, *Stenella* (*frontalis* only), or *Tursiops* are visually detected approaching the vessel or towed acoustic sources, 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 will use best professional judgment in making the decision to call for a shutdown.

Shutdown of acoustic sources is required upon observation of either a species for which incidental take is not authorized or a species for which incidental take has been authorized but the authorized number of takes has been met, entering or within the zone defined for Level B harassment (i.e., within approximately 463 ft (141 m) of HRG survey equipment operating below 180 kHz listed in Table 6-1).

Shutdown is not required during HRG survey operations using only non-impulsive sources (e.g., USBL and parametric sub-bottom profilers) other than non-parametric sub-bottom profilers (e.g., CHIRPs). Pre-clearance and ramp-up, but not shutdown, are required when using non-impulsive, non-parametric subbottom profilers.

12. Mitigation Measures to Protect Subsistence Uses – Arctic Plan of Cooperation

Potential impacts to species or stocks of marine mammals will be limited to individuals of marine mammal species located in the Mid-Atlantic Bight 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 Atlantic Shores' marine characterization surveys 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 Monitoring

Visual monitoring protocols are described in Section 11.4.

13.2 Reporting

Atlantic Shores will provide the following communications or reports as necessary during survey activities:

- Within 90 days after survey demobilization, or 60 days prior to a requested date or issuance of any future IHAs for projects at the same location, whichever comes first, a final technical monitoring report will be submitted to BOEM and NOAA Fisheries (to renewable_reporting@boem.gov and PR.ITP.MonitoringReports@noaa.gov). that fully documents the methods and monitoring protocols, summarizes the data recorded during monitoring, describes, assesses, and compares the effectiveness of monitoring and mitigation measures. Any recommendations made by NOAA Fisheries will be addressed in the final report prior to acceptance by NOAA Fisheries. PSO effort datasheets and sightings data and trackline data in Excel spreadsheet format will also be provided with the draft and final monitoring report.
- Data from all PSO observations must be recorded based on standard PSO collection and reporting requirements. PSOs must use standardized electronic data forms to record data. The following information must be reported electronically in a format approved by BOEM and NOAA Fisheries:

  Visual Effort:
  a. Vessel name;
  b. Dates of departures and returns to port with port name;
  c. Lease number;
  d. PSO names and affiliations;
  e. PSO ID (if applicable);
  f. PSO location on vessel;
  g. Height of observation deck above water surface (in meters);

h. Visual monitoring equipment used;
i. Dates and times (Greenwich Mean Time) of survey on/off effort and times corresponding with PSO on/off effort;
j. Vessel location (latitude/longitude, decimal degrees) when survey effort begins and ends; vessel location at beginning and end of visual PSO duty shifts; recorded at 30 second intervals if obtainable from data collection software, otherwise at practical regular interval;
k. Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any change;
l. Water depth (if obtainable from data collection software) (in meters);
m. Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions change significantly), including wind speed and direction, Beaufort scale, Beaufort wind force, swell height (in meters), swell angle, precipitation, cloud cover, sun glare, and overall visibility to the horizon;
n. Factors that may be contributing to impaired observations during each PSO shift change or as needed as environmental conditions change (e.g., vessel traffic, equipment malfunctions);
o. Survey activity information, such as type of survey equipment in operation, acoustic source power output while in operation, and any other notes of significance (i.e., pre-clearance survey, ramp-up, shutdown, end of operations, etc.);

Visual Sighting (all Visual Effort fields plus):

a. Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);
b. Vessel/survey activity at time of sighting;
c. PSO/PSO ID who sighted the animal;
d. Time of sighting;
e. Initial detection method;
f. Sightings cue;
g. Vessel location at time of sighting (decimal degrees);
h. Direction of vessel's travel (compass direction);
i. Direction of animal's travel relative to the vessel;
j. Identification of the animal (e.g., genus/species, lowest possible taxonomic level, or unidentified); also note the composition of the group if there is a mix of species;
k. Species reliability;
l. Radial distance;
m. Distance method;
n. Group size; Estimated number of animals (high/low/best);
o. Estimated number of animals by cohort (adults, yearlings, juveniles, calves, group composition, etc.);
p. Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);
q. Detailed behavior observations (e.g., number of blows, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior);
r. Mitigation Action; Description of any actions implemented in response to the sighting (e.g., delays, shutdown, ramp-up, speed or course alteration, etc.) and time and location of the action.
s. Behavioral observation to mitigation;
t. Equipment operating during sighting;
u. Source depth (in meters);
v. Source frequency;
w. Animal's closest point of approach and/or closest distance from the center point of the acoustic source;
x. Time entered shutdown zone;
y. Time exited shutdown zone;

z. Time in shutdown zone;
aa. Photos/Video

- If a NARW is observed at any time by PSOs or personnel on any project vessels, during surveys or during vessel transit, the sighting will be reported within two hours of occurrence when practicable and no later than 24 hours after occurrence to the NOAA Fisheries NARW Sighting Advisory System (866-755-6622) or the U.S. Coast Guard via channel 16. If an injured or dead NARW is discovered, Atlantic Shores will report the incident as quickly as possible to NOAA Fisheries by phone (866-755-6622).
- Sightings of any injured or dead listed species must be immediately reported, regardless of whether the injury or death is related to survey operations, to BOEM (renewable_reporting@boem.gov), NOAA Fisheries (nmfs.gar.incidental.take@noaa.gov), and the appropriate regional NOAA stranding hotline (from Maine-Virginia report sightings to 866-755-6622, When reporting sightings of injured or dead listed species, the following information must be included:
    a. Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
    b. Species identification (if known) or description of the animal(s) involved;
    c. Condition of the animal(s) (including carcass condition if the animal is dead);
    d. Observed behaviors of the animal(s), if alive;
    e. If available, photographs or video footage of the animal(s); and
    f. General circumstances under which the animal was discovered.
- In the event of a vessel strike of a protected species by any survey vessel, the project proponent must immediately report the incident to BOEM (renewable_reporting@boem.gov) and NOAA Fisheries (nmfs.gar.incidental.take@noaa.gov) and for marine mammals to the NOAA stranding hotline: from Maine-Virginia, report to 866-755-6622. The report must include the following information:
    a. Name, telephone, and email or the person providing the report;
    b. The vessel name;
    c. The Lease Number;
    d. Time, date, and location (latitude/longitude) of the incident;
    e. Species identification (if known) or description of the animal(s) involved;
    f. Vessel's speed during and leading up to the incident;
    g. Vessel's course/heading and what operations were being conducted (if applicable);
    h. Status of all sound sources in use;
    i. Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;
    j. Environmental conditions (wave height, wind speed, light, cloud cover, weather, water depth);

k. Estimated size and length of animal that was struck;

l. Description of the behavior of the species immediately preceding and following the strike;

m. If available, description of the presence and behavior of any other protected species immediately preceding the strike;

n. Disposition of the animal (e.g., dead, injured but alive, injured and moving, blood or tissue observed in the water, last sighted direction of travel, status unknown, disappeared); and

o. To the extent practicable, photographs or video footage of the animal(s).

14. Suggested Means of Coordination

All marine mammal data collected by Atlantic Shores during marine characterization survey 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 during field verification of the safety and/or Exclusion Zones by Atlantic Shores during HRG surveys 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. List of Preparers

Jeff Nield
EDR
Senior Project Manager & New England Practice Leader

Caitlin Pfeil
EDR
Environmental Scientist

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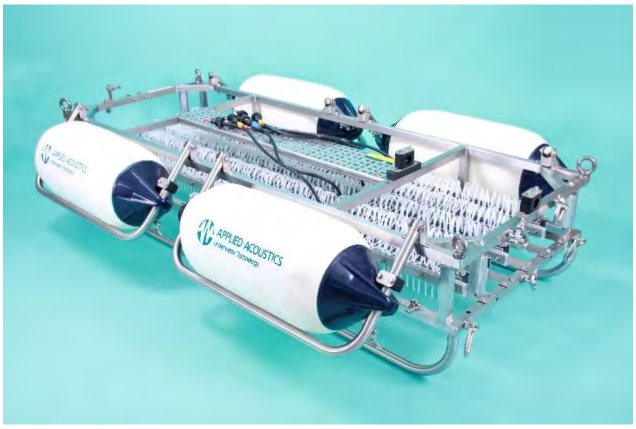
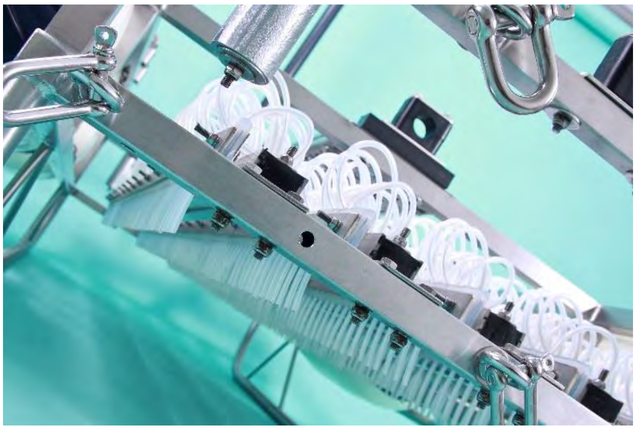
Appendix A

Manufacturer Specifications

Applied Acoustic Engineering Ltd
Marine House, Marine Park, Gapton Hall Road
Great Yarmouth, NR31 0NB
United Kingdom

Dura-Spark UHD, Seismic Sound Source





Key Features

- Long life, durable electrodes
- Pulse stability
- High resolution sub-bottom data, up to 25cms
- Tip array selection from on board junction box
- Flip-flop capability
- GNSS receiver option (101G MiniPod)

Applications

- High and Ultra-High Resolution geophysical surveys
- Single and multi-channel acquisition
- Water depths of 5 to >1000m

The Dura-Spark UHD has been designed to provide a stable, repeatable sound source for sub-bottom geophysical surveys. The long life, durable electrodes produce a consistent pulse signature and keep operational maintenance to a minimum. This provides increased survey efficiency and equipment reliability as the sparker tips rarely need replacement.

The Dura-Spark UHD consists of either 5 or 3 arrays of 80 tips that allow the operator to tune the source from the vessel to its application. This flexibility, together with selectable source depth, allows the sound source to be used in both shallow and deep waters.

The typical operational bandwidth of the Dura-Spark UHD is 300Hz to 1.2kHz. When coupled with the CSP-Nv Seismic Power Supply the system offers 2000J/s peak discharge rate, as well as industry leading design and safety standards.

Dura-Spark UHD Technical Specification

PHYSICAL

Dimensions	Length 1893mm Height 372mm frame, 622mm including floatation Width 650mm frame, 1280mm including floatation
Weight	130kg (max)
Connector	RMK 1/0 complete with locking collar

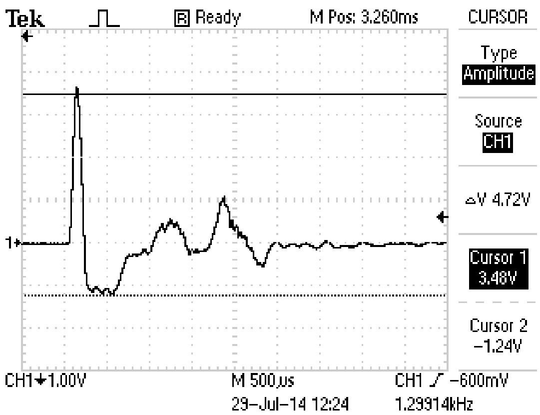
ELECTRICAL

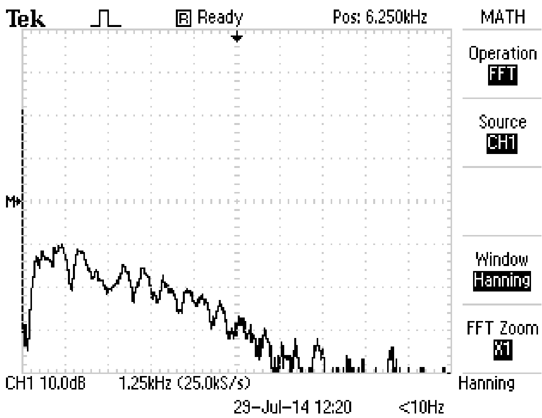
400 tip	2000J, 5J per tip to minimise bubble collapse component, 2400J maximum
240 tip	1000J, 5J per tip to minimise bubble collapse component, 1250J Maximum
Operating voltage	3000-4000V
Maximum number of tips	400 (5 x 80), 240 (3 x 80)
Power supply	CSP-Nv1200, CSP-Nv2400, CSP-SNv1250

SOUND OUTPUT

Source level	226dB re 1µPa at 1m (typical)
Pulse length	0.5 to 1.5ms Dependent on power applied

TYPICAL PULSE SIGNATURES AT 2000J





APPLIED ACOUSTICS
Underwater Technology
An AAE Technologies Group Company

Registration No. QU160081a
ISO9001:2015

Applied Acoustic Engineering Ltd
Marine House, Marine Park
Gapton Hall Road
Great Yarmouth NR31 0NB
United Kingdom

