Public

Marine Mammal Monitoring and Mitigation Plan for Construction of the Alaska LNG Project in Prudhoe Bay, Alaska

December 21, 2020

AKLNG-6010-REG-GRD-REC-00005

Alaska Gasline Development Corporation
3201 C Street, Suite 201
Anchorage, Alaska 99503
T: 907-330-6300
www.alaska-lng.com

REVISION HISTORY

Rev	Date	Description	Originator	Reviewer	Approver
0	Feb 24, 2020	4MP for IHA for Use	S. Wisdom	Lisa Haas	Frank Richards
1	Jun 1, 2020	4MP for IHA	S. Wisdom	Lisa Haas	Frank Richards
2	Dec 4, 2020	For Use	S. Wisdom	Lisa Haas	Frank Richards
3	Dec. 21, 2020	For Use	Lisa Haas	Lisa Haas	Frank Richards
Approver Signature*					

*This signature approves the most recent version of this document.

MODIFICATION HISTORY

Rev	Section	Modification
3	2.8.2	Clarified NMFS would be the approver of the location of an acoustics monitoring device if work is done during the contingency period.

TABLE OF CONTENTS

Acronyms and Abbreviations **5**

1. Description of Activities **7**
- 1.1. Purpose of the Plan 7
- 1.2. Project Location 8
- 1.3. Description of Alaska LNG Activities 11
- 1.4. Applicable Noise Criteria 12
  - 1.4.1. Level A and B Harassment Zones 13
- 1.5. Marine Mammal Monitoring and Mitigation Program 15

2. Marine Mammal Monitoring Overview **16**
- 2.1. Monitoring Zones 16
- 2.2. Monitoring Methods 16
  - 2.2.1. Sound Source Verification 16
  - 2.2.2. Acoustic Monitoring 18
  - 2.2.3. Daytime Monitoring 19
  - 2.2.4. Nighttime and Low Visibility Monitoring 21
- 2.3. Observer Qualifications and Training 24
- 2.4. Equipment 25
- 2.5. PSO Handbook 25
- 2.6. Communications 26
- 2.7. Data Collection 26
  - 2.7.1. Effort 27
  - 2.7.2. Sightings 27
  - 2.7.3. Mitigation 27
- 2.8. Mitigation Measures 28
  - 2.8.1. In-Water Activity Mitigation Measures 28
  - 2.8.2. Ice-Covered Season Mitigation Measures 30
- 2.9. Subsistence Mitigation Measures 31

3. Reporting **33**
- 3.1. SSV Report 33
- 3.2. Weekly Reports 33
- 3.3. Monthly Reports 33
- 3.4. Technical Reports: 90-Day Monitoring and Final Reports 33
- 3.5. Notification of Injured or Dead Marine Mammals 34

4. References **36**

List of Tables

Table 1. Planned Alaska LNG Activities within the Geographic Region 11

Table 2. Marine Mammal Injury and Disturbance Thresholds for Sound 13

Table 4. Calculated Distances[1] to Level A Underwater Thresholds 14
Table 5. Calculated Distances to Level B Underwater Thresholds 15
Table 6. Calculated Distances to Level B Airborne Thresholds 15
Table 7. Level A Exclusion and Level B Monitoring Zones 16

List of Figures

Figure 1: Alaska LNG Project Vicinity Map 9
Figure 2: Geographic Region: West Dock Modifications 10
Figure 3: Recommended Configuration of Acoustic Recorders for the Sound Source Verification..... 17
Figure 4: Recommended Configuration of Acoustic Recorders for Acoustic Monitoring 19
Figure 5: PSO location and monitoring zones from Dock Head 4 20
Figure 6: Night Vision Binoculars with Infrared Illuminator (Model shown is Night Owl NOXB-5 Explorer Pro 5X) 22
Figure 7: Digital infrared Video Recorders (Model shown is Ordro AC7) 23