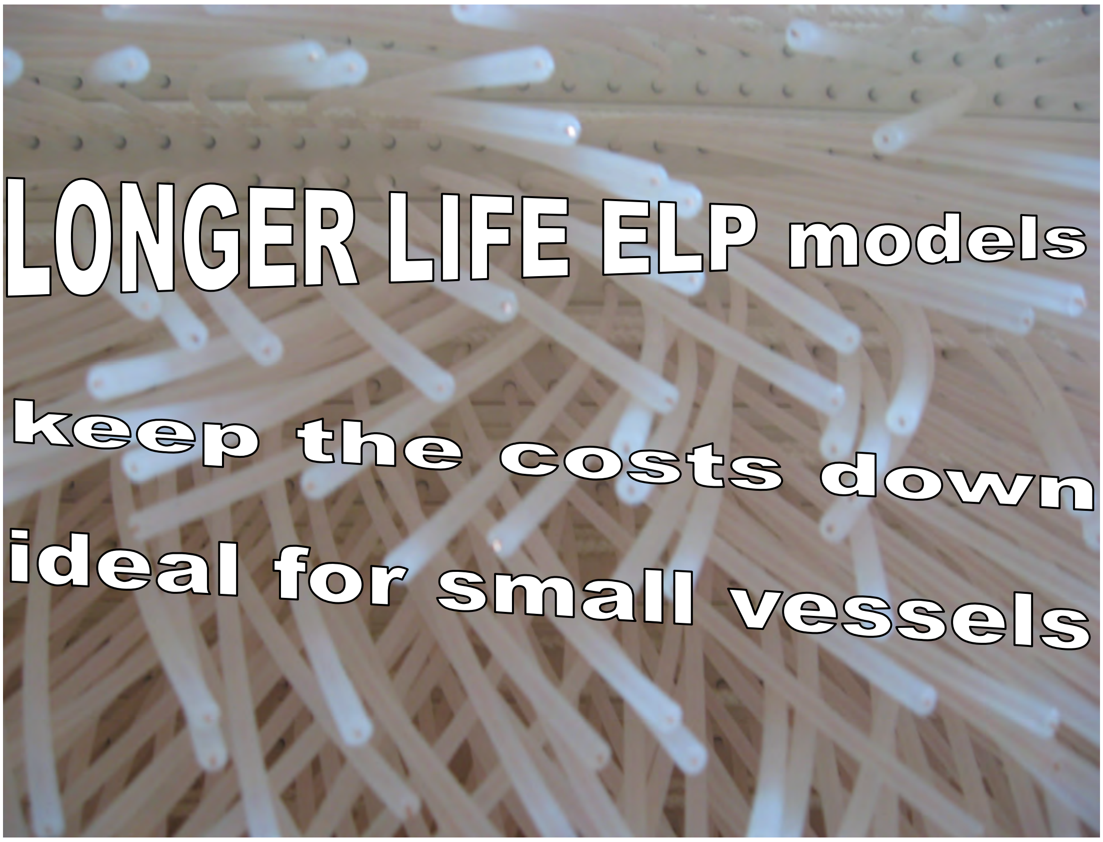
T +44(0)1493 440355
F +44(0)1493 440720
E general@appliedacoustics.com
W www.appliedacoustics.com

SIG sparker-electrodes

SIG

www.marine-seismic-equipments.com

- Longer life ELP models,
- Floating spark-arrays,
- no catamaran necessary,
- Easily replaceable,
- Interchangeable on the same high voltage tow cable



SIG sparker-electrodes

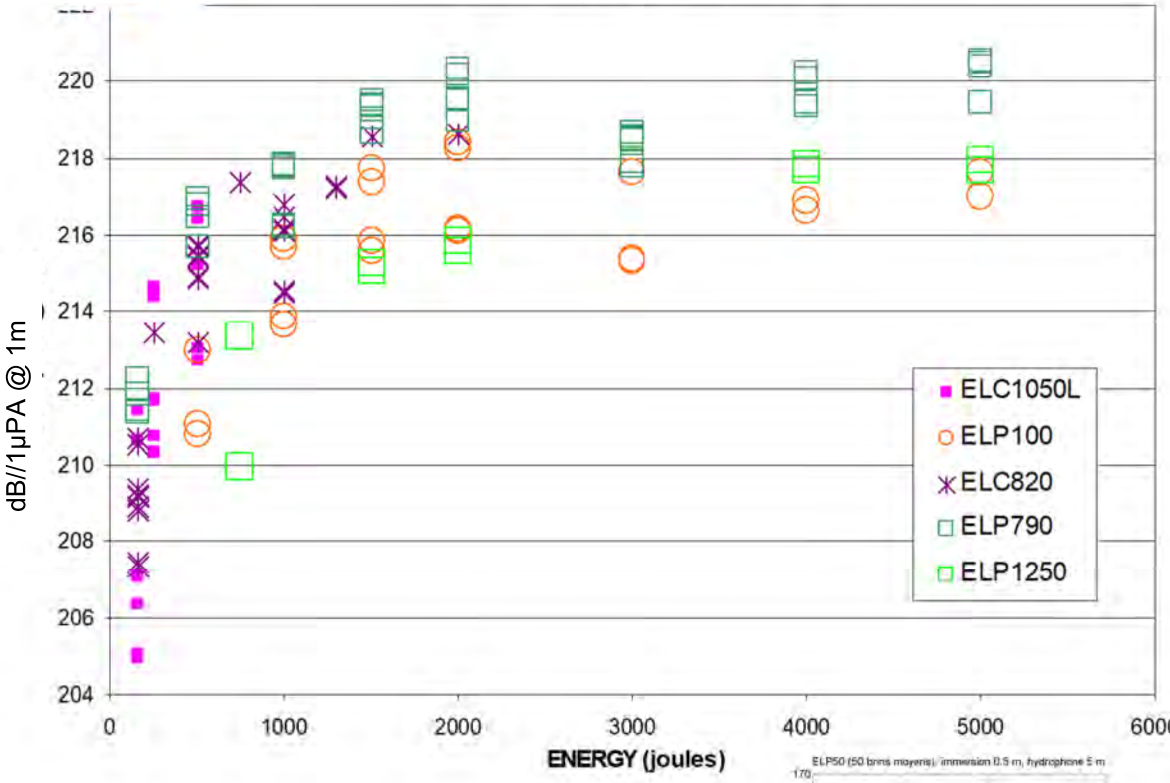
S.I.G.
ZA Route de Campbon
44130 BOUVRON
FRANCE

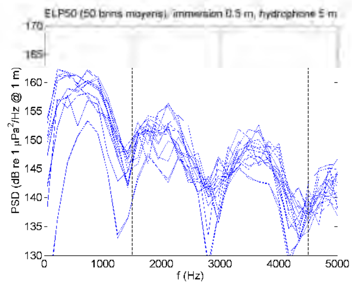
Tel : +33 (0)240 56 31 16
Fax : +33 (0)240 56 20 55
www.marine-seismic-equipments.com
info@sigfrance.com

SIG SPARKER-ELECTRODES MODELS

- ELC 1050L
- ELC1200L
- ELC820
- EDL1020
- ELP 790
- ELP1250

Higher frequency	ELC1050L & ELC1200L	ELC820	EDL1020
Operating energy level :	100 to 500 joules	500 to 1000 joules	400 to 2000 joules
Frequency spectrum :	1000—1400 Hz	900—1400 Hz	900—1400 Hz
Acoustic power level :	217 dB re 1µPa @ 1 m	219 dB re 1µPa @ 1 m	220 dB re 1µPa @ 1 m
Pulse duration :	0.8 ms @ 250 J Immersed 20 cm	0.8 ms @ 750 J Immersed @ 20 cm	1.1 ms @ 1500 J, Immersed @ 40 cm
Dimensions :	0.50 m x 0.60 m x 0.04 m	1 m x 0.60 m x 0.04 m	1 m x 0.60 m x 0.06 m
Weight :	1.0 kg	1.8 kg	3.5 kg



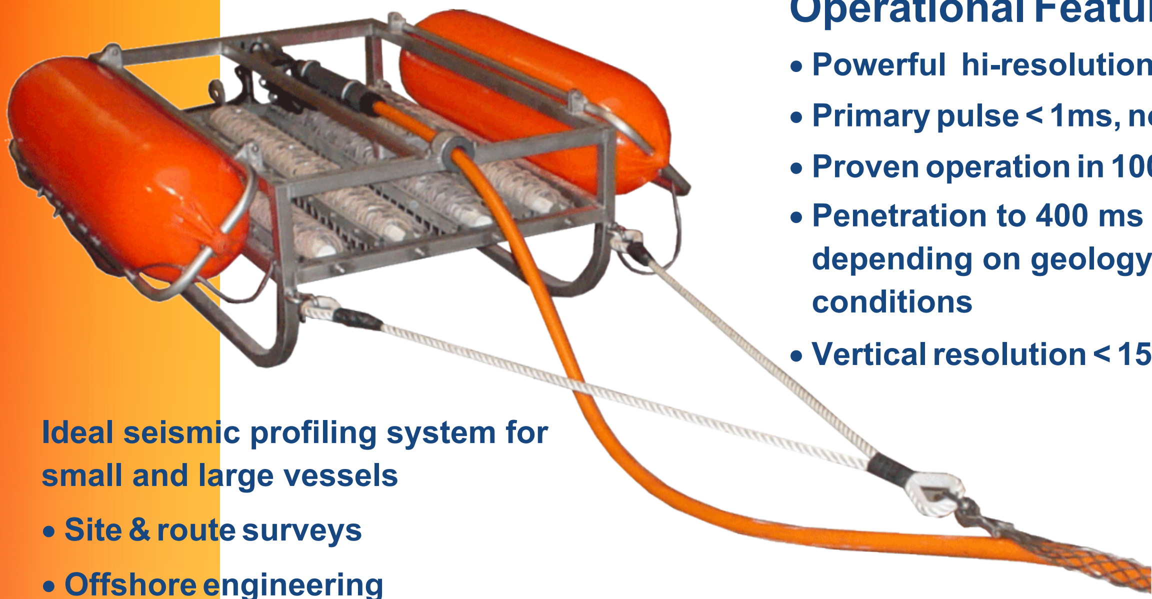


ELP SERIES
COMPROMISE BETWEEN THE LOW COST
AND THE NECESSARY TRIMMING
THE ELP SERIES IS LONGER LIFE

Lower frequency	ELP790	ELP1250
Operating energy level :	100 to 3000 joules Optimal 400-1200 joules	1000 to 6000 joules Optimal 1600 joules
Frequency spectrum :	< 800 Hz after 1000 J @ 50cm	Centered 1200 Hz @ 30cm
Acoustic power level :	220 dB re 1µPa @ 1 m	216-218 dB re 1µPa @ 1 m
Pulse duration (immersed @ 30 cm)	Primary 1.18 ms @ 500 J Delta T secondary 2.9 ms @ 1000 J	Primary 1.27 ms @ 2000 J Delta T secondary 2.8 ms @ 4000 J
Dimensions :	1 m x 0.60 m x 0.06 m	1 m x 0.60 m x 0.06 m
Weight :	2 kg	5.2 kg

Geo-Source 200 - 400

Marine Multi-Tip Sparker System



Operational Features

- Powerful hi-resolution seismic source
- Primary pulse < 1ms, no ringing
- Proven operation in 1000 m water depth
- Penetration to 400 ms below seabed, depending on geology and survey conditions
- Vertical resolution < 15 cm

Ideal seismic profiling system for small and large vessels

- Site & route surveys
- Offshore engineering
- Mineral exploration
- Oceanographic research

INNOVATIVE Preserving Electrode Mode

The innovative Geo-Source 200 has been designed for operation with the Geo-Spark 1000 pulsed power supply (PPS) using the patented **Preserving Electrode Mode.** This mode uses a NEGATIVE electric discharge pulse instead of a positive pulse.

(Please note that this negative pulse is NOT the same as the simple reversal of the positive polarity of a 'standard' power supply.)

Maintenance free electrodes 5 year guarantee

The Preserving Electrode Mode **reduces the tip wear to practically zero**. You can shoot day after day, week after week, month after month with practically **NO tip maintenance.**

Always a stable acoustic pulse

Zero tip wear is essential for the **acoustic repeatability** of the pulse, which depends largely on a constant, unaltered electrode surface and tip insulation.

Efficient & Cost Effective

With the Geo-Spark HV power supplies you will save a lot of time and money, since the electrodes do NOT burn off like in all other systems.

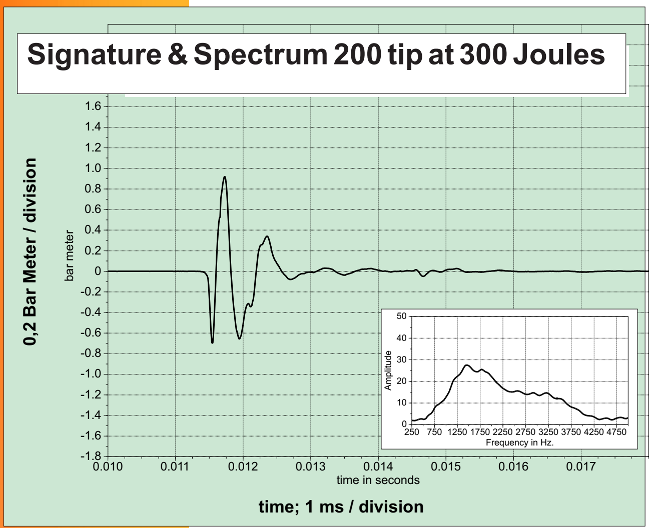
You don't need to trim tips during the survey. There is no need to have any stock of consumables.

Examples of Records

To see examples of our sparker records, please visit the 'Downloads' page on our website: ***www.geo-spark.com***

Geo-Source 200-400

Technical Specifications



Electrodes Geometry

The electrode modules are evenly spaced in a planar array of 0.75 m x 1.00 m. This geometry not only enhances the downward projection of the acoustic energy, it also reduces the primary pulse length, since all tips are perfectly in phase.

Control of Source Parameters 200 - 400 tips

The advanced Geo-Source 200-400 design gives you total control of the source depth and the energy (Joules) per tip

Source depth

Two floats provide a stable towing configuration and insure the proper depth of the electrode tips. This is critical to achieve constructive interference between the primary pulse and its own sea-surface reflection (surface ghost)

Number of tips in use and Energy per tip

Four individually powered electrode modules of 50 or 100 tips each allow you to distribute the energy from the Geo-Spark power supply over 50, 100......, up to 400 tips. (Each tip has an exposed surface area of 1.4 mm^2.)

200 tips, the classic 200 tip configuration is normally used with the Geo-Spark 1000 PPS and consists of four 50-tip electrode modules. This configuration gives an excellent hi-res pulse over the 100 to 500 J power range.

400 tips, for higher energies above 1000 J, and in particular with the Geo-Spark 2000X, we recommend a 400 tip configuration with 4 x 100-tip electrode modules

Coaxial High Voltage (HV) Power/Tow Cable

The Geo-Source 200 is towed by a very high quality, Kevlar-reinforced, coaxial power/tow cable with stainless steel kellum grip. This dedicated high voltage (HV) cable contains **4 x 10 mm^2** inner cores (negative) plus a **40 mm^2** braiding (ground-referenced). It is designed to have a very low self-inductance to preserve the high dI/dt pulse output of the Geo-Spark 1000 PPS.

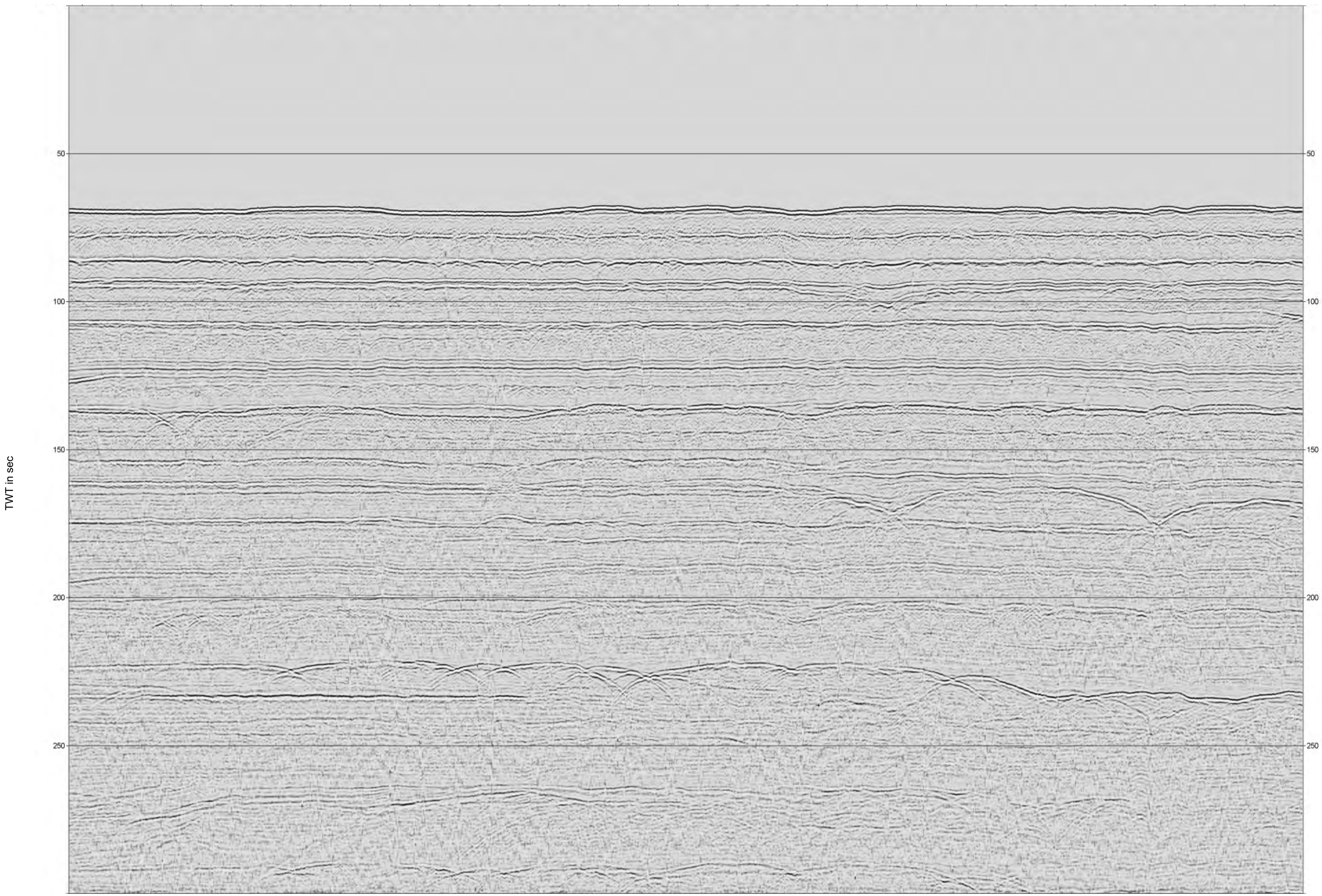
The coaxial structure of the HV cable reduces the electromagnetic interference to the absolute minimum.

The wet end of the cable is terminated with four special HV connectors to the electrode modules and a ground connector to the frame. Connecting or disconnecting the cable to the Geo-Source 200 takes only 10 minutes; so you can handle the sparker sled and the HV cable as independent units.

The dry end of the cable is terminated at the Geo-Source 200 patch panel, which allows you to select the number of electrode arrays in use

Maintenance free electrodes, no trimming, stable signature

GEO Marine Survey Systems b.v.
Sheffieldstraat 8, 3047 AP Rotterdam
The Netherlands
Phone: + 31 10 41 55 755
Fax: +31 10 41 55 351
info@geomarinesurveysystems.com
Website: www.geo-spark.com



Location: Thailand

Date: August 2008

Client: MVM Surveys

Water Depth: 50 - 300 m

Acquisition

Source: Geo-Spark 200
Power Supply: Geo-Spark 1 kJ
Power: 300 J
Streamer: Geo sense
Recording System: Geo-Trace 2
Shot interval: 0.5 s
Record length: 300 ms
Sample Rate: 8000 Hz

Processing

Frequency filtering
Gain
Swell filter
Muting

Display

Horizontal scale 1:4000
Vertical scale 1 cm = 8 ms
One timeline every 50 ms

Geo-Resources BV
Heemraadssingel 235
3023 CD Rotterdam
Netherlands

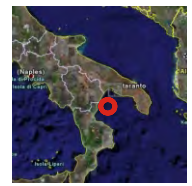
Phone: +31 10 425 83 70
Fax: +31 10 244 01 04

info@geo-resources.com
www.geo-resources.com

Geo-Spark 200 Thailand- August 2008

Alternating sand and clay layers.
Strong reflector at the base of layer turbiditic sequence represents the top of Messinian evaporites.

Taranto Italy - May 2005



Location: Taranto Italy

Date: May 2005

Client: Nautilus

Water Depth: 450 - 650 m

Acquisition

Source: Geo-Spark 200
Power Supply: Geo-Spark 1 kJ
Power: 700 J
Streamer: Geo-sense 8 elements
Recording System: Geo-Trace 2
Shot interval: 3 s
Record length: 1500 ms
Sample Rate: 8000 Hz

Processing

Frequency filtering
Gain
Swell filter
Muting

Display

Horizontal scale 1:12000
Vertical scale 1 cm = 15 ms
One timeline every 50 ms

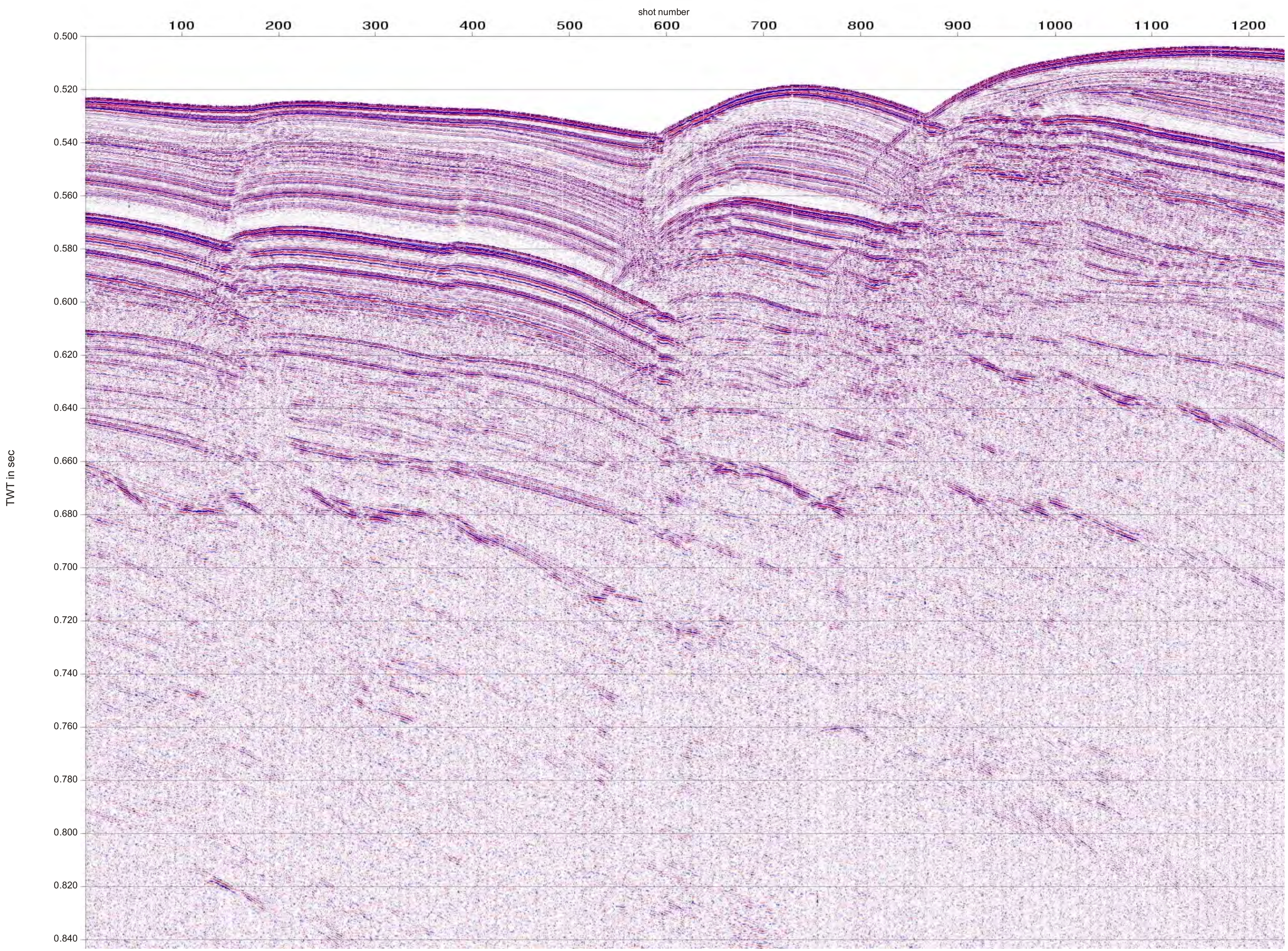
Geo-Resources BV
Heemraadssingel 235
3023 CD Rotterdam
Netherlands

Phone: +31 10 425 83 70
Fax: +31 10 244 01 04

info@geo-resources.com
www.geo-resources.com

Approximately 500m

M09



Mediterranean Sea Egypt , October 2005

RESOURCES

Location: Mediterranean Sea, Egypte

Date: October 2005

Client : Impresub

Water Depth: 350 - 400 m

Acquisition

Source: Geo-Spark 200
Power Supply: Geo-Spark 1 KJ
Streamer: Geo sense 8 elements
Recording System: Geo-Trace 2
Shot interval: 2 s
Record length: 1000 ms
Sample Rate: 10000 Hz