List of Appendices

A: Marine Mammal Effort, Sighting, and Mitigation Data Fields

ACRONYMS AND ABBREVIATIONS

4MP .....Marine Mammal Monitoring and Mitigation Plan
AEWC.....Alaska Eskimo Whaling Commission
AGDC .....Alaska Gasline Development Corporation
AMAR .....Autonomous Multichannel Acoustic Recorder
CAA.....conflict avoidance agreement
dB re 1 µPa.....decibels referenced to one microPascal
DH2 .....Dock Head 2
DH3 .....Dock Head 3
DH4 .....Dock Head 4
ESA .....Endangered Species Act
FR .....Federal Register
GTP .....Gas Treatment Plant
Hertz.....Hertz
IHA.....Incidental Harassment Authorizations
IR .....infrared
kHzt .....kiloHertz
Lpk.....peak level
LNG.....liquefied natural gas
MLLW .....mean lower low water
MMPA .....Marine Mammal Protection Act
NMFS.....National Marine Fisheries Service
NOAA.....National Oceanic and Atmospheric Administration
NVD .....Night Vision Devices
NSB.....North Slope Borough
PAM.....passive acoustic monitoring
PBTL.....Prudhoe Bay Transmission Line
PBU.....Prudhoe Bay Unit
PM .....Project Manager
POC.....Plan of Cooperation
PSO .....Protected Species Observer
PTTL.....Point Thompson Transmission Line
PTS.....permanent threshold shift
PTU .....Point Thomson Unit
QA/QC .....quality assurance and quality control
rms .....root-mean-square
SEL.....sound exposure level
SPL.....sound pressure level
STP.....Seawater Treatment Plant
SSV.....sound source verification

TTS.....temporary threshold shift

1. DESCRIPTION OF ACTIVITIES

1.1. Purpose of the Plan

The Alaska Gasline Development Corporation (AGDC) is the project sponsor and "Applicant" for the Alaska LNG Project (Project), and hereby requests the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) to issue an incidental harassment authorization (IHA) pursuant to Section 101(a)(5) of the Marine Mammal Protection Act (MMPA) for the non-lethal unintentional taking of small numbers of marine mammals incidental to construction activities in Prudhoe Bay, Alaska for the Project over a one-year period beginning July 1, 2023 through June 30, 2024.

The Alaska LNG Project is expected to produce noise levels that could exceed Level B (disturbance) harassment thresholds established by NMFS for marine mammals under the MMPA (70 Federal Register [FR] 1871-1875). Level B harassment means 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, but that does not have the potential to injure a marine mammal or marine mammal stock in the wild. For certain species only (seals and bowhead whales), the Alaska LNG Project is expected to produce noise that could exceed Level A (injury) levels. Level A harassment means any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild. The Applicant seeks authorization for the potential taking through potential injury (Level A) of small numbers of bowhead whale, ringed seal, spotted seal, and bearded seal in the Beaufort Sea. These takes are less than 1 percent of the population of each species and may have no more than a minor effect on individual animals or no effect on the populations of these four species.

AGDC is requesting an IHA for the take of small numbers of marine mammals, by Level A and B harassment, incidental to the Alaska LNG Project, which involves construction activities including modifications to the existing West Dock causeway and associated dock heads in Prudhoe Bay, Alaska. This Marine Mammal Monitoring and Mitigation Plan (4MP) has been prepared in support of the IHA.

Bowhead whales (*Balaena mysticetus*), gray whales (*Eschrichtius robustus*), beluga whales (*Delphinapterus leucas*), ringed seals (*Phoca hispida*), spotted seals (*Phoca largha*), and bearded seals (*Erignathus barbatus*) may be encountered near the construction activities in the Prudhoe Bay area. A small number of Level B takes is requested for these six species of marine mammals. A small number of Level A takes is requested for the three seal species. Marine mammals are protected under the MMPA; the Western Arctic stock of bowhead whales is listed as endangered and the Alaska stocks of ringed and bearded seals are also listed as threatened under the Endangered Species Act (ESA). The overall goal of the 4MP is to comply with the MMPA and ESA during in-water pile installation and other associated construction activities conducted during the Alaska LNG Project. Please refer to the IHA application for detailed information on the Project, potential effects on marine mammals and their habitat, and mitigation measures.

1.2. Project Location

AGDC plans to construct one integrated liquefied natural gas (LNG) Project (**Error! Reference source not found.**) with interdependent facilities for the purpose of liquefying supplies of natural gas from Alaska, in particular from the Point Thomson Unit (PTU) and Prudhoe Bay Unit (PBU) production fields on the Alaska North Slope (North Slope), for export in foreign commerce and for in-state deliveries of natural gas. The Project includes a liquefaction facility (Liquefaction Facility) in Southcentral Alaska; an approximately 807-mile (1,299-kilometer) natural gas pipeline (Mainline); a gas treatment plant (GTP) within the PBU on the North Slope; an approximately 63-mile (101-kilometer) gas transmission line connecting the GTP to the PTU gas production facility (PTU Gas Transmission Line or PTTL); and an approximately 1-mile (1.6-kilometer) gas transmission line connecting the GTP to the PBU gas production facility (PBU Gas Transmission Line or PBTL). These facilities are essential to export natural gas in foreign commerce and would have a nominal design life of 30 years.