Display

Horizontal scale 1:9000
Vertical scale 1 cm = 10 ms
One timeline every 20 ms

Geo-Resources BV
Heemraadssingel 235
3023 CD Rotterdam
Netherlands

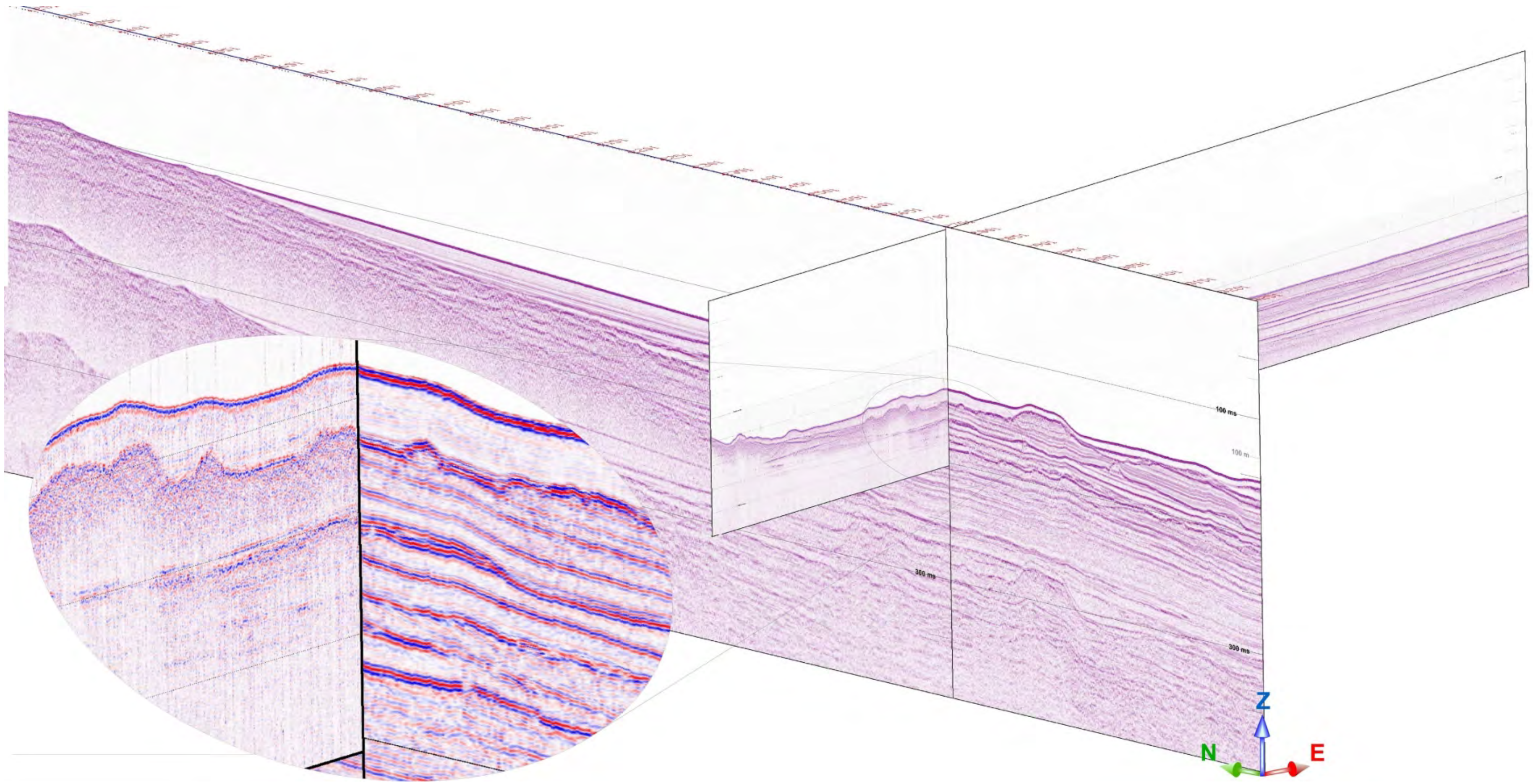
Phone: +31 10 425 83 70
Fax: +31 10 244 01 04

info@geo-resources.com
www.geo-resources.com

Approximately 500m

Comparison between the Sparker Geo-Spark 800 and a Chirp system.

Appreciate the difference of resolution and penetration.



Location: Elba Italy

Date: November 2004

Water Depth: 75 - 115 m

Courtesy of Danillo Morelli, Trieste University

Acquisition

Source: Geo-Spark 800
Power Supply: Geo-Spark 6 kJ
Recording System: Geo-Trace 2
Shot interval: 2 s
Record length: 1000 ms
Sample Rate: 6000 Hz

Sparker Processing

Frequency filtering
Gain
Swell filter
Muting

Display

Horizontal scale 1:5000
Vertical scale 1 cm = 25 ms
One scale line every 100 ms
Data displayed in 3D with OpendTect

Geo-Resources BV
Heemraadssingel 235
3023 CD Rotterdam
Netherlands

Phone: +31 10 425 83 70
Fax: +31 10 244 01 04

info@geo-resources.com
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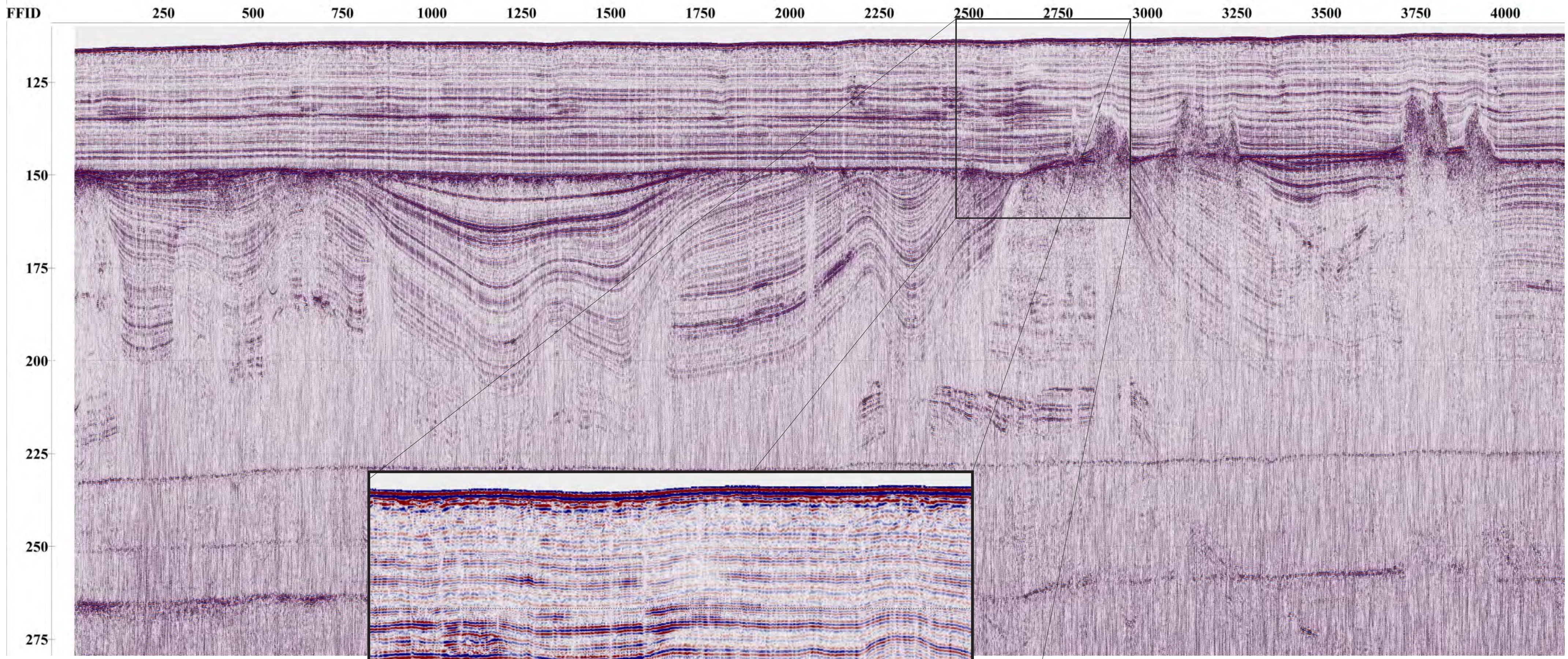
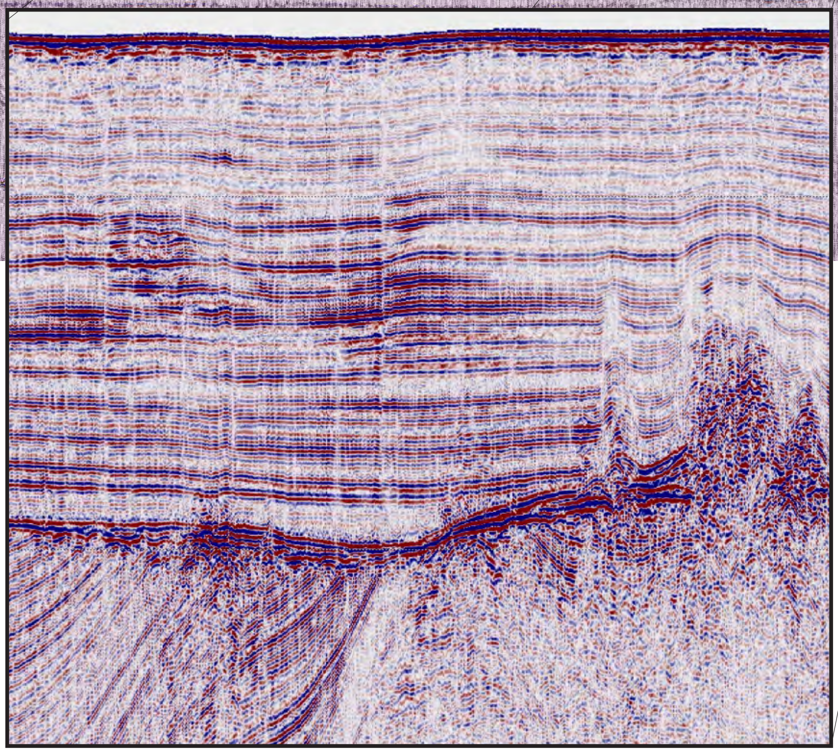
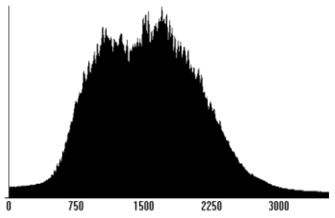
Elba Italy - November 2004

Approximately 200m







Appreciate the frequency content up to 3000 Hz and the decimeter scale resolution

Sparker profile shot with the Geo-Source 200 LW using the Geo-Spark 1000 pulsed power supply

Energy: 300 J, Negative Discharge Technology

Vertical Scale in meters, Aspect ratio 1 :20

Location: Sicily, Gellasabbia
Date: May 2012
Geophysicist: Dr. Henrique Duarte

Geo-Source 400 Light Weight

Dimensions (cm) & Weight	110 (L) x 120 (W) x 60 (H) for 80 kg
Tips Number	400
Operation Depth (m)	0 - 2,500
Dominant Frequencies	1000-1500 Hz (at 800 Joules)
Compatible Power Supply	Geo-Spark 1000 Geo-Spark 2000 XF Geo-Spark 7000 XF

2.1.2 Processor Unit Specs

The specifications for the Processing Unit within the rack mount topside are shown in TABLE 2-2.

SPECIFICATION	VALUE
Mother Board	Intel I7 6700 Quad Core 3.4GHz. 8 MB Cache
Sonar Interface	Sonar Interface board (Tiger board) composed of carrier board, Acquisition board, and Sonar board
Memory	8 GB DDR4 RAM
Hard Drives	500 GB minimum (operating system) 1 TB minimum (Removable Drive [Hot Swappable])
DVD-R/W drive	10x4x32 minimum speed
Operating system	Windows 7 64 Bit
Application software	DISCOVER Sub-Bottom
Display	High resolution 23-inch flat panel LCD monitor
Keyboard	High impact industrial
Trackball	High impact industrial
I/O ports	(4) RS-232 Front: (2) Ethernet Ports (2) USB2 Rear: (2) USB2 (2) USB3 (2) USB3.1
Analog input	16-bit resolution, 200 kHz max sampling rate
Analog Output	16-bit resolution, 200 kHz max sampling rate
Pulse type	Full Spectrum CHIRP FM
Pulse length	5-100 ms, depending on tow vehicle and application
Bandwidth	0.5-15 kHz, depending on tow vehicle and application
Trigger in	TTL negative edge triggered
Trigger out	TTL negative edge triggered, 5ms ling pulse minimum
Sampling rate	20, 25, 40, or 50 kHz, depending on the transmit upper frequency
Acoustic power	212 dB re1 NPa @ 1 meter peak (approx.) at center frequency
Input voltage	120-220 VAC, 50/60 Hz, auto sense

Table 2-2: 3200-XS Topside Processor Specs

2.1.3 Power Amplifier

The specifications for the Power Amplifier are show in TABLE 2-5, TABLE 2-4, and TABLE 2-5.