The proposed Project construction activities in Prudhoe Bay for which an IHA is being requested consist of modifications to the existing West Dock causeway and associated dock heads. Aspects of these proposed West Dock modifications that have the potential to incidentally harass marine mammals are: the airborne and underwater noise generated by vibratory and impact pile driving and some construction activities through ice. The Geographic Region for these activities covers a total of approximately 155 square miles or 99,275 acres (402 square kilometers) surrounding the West Dock causeway, a proposed temporary barge bridge, and a proposed barge marshalling area (**Error! Reference source not found.**, REF _Ref535926325 \h **Error! Reference source not found.**).

Figure 1: Alaska LNG Project Vicinity Map

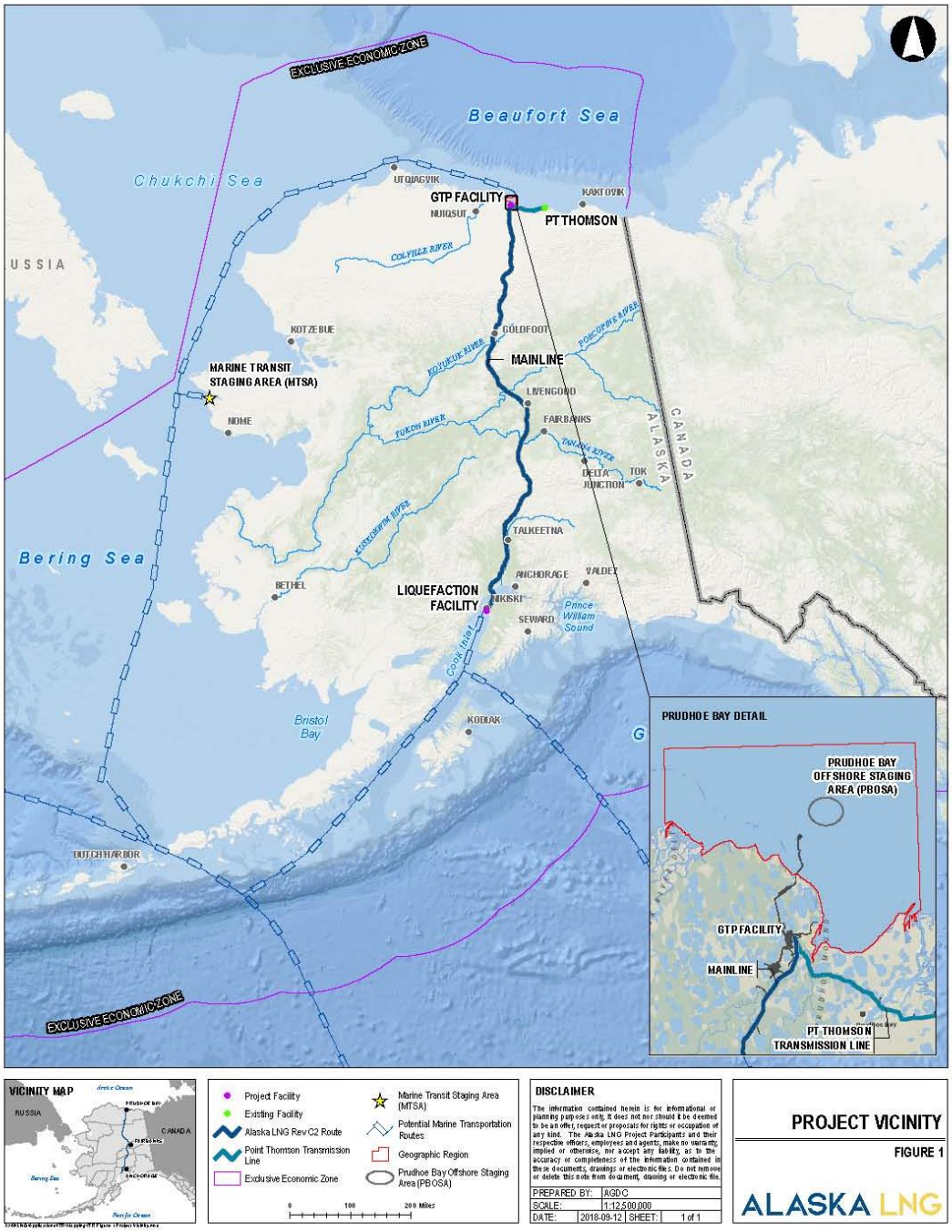
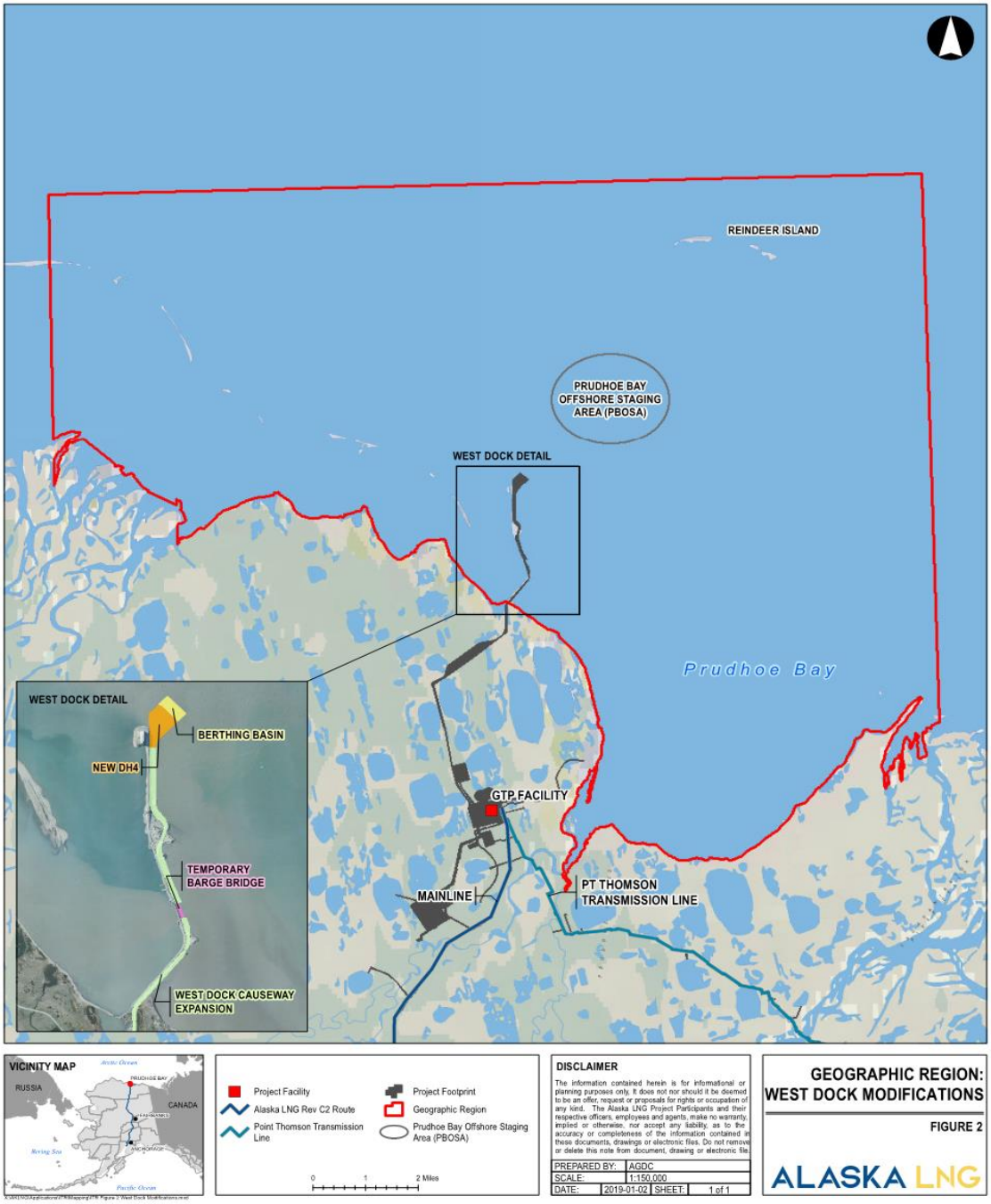


Figure 2: Geographic Region: West Dock Modifications



1.3. Description of Alaska LNG Activities

This 4MP pertains to the pile driving activities associated with the first year of construction of the Project in the Prudhoe Bay area that would take place in the marine environment and potentially result in the incidental harassment of marine mammals, as defined by the MMPA. Other activities are included for reference only. Alaska LNG components with activities to be included in the IHA are summarized in the 2023 Year of Table 1. Activities denoted as occurring during years 2024 to 2028 of Table 1 do not require an IHA.

Table 1. Planned Alaska LNG Activities within the Geographic Region

Project Component	Activity	Year		
		2023	2024	2025-2028
Causeway Widening	Haul and deposit gravel	*		
DH4 Construction	Gravel hauling and deposition	*		
	Install sheet pile walls (pile driving)	*		
	Install mooring dolphins (pile driving)	*		
	Install bag armor	*		
	Excavate overfill / re-compact gravel		*	
	Prepare seabed / level