2.1.3.1 Power Output

SPECIFICATION	VALUE
2-ohm Dual (*per channel*)	20 mS BURST: 4,700 W 20 Hz – 20 kHz: 2,800 W 1 kHz: 2,800 W
4-ohm Dual (*per channel*)	3,500 W
8-ohm Dual (*per channel*)	1,500 W
4-ohm Bridge	5,600 W
8-ohm Bridge	6,000 W

Table 2-3: Power Amplifier Specs: Power Output

EdgeTech

2000 SERIES

COMBINED SIDE SCAN SONAR & SUB-BOTTOM PROFILING SYSTEM

KEY SPECIFICATIONS

SIDE SCAN SONAR		
Frequency (dual simultaneous CHIRP)	100/400 kHz	300/600 kHz
Operating Range	100 kHz: 500 meters/side 400 kHz: 150 meters/side	300 kHz: 230 meters/side 600 kHz: 120 meters/side
Beam Width (2-way) & Along Track Resolution	100 kHz: 1.08 deg or 1.90 m @ 100 m 400 kHz: 0.56 deg or 0.96 m @100 m	300 kHz: 0.6 deg or 1.0 m @ 100 m 600 kHz: 0.26 deg 0.45 m @ 100 m
Across Track Resolution	100 kHz: 6.3 cm 400 kHz: 1.8 cm	300 kHz: 2.8 cm 600 kHz: 1.4 cm

SUB-BOTTOM PROFILER	2000-CSS	2000-DSS	2000-TVD
Frequency Band	500 Hz – 12 kHz	2-16 kHz	1-10 kHz
Resolution	8-20 cm	6-10 cm	9-25 cm
Penetration in coarse sand	20m	6m	20m
Penetration in clay	200m	80m	200m
TOWFISH	**2000-CSS**	**2000-DSS**	**2000-TVD**
Length	160 cm (63")	145 cm (57")	226 cm (89")
Width	124 cm (49")	74 cm (30")	81 cm (32")
Height	47 cm (18.5")	84 cm (33")	55 cm (22")
Weight in Air	232 kg (510 lbs.)	145 kg (320 lbs.)	250 kg (550 lbs.)
Maximum Water Depth	300m	2,000m	3000m

TOPSIDE PROCESSOR	
Hardware	Standard 19" rack
Operating System	Windows XP
Display	Dual 22" high resolution flat panel monitors
Archive	DVD-R/W and/or LAN connection
File Format	Native JSF or XTF for side scan, SEG-Y for sub-bottom
Output	Ethernet
Power Input	90 to 132 VAC and 180 to 260 VAC, Auto voltage detect and switching, 47-63 Hz

For more information please visit EdgeTech.com

info@EdgeTech.com | USA 1.508.291.0057

SPECIFICATION	SB-424 VALUE	SB-216S VALUE	SB-512i VALUE
Frequency range	4-24 kHz	2-16 kHz	0.5-12 kHz
Pulse type	FM	FM	FM & WB (wide band)
Pulse bandwidth/pulse length	4-24 kHz/10 ms 4-20 kHz/10 ms 4-16 kHz/10 ms	2-15 kHz/20 ms 2-12 kHz/20 ms 2-10 kHz/20 ms	0.5-8.0 kHz/5 ms FM 0.5-2.7 kHz/40 ms WB 0.5-6.0 kHz/20 ms WB 0.5-4.5 kHz/50 ms FM 0.5–6.0 kHz/9 ms FM 0.5–6.0 kHz/18 ms FM 0.5–7.2 kHz/30 ms FM 0.7–12.0 kHz/20 ms FM 2.0–12.0 kHz/20 ms FM
Calibration:	Gaussian-shaped pulse spectrum	Gaussian-shaped pulse spectrum	Gaussian- and rectangular-shaped pulse spectrum
Vertical resolution[a]	4 cm (4–24 kHz) 6 cm (4–20 kHz) 8 cm (4–16 kHz)	6 cm (2–15 kHz) 8 cm (2–12 kHz) 10 cm (2–10 kHz)	19 cm (1–5.0 kHz) 12 cm (1.5–7.5 kHz) 8 cm (2–12 kHz)
Penetration in course and calcareous sand[b]	2 m (typ)	6 m (typ)	30 m (typ)
Penetration in soft clay[b]	40 m	80 m	250 m
Beam width	16°, 4–24 kHz 19°, 4–20 kHz 23°, 4–16 kHz	17°, 2–15 kHz 20°, 2–12 kHz 24°, 2–10 kHz	41°, 0.5–5 kHz 32°, 1–6 kHz 24°, 1.5–7.5 kHz 16°, 2–12 kHz
Optimum tow vehicle pitch/roll[c]	<7°, 4–24 kHz <8°, 4–20 kHz <10°, 4–16 kHz	<7°, 2–15 kHz <8°, 2–12 kHz <10°, 2–10 kHz	<16°, 0.5–5 kHz <13°, 1–6 kHz <10°, 2–8 kHz <8°, 2–10 kHz <7°, 2–12 kHz
Optimum tow height	3-5m above sea floor	3-5 m above sea floor	3-5 m above sea floor
Transmitters	1	1	2
Receive arrays	2	2	4
Output power	2000 W	2000W	2000 W
Tow vehicle size	77 cm (30 in.) L 50 cm (20 in.) W 34 cm (13 in.) H	105 cm (41 in.) 67 cm (26 in.) W 46 cm (18 in.) H	158 cm (62 in.) L 134 cm (53 in.) W 46 cm (18 in.) H
Shipping container size	91 cm (36 in.) L 66 cm (26 in.) W 64 cm (25 in.) H	117 cm (46 in.) L 79 cm (31 in.) W 61 cm (24 in.) H	173 cm (68 in.) L 137 cm (54 in.) W 71 cm (28 in.) H
Weight in air	35 kg (78 lb)	72 kg (160 lb)	186 kg (410 lb)
Shipping weight	110 kg (243 lb)	162 kg (357 lb)	356 kg (783 lb)
Tow cable requirements	3 shield-twisted wire pairs	3 shield-twisted wire pairs	3 shield-twisted wire pairs
Depth rating	300 m (984 ft) max	300 m (984 ft) max	300 m (984 ft) max

Table 2-6: Tow Vehicle Specifications

Sub-Bottom Imager™ Sound Source Analysis

for

Information

January 5, 2015

RPT-04563-1

Table of Contents

1 PURPOSE OF DOCUMENT

The purpose of this document is to summarize sound level information pertaining to the Sub-Bottom Imager™ (SBI) high frequency (HF) acoustic projectors, which are operated from a moving platform such as an ROV or vessel. This document will serve as a basis for sound source verification as may be requested by clients.

2 MEASUREMENT APPROACH

In this document, distances to Sound Pressure Level (SPL) and Sound Exposure Level (SEL) isopleths were estimated assuming spherical and cylindrical spreading, where appropriate. This approach does not consider variations in sound propagation due to the geoacoustic properties of the seabed as well as hybrid models.

The Sub-Bottom Imager™ is operated at a nominal elevation of 3.5m (±0.5m) above the seafloor from a moving platform such as an ROV or an over-the-side mounting on a vessel for shallow water applications (i.e. <10m water depth). In this analysis, the acoustic sources are assumed to be omni-directional point sources; the beam pattern of each acoustic projector was not taken into consideration. As such, this analysis is therefore a worst-case approach given that the source does have directionality. All Source Levels (SL) from transducers are assumed to be levels that would occur directly under the transducers in the direction of the seabed (peak of main lobe). The transducer face is assumed to be at the normal elevation of 3.5 m above the seabed.

3 SUB-BOTTOM IMAGER™ SYSTEM AND ACQUISTION PRINCIPLES

The Sub-Bottom Imager™ (SBI) uses multi-aspect acoustic intensity imaging to delineate sub-seabed stratigraphy and buried objects. These buried objects can be infrastructure such as cables and pipelines or can be geohazards such as boulders, hard-ground, man-made debris, abandoned seabed infrastructure and unexploded ordnance. SBI surveys reduce risk and offers subsequent cost reductions during the installation and burial of offshore infrastructure such as pipelines, power cables and umbilicals.

The SBI is an ROV/Vessel deployed unit with a 3.8m folding boom containing sonar projectors and receivers and associated electronics in bottles (Figure 1). The SBI utilizes high frequency (HF) chirp projectors to deliver a continuous 5m x 5m swath below the sub-seabed in real time (Figure 3). The high-resolution volumetric images provide 3D imaging of offshore infrastructure and geohazards to penetration depths of 5m or more depending on soil complexity (Figure 3).

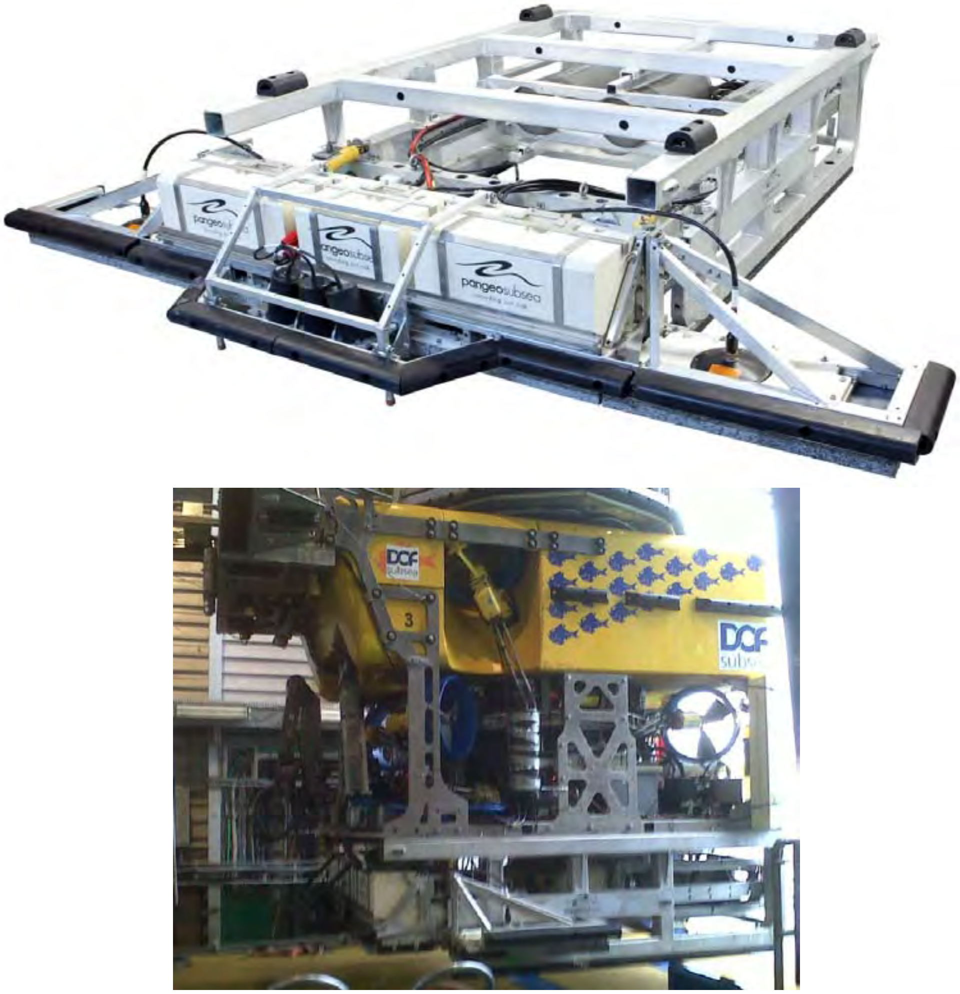


Figure 1: Sub-Bottom Imager™ (complete SBI equipment on an ROV skid (top panel) and SBI on a WROV bottom skid with multibeam also onboard (bottom panel)

3.1 Volumetric Imaging

During acquisition, the Sub-Bottom Imager™ repetitively ensonifies the volume of seabed under the hydrophone array and continuously receives the resulting acoustic reflections from within the seabed, as the array moves forward on the platform. This “raw” sonar data is digitized and transmitted via Ethernet over the vehicles fibre optic umbilical to the surface support vessel.

The high-volume, continuous flow of data is “rendered” on board by computers employing parallel processing architectures to produce a 3D volumetric data set of the seabed (Figure 3). The acoustic data is processed using a combination of beam forming algorithms and synthetic aperture algorithms to render a 3D data volume representing the acoustic reflectivity of the sub-bottom (Figure 2). The seabed under the array can be thought of as a three dimensional cube, encompassing an array of voxels, each comprising x, y, z position, signal intensity, and contribution count. The data is referenced to INS position and each cell contains the average signal intensity of the number of times that voxel was contributed to as the array traversed over top.

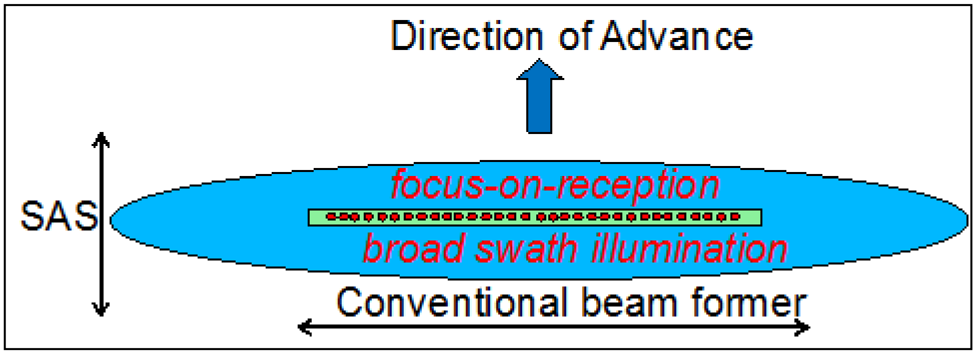


Figure 2: Schematic of SBI Method of Operation

Figure 3 shows the ensonified seabed volume after rendering limits are applied, visualized in the 3D survey software environment (in this case NaviModel). Signal intensity is represented by color with blue representing quieter areas and red higher intensity reflections. The upper blue layer is the water column below the transducer array with the adjacent red layer the seabed interface. The acoustic beam spreads out as the signal penetrates into the seabed, giving a volume width of 3.5m at the transducer, increasing to approximately 5m at the lower extent of the vertical penetration into the seabed of about 5m. The SBI rendered image is used to identify acoustic stratigraphy and acoustic anomalies, consistent with buried objects and geohazards, with a depth-dependent spatial resolution that is a function of the type of seabed (Figure 4).

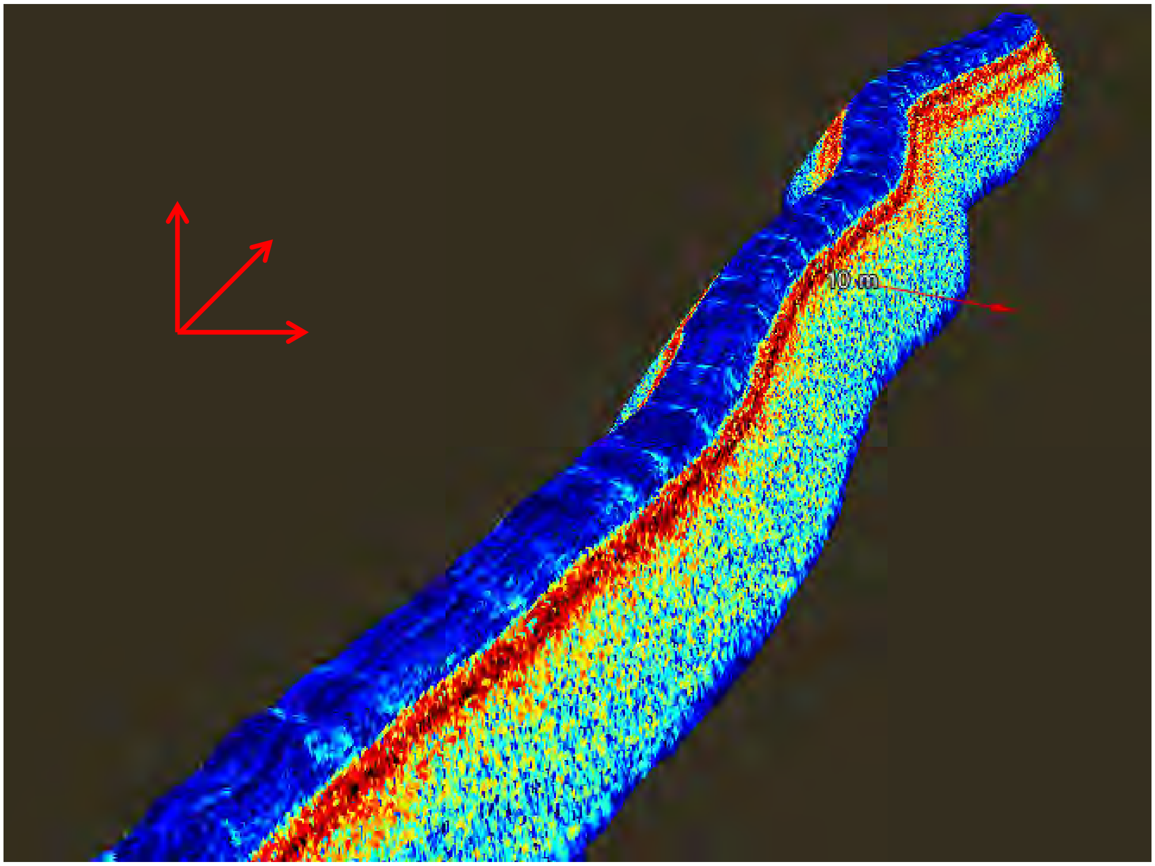


Figure 3: SBI rendered data volume along ROV flight path. This data volume is sectioned and sliced to reveal details of stratigraphy and buried.

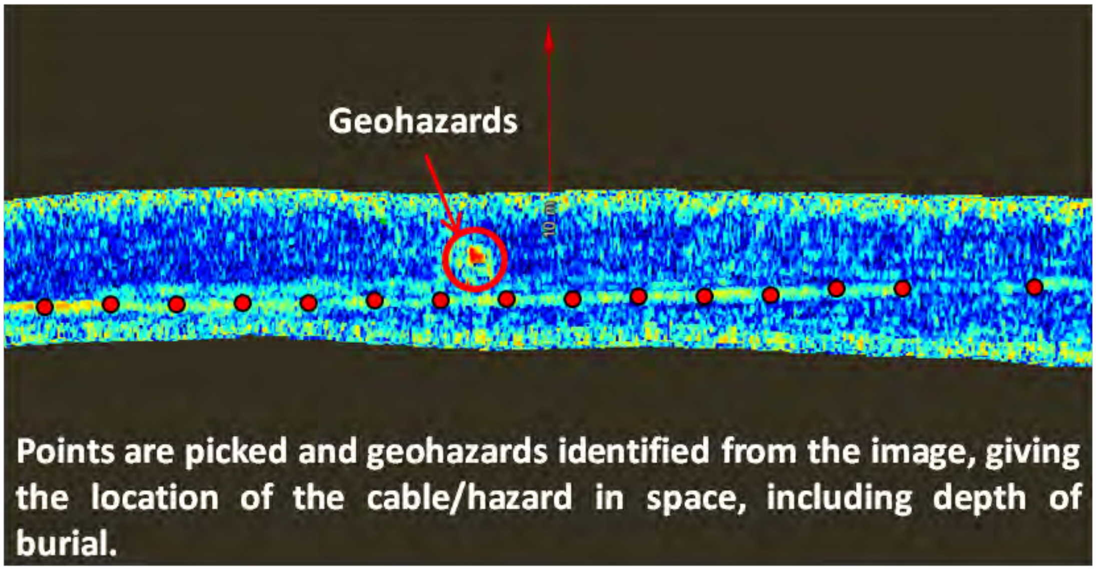


Figure 4: The SBI rendered image is used to provide x-y-z position of surveyed infrastructure and identified geohazards

4 RECEIVED SOUND LEVEL ANALYSIS

4.1 Acoustic Metrics

Sound pressure levels metrics are used to evaluate the levels of the Sub-Bottom Imager HF chirp sound sources and their effects on marine life. The acoustic metrics used are:

- rms sound pressure level (SPL, dB re 1µPa) in a stated frequency band over a time window of T seconds and containing the pulse is defined as:

$$SPL = 10\log_{10}\left(\frac{1}{Tp_0^2}\int_T p^2(t)dt\right) \quad (1)$$

- sound exposure level (SEL, dB re 1µPa^2.s) is the time integral of the squared pressure in a stated frequency band over a stated time interval or event. In this case SEL_{sweep} represents 100% of the acoustic energy inone sweep:

$$SEL = 10\log_{10}\left(\frac{1}{T_0p_0^2}\int_T p^2(t)dt\right) \quad (2)$$

where T_0 is a reference time interval of 1 s and T is the duration of the transmitted signal and in marine settings the reference sound pressure, p_0, equals 1 µPa.

The SPL and SEL are related by the following expression (where $T_0 = 1s$), which depends only on the duration of the time window T:

$$SEL = SPL + 10\log_{10}(T) \quad (3)$$

- cumulative sound exposure level ($cSEL$, dB re 1µPa^2.s) represents the total energy received over a defined operational period (in this case 24 hours). For the Acoustic Corer™ case:

$$cSEL = SPL + 10\log_{10}(T_{sweep}) + 10\log_{10}(N_{sweep}) \quad (4)$$

where N_{sweep} is the number of sweeps transmitted in 24 hours.

The distances to isopleths of 180 and 160 dB re 1µPa for SPL and180 and 160 dB re 1µPa^2.s for SEL, as well as 198 and 186 dB re 1µPa^2.s for $cSEL$ are shown respectively in Table 2, Table 4, and Table 5 and are calculated as recommended in Southall et al. (2007), NMFS (2005) and MMPA (2007). In order to calculate the above levels the following transmission loss (TL) models are used:

- up to a distance of 3.5m a spherical spreading loss is assumed,

$$TL_{spherical} = 20\ \log_{10} R \quad (5)$$

- at distances greater than 3.5m is estimated assuming cylindrical spreading loss:

$$TL_{cylindrical} = 10\ \log_{10} R \quad (6)$$

IMPORTANT: It is crucial to recognize that this model represents the worse case scenario. That is, the transmission loss model is a substantial under-estimate of actual transmission losses as:

- directivity of the transmit signal is not taken into account and the values used are those of the rms pressure on the peak of the main lobe,

- transmission into sediments and absorption are not taken into consideration,
- the main lobe of the transducer points orthogonally to the seafloor and therefore substantial amount of the transmitted energy of the main lobe is transmitted into the subsurface
- in most applications of the SBI the water depth is greater than 20 metres and therefore the cylindrical transmission loss model beyond the 3.5 metre radius is substantially under-estimating the actual transmission loss.

Hence, the distance to the SPL_{iso} isopleth, $R(SPL_{iso})$, is calculated as in [5]:

$$R(SPL_{iso}) = \begin{cases} 10^{\frac{SPL(1) - SPL_{iso}}{20}} if SPL(1) \geq \; SPL_{iso} \; \geq SPL(3.5) \\ 10^{\frac{SPL(3.5) - SPLiso + 10\log_{10}(3.5)}{10}} if SPL_{iso} \; \leq \; SPL(3.5) \end{cases} \qquad (7)$$

Where $SPL(x)$ the rms sound pressure level at x meters away from the transmitter (note that by definition $SPL(1) = SPL$) and,

$$SPL(3.5) = \; SPL(1) - 20\log_{10}(3.5)$$

The distance to the SEL_{iso} isopleths is calculated as in [5]:

$$R(SEL_{iso}) = \begin{cases} 10^{\frac{SEL(1) - SEL_{iso}}{20}} if SEL(1) \geq \; SEL_{iso} \; \geq SEL(3.5) \\ 10^{\frac{SEL(3.5) - SEL_{iso} + 10\log_{10}(3.5)}{10}} if SEL_{iso} \; \leq \; SEL(3.5) \end{cases} \qquad (8)$$

Where $SEL(x)$ the rms sound pressure level at x meters away from the transmitter (note that by definition $SEL(1) = SEL$) and,

$$SEL(3.5) = \; SEL(1) - 20\log_{10}(3.5)$$

For the purpose of these calculations the source is considered stationary, which provides a substantial over-estimate of distances to sound level isopleths. The sound pressure levels of the cumulative sound pressure level, $cSEL$, are calculated as in the case of SEL, however all instances of SEL in Equation (8) are replaced with $cSEL$.

5 SOUND SOURCE INFORMATION AND CALCULATIONS

5.1 Volumetric Data Acquisition (HF Chirp Transducers)

5.1.1 High Frequency Chirp Transducer Background Information

The SBI is equipped with a Neptune 4108 C/D transducer as its HF chirp source. The transducer is generally operated in the 4.5 to 12.5 kHz frequency band. The continuous wave (CW) source level associated with these frequencies is shown in Table 1and Figure 5. From this figure the continuous sweep source level ($SL_{p\text{-}continuous}$) is determined to be 190 dB re 1μPa•m. In Table 1, the CW source level were determined using a calibrated S-range transducer and a calibrated hydrophone to illustrate the Neptune 4108 A/B transmit voltage sensitivities at each tested frequency.

Table 1: HF transducer continuous wave source level with frequency

Frequency (Hz)	CW Source Level (dB re: 1μPa·m)
4000	179.7
4500	180.0
5000	191.6
5500	189.8
6000	191.4
6500	189.0
7000	188.3
7500	189.4
8000	189.3
8500	187.3
9000	186.5
9500	186.7
10000	185.9
10500	186.1
11000	185.7
11500	187.1
12000	187.0
12500	187.9
13000	188.8
13500	184.9
14000	181.8

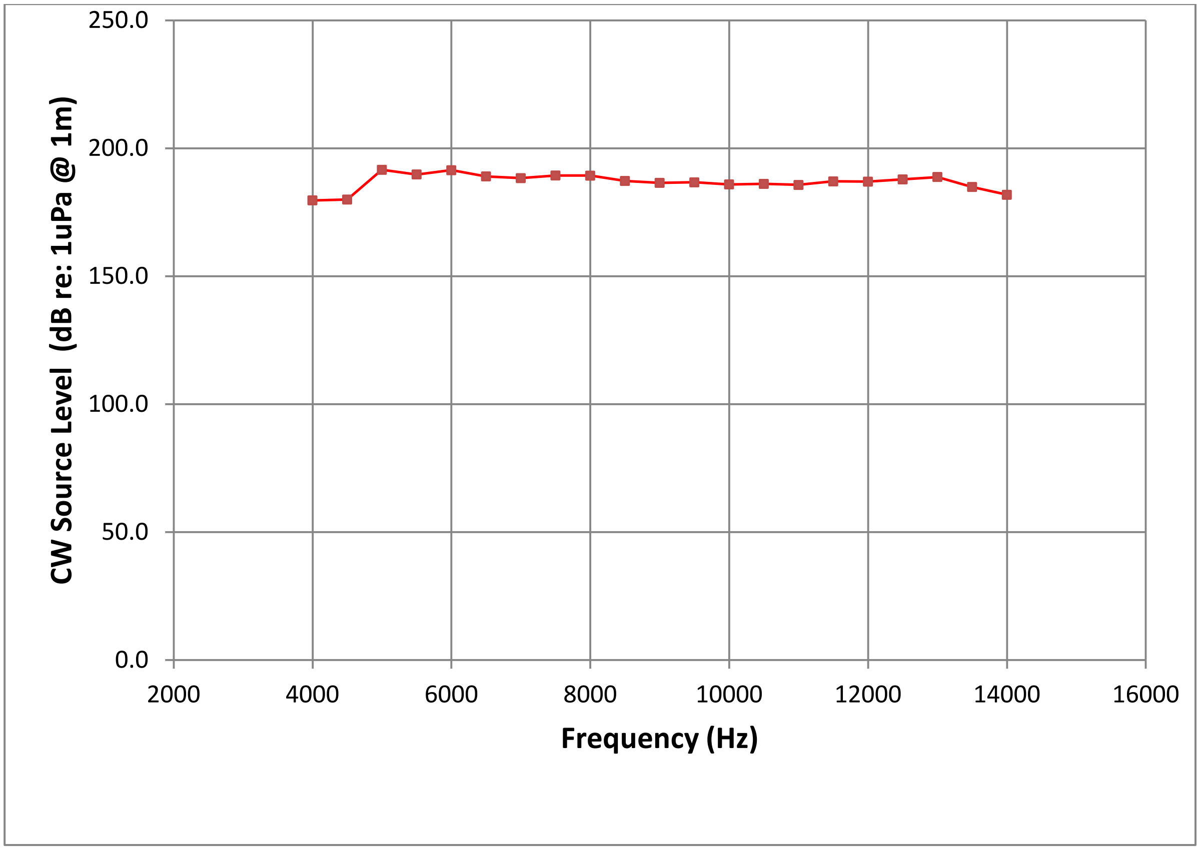


Figure 5: High Frequency transducer continuous wave sound level versus frequency

5.1.2 HF Chirp Transducer Acoustic Metrics

For a continuous SBI sweep:

$SL_{p\text{-}continuous}$= 190 dB re 1μPa•m

where at 1m from the source,

$$SPL_{chirplet} = SL_{p-continuous}$$

Therefore, for a sweep with a triangular wave-shape modulation:

$$SPL = SPL_{sweep} + 20 \log_{10} M$$

where,

M = triangular wave-shape modulation and rms to peak factor = $\sqrt{2/3}$

Provided that the SPL values are relatively flat across the total sweep bandwidth (as shown in Figure 5), the SPL value for the entire sweep is calculated as:

$SPL = 190 - 1.8 = 188.2$ dB re 1μPa @1m

and the sound exposure level associated with a single sweep is:

$$SEL = SPL + 10 \log_{10} T_{sweep}$$

where T_{sweep} is the total time between start of the sweep to the beginning of the next sweep,

$$T_{sweep} = 0.0769 \text{ sec}$$

which results in,

$$SEL = 188.2 + 10 \log_{10}(0.0769) = 177.1 \text{ dB re } 1\mu Pa^2.s \text{ @ } 1m$$

The cumulative SEL ($cSEL$) is calculated by adding the SEL values (in dB scale) from all the sweeps received in 1 hour given a ping rate of 7 Hz. The calculation also assumes the worst-case scenario that the receiver does not move away from the source as the source moves in the water column:

$$cSEL = SEL + 10 \log_{10}(N_{sweep})$$

where N_{sweep} (= 25200) is the total number of sweeps received in 1 hour resulting in,

$$cSEL = 177.1 + 10 \log_{10}(25200) = 221.1 \text{ dB re } 1\mu Pa^2.s \text{ @ } 1m$$

The distance to the SPL_{iso} isopleths is calculated using Equation 7 and the distances to the SEL_{iso} and $cSEL_{iso}$ isopleths is calculated using Equation 8.

The results of the isopleth calculations are shown in the table below**.**

Table 2: Source levels and maximally over-estimated distance to sound level isopleths for the high frequency (HF) chirp source

Source	SPL dB re: 1μPa	SEL dB re: 1μPa^2.s	Range (m) to $\boldsymbol{SPL_{iso}}$		Range (m) to $\boldsymbol{SEL_{iso}}$		Range (m) to $\boldsymbol{cSEL_{iso}}$	
			180 dB re: 1μPa	160 dB re: 1μPa	180 dB re: 1μPa^2.s	160 dB re: 1μPa^2.s	198 dB re: 1μPa^2.s	186 dB re: 1μPa^2.s
SBI HF Chirp	188.2	177.1	2.6	188.8	N/A	14.7	58.3	924.6

6 CONCLUSION

The results of sound level analysis are summarized in Table 3 and Table 4. The distances to *SPL* isopleths of 180 and 160 dB re1µPa, LF and HF Chirp *SEL* isopleths of 180 and 160 dB re: 1µPa^2.s, as well as LF and HF Chirp *cSEL* isopleths of 198 and 186 dB re: 1µPa^2.s are calculated as recommended Southall et al. (2007), NMFS (2005), MMPA (2007).

The calculation assumes the worst-case scenario and does not take into account the directivity of the transmit signal. There are risks associated with acoustic sounding where mammals may be present, but these are minimal due to the SBI operating height of 3.5m above the seafloor. This risk can be reduced further by implementing mitigation procedures that would involve beginning the survey, as part of set-up procedures, using low acoustic power settings and gradually increasing to full power levels to carry out the survey proper. By so doing, marine mammals within the vicinity of the survey area are made aware of the survey activity without harm and can move away from the area prior to the commencement of the survey using full acoustic power.

Table 3: Mean Received Levels at RUNES

Transducer (Frequency)	Pulse Width	Mean Received Level	Variance	Signal-to-Noise Ratio
HF Chirp (4.5 kHz – 12.5 kHz)	4.5 ms	134 dB	12	49 dB

Table 4: Summary of sound level results

Source	*SPL* dB re: 1µPa	*SEL* dB re: 1µPa^2.s	Range (m) $SPL_{isopleth}$		Range (m) to $SEL_{isopleth}$		Range (m) to $cSEL_{isopleth}$	
			180 dB re: 1µPa	160 dB re: 1µPa	180 dB re: 1µPa^2.s	160 dB re: 1µPa^2.s	198 dB re: 1µPa^2.s	186 dB re: 1µPa^2.s
SBI HF Chirp	188.2	177.1	2.6	188.8	N/A	14.7	58.3	924.6

7 REFERENCES

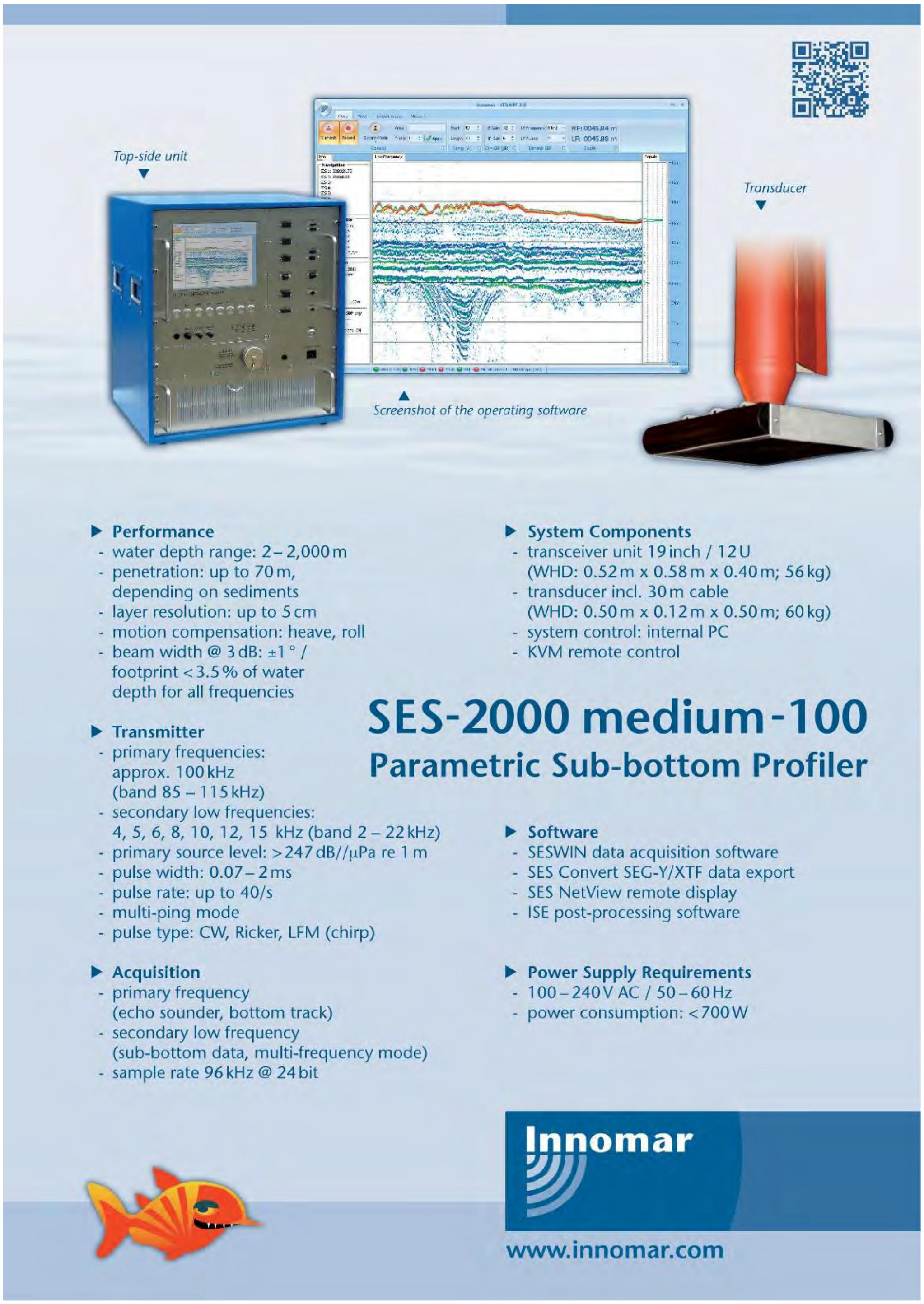
[1] B.L. Southall, AE.. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack, 2007. Marine Mammal Noise Exposure Criteria: Initial Recommendations. Aquatic Mammals, Volume 33, Number 4.

[2] Marine Mammal Protection Act (MMPA) amendment, 2007. Marine Mammal Commission with amendments by NOAA's National Marine Fisheries Service.

[3] National Marine Fisheries Service (NMFS), 2005. Assessment of acoustic exposures on marine mammals in conjunction with USS Shoup active sonar transmissions in Haro Strait, Washington, 5 May 2003.(NMFS Office of Protected Resources report).

[4] Analytical review of the Acoustic Corer™ sound source analysis report by PanGeo Subsea, 2013. Prepared for PanGeo Subsea by Jasco Applied Sciences.

Innomar Sub-bottom Profiler



Top-side unit

Screenshot of the operating software

Transducer

Performance
- water depth range: 2 – 2,000 m
- penetration: up to 70 m, depending on sediments
- layer resolution: up to 5 cm
- motion compensation: heave, roll
- beam width @ 3 dB: ±1 ° / footprint < 3.5 % of water depth for all frequencies

Transmitter
- primary frequencies: approx. 100 kHz (band 85 – 115 kHz)
- secondary low frequencies: 4, 5, 6, 8, 10, 12, 15 kHz (band 2 – 22 kHz)
- primary source level: > 247 dB//μPa re 1 m
- pulse width: 0.07 – 2 ms
- pulse rate: up to 40/s
- multi-ping mode
- pulse type: CW, Ricker, LFM (chirp)

Acquisition
- primary frequency (echo sounder, bottom track)
- secondary low frequency (sub-bottom data, multi-frequency mode)
- sample rate 96 kHz @ 24 bit

System Components
- transceiver unit 19 inch / 12 U (WHD: 0.52 m x 0.58 m x 0.40 m; 56 kg)
- transducer incl. 30 m cable (WHD: 0.50 m x 0.12 m x 0.50 m; 60 kg)
- system control: internal PC
- KVM remote control

SES-2000 medium-100
Parametric Sub-bottom Profiler

Software
- SESWIN data acquisition software
- SES Convert SEG-Y/XTF data export
- SES NetView remote display
- ISE post-processing software

Power Supply Requirements
- 100 – 240 V AC / 50 – 60 Hz
- power consumption: < 700 W

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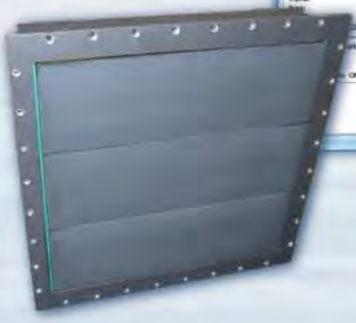
Screenshot of the operating software

Transducer



Top-side unit

INNOMAR deep-36
Parametric Sub-bottom Profiler

▶ Performance
- water depth range: 5 – 6,000 m (option 10,000 m)
- penetration: up to 150 m, depending on sediments
- layer resolution: up to 12 cm
- motion compensation: heave, roll, pitch (option)
- beam width @ 3 dB: ± 1.5° / footprint < 5.5 % of water depth for all frequencies

▶ Transmitter
- primary frequencies: approx. 36 kHz (band 30 – 42 kHz)
- secondary low frequencies: 2, 3, 4, 5, 6, 7 kHz (band 1 – 10 kHz)
- primary source level: > 245 dB//µPa re 1 m
- pulse width: 0.15 – 5 ms
- pulse rate: up to 40/s
- multi-ping mode
- pulse type: CW, Ricker, LFM (chirp)

▶ Acquisition
- primary frequency (echo sounder, bottom track)
- secondary low frequency (sub-bottom data, multi-frequency mode)
- sample rate 48 kHz @ 24 bit

▶ System Components
- transceiver unit 19 inch / 16 U (WHD: 0.52 m x 0.74 m x 0.50 m; 95 kg)
- transducer with frame excl. cable (WHD: 0.90 m x 0.30 m x 0.90 m; 335 kg)
- system control: internal PC
- KVM remote control

▶ Software
- SESWIN data acquisition software
- SES Convert SEG-Y/XTF data export
- SES NetView remote display
- ISE post-processing software

▶ Power Supply Requirements
- 100 – 240 V AC / 50 – 60 Hz
- power consumption < 900 W

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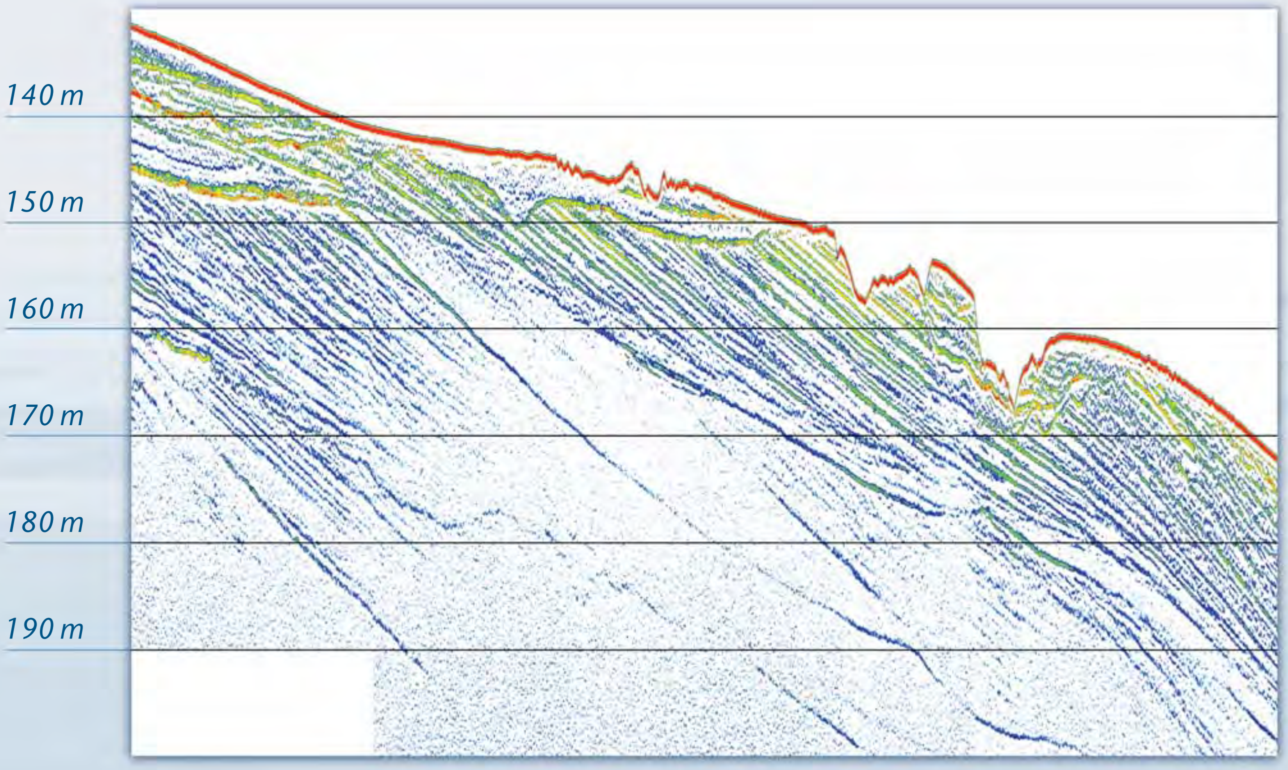
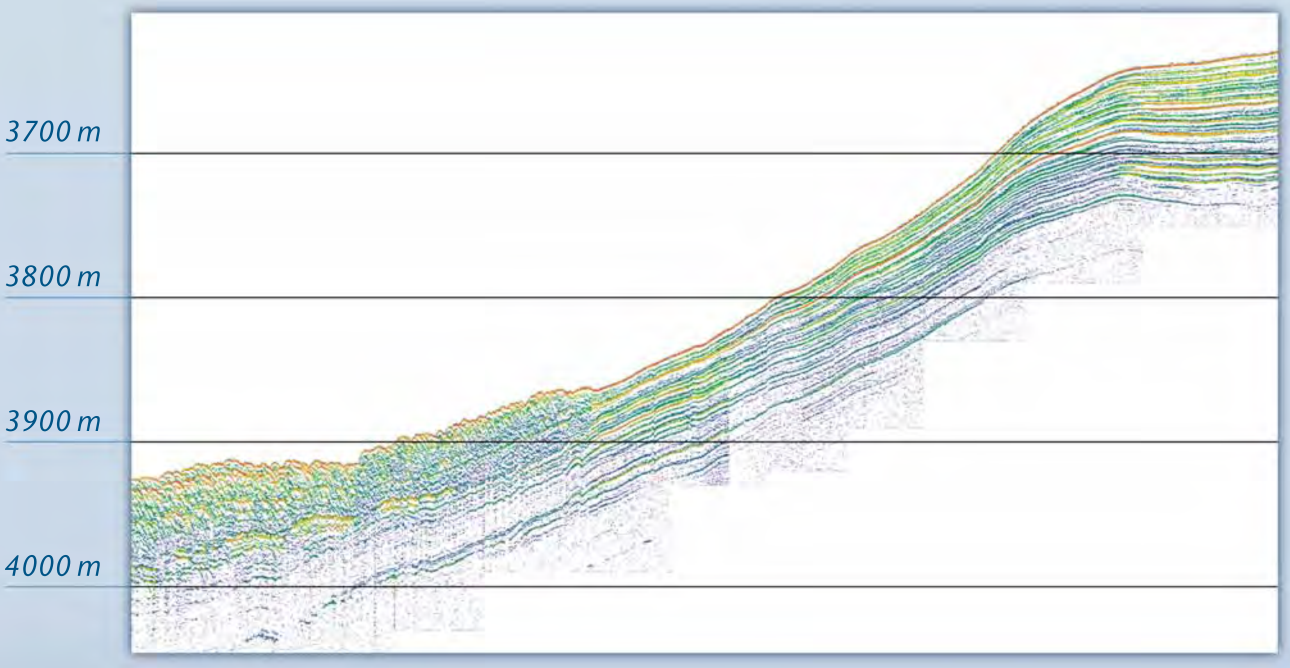
Survey examples of SES-2000 deep-36



South Korean Coast echo plot example
Frequency 4 kHz, pulse length 750 µs, profile length 11 km, survey speed 13 knots



***Atlantic Ocean (Argentina) echo plot example** – Frequency 4 kHz, pulse length 1500 µs, profile length 65 km*

Innomar Technologie GmbH

Schutower Ringstraße 4
D-18069 Rostock
Phone +49 381 44079-0
E-Mail info@innomar.com

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www.innomar.com

Appendix B

Distances to Acoustic Thresholds Corresponding to Level B Harassment for High Resolution Geophysical Sources

Source Name: SIG ELC 820 Sparker at 750J

INPUT VALUES (LEVEL B)	
Threshold Level	*160*
Source Level (dBrms)	*203*
Frequency (kH)	*0.01*
Beamwidth (degree)	*180*
Water depth (m)	*5*

COMPUTED VALUES (LEVEL B)	DO NOT CHANGE
alpha (dB/km)	8.8249E-07
TL coefficient	20
Slant distance of threshold (m)	**141**
Vertical depth of threshold (m)	8.6373E-15
Horizontal Threshold Range (m)	**141**

Source Name: Geo Marine Survey System 2D SUHRS at 400J

INPUT VALUES (LEVEL B)	
Threshold Level	*160*
Source Level (dBrms)	*195*
Frequency (kH)	*0.2*
Beamwidth (degree)	*180*
Water depth (m)	*5*

COMPUTED VALUES (LEVEL B)	DO NOT CHANGE
alpha (dB/km)	0.000352994
TL coefficient	20
Slant distance of threshold (m)	**56**
Vertical depth of threshold (m)	3.43042E-15
Horizontal Threshold Range (m)	**56**

Source Name: Edgetech 2000-DSS

INPUT VALUES (LEVEL B)	
Threshold Level	*160*
Source Level (dBrms)	*195*
Frequency (kH)	*2*
Beamwidth (degree)	*24*
Water depth (m)*	*5*

COMPUTED VALUES (LEVEL B)	DO NOT CHANGE
alpha (dB/km)	0.035275879
TL coefficient	20
Slant distance of threshold (m)	**56**
Vertical depth of threshold (m)	54.77626564
Horizontal Threshold Range (m)	**1.062782808**

Source Name: Edgetech 216

INPUT VALUES (LEVEL B)	
Threshold Level	*160*
Source Level (dBrms)	*179*
Frequency (kH)	*2*
Beamwidth (degree)	*24*
Water depth (m)*	*5*

COMPUTED VALUES (LEVEL B)	DO NOT CHANGE
alpha (dB/km)	0.035275879
TL coefficient	20
Slant distance of threshold (m)	**9**
Vertical depth of threshold (m)	8.803328407
Horizontal Threshold Range (m)	**1.062782808**

Source Name: Edgetech 424

INPUT VALUES (LEVEL B)	
Threshold Level	*160*
Source Level (dBrms)	*180*
Frequency (kH)	*4*
Beamwidth (degree)	*71*
Water depth (m)*	*10*

COMPUTED VALUES (LEVEL B)	DO NOT CHANGE
alpha (dB/km)	0.140819438
TL coefficient	20
Slant distance of threshold (m)	**10**
Vertical depth of threshold (m)	8.141155184
Horizontal Threshold Range (m)	**5.807029557**

Source Name: Edgetech 512i

INPUT VALUES (LEVEL B)	
Threshold Level	*160*
Source Level (dBrms)	*179*
Frequency (kH)	*0.7*
Beamwidth (degree)	*80*
Water depth (m)*	*10*

COMPUTED VALUES (LEVEL B)	DO NOT CHANGE
alpha (dB/km)	0.004323847
TL coefficient	20
Slant distance of threshold (m)	**9**
Vertical depth of threshold (m)	6.894399988
Horizontal Threshold Range (m)	**5.785088487**

Source Name: Pangeosubsea Sub-Bottom Imager™

INPUT VALUES (LEVEL B)	
Threshold Level	*160*
Source Level (dBrms)	*190*
Frequency (kH)	*4*
Beamwidth (degree)	*120*
Water depth (m)	*5*

COMPUTED VALUES (LEVEL B)	DO NOT CHANGE
alpha (dB/km)	0.140819438
TL coefficient	20
Slant distance of threshold (m)	**32**
Vertical depth of threshold (m)	16
Horizontal Threshold Range (m)	**8.660254038**

Appendix C

Marine Mammal Seasonal Densities

Table C-1 Lease Area – Marine Mammal Seasonal Densities

Species	Winter Density [a/] (No./100 km²)	Spring Density [a/] (No./100 km²)	Summer Density [a/] (No./100 km²)	Fall Density [a/] (No./100 km²)
North Atlantic right whale	**0.499**	0.426	0.002	0.009
Humpback whale	**0.076**	0.027	0.011	0.024
Fin whale	0.058	**0.100**	**0.100**	0.094
Sei whale	0.001	**0.004**	0.000	0.001
Minke whale	0.019	**0.055**	0.016	0.012
Sperm whale	0.000	0.002	**0.013**	0.008
Long-finned pilot whale	**0.036**	**0.036**	**0.036**	**0.036**
Bottlenose dolphin (Offshore stock)	1.508	2.776	**21.752**	9.125
Short beaked common dolphin	**3.120**	1.156	1.622	2.636
Atlantic white-sided dolphin	0.197	**0.487**	0.151	0.200
Atlantic spotted dolphin	0.003	0.009	**0.076**	0.060
Risso's Dolphin	0.002	0.001	**0.010**	0.003
Harbor porpoise	**2.904**	2.132	0.018	0.683
Harbor seal	2.251	**2.446**	0.036	0.038
Gray Seal	1.011	**1.099**	0.016	0.017

Table C-2 ECR Survey Area – Marine Mammal Seasonal Densities

Species	Winter Density [a/] (No./100 km²)	Spring Density [a/] (No./100 km²)	Summer Density [a/] (No./100 km²)	Fall Density [a/] (No./100 km²)
North Atlantic right whale	**0.182**	0.149	0.001	0.011
Humpback whale	**0.082**	0.031	0.011	0.046
Fin whale	0.057	**0.080**	0.063	0.078
Sei whale	0.000	**0.004**	0.000	0.000
Minke whale	0.010	**0.017**	0.003	0.003
Sperm whale	0.001	0.004	0.003	**0.005**
Long-finned pilot whale	0.012	0.012	0.012	0.012
Bottlenose dolphin (Offshore stock)	1.565	3.291	**21.675**	7.773
Short beaked common dolphin	1.370	0.330	0.522	**1.644**
Atlantic white-sided dolphin	0.127	**0.213**	0.089	0.131
Atlantic spotted dolphin	0.001	0.002	**0.059**	0.022
Risso's Dolphin	0.000	0.000	**0.001**	**0.001**
Harbor porpoise	**7.357**	1.965	0.059	1.488
Harbor seal	3.781	4.001	0.053	0.075
Gray Seal	1.699	1.798	0.024	0.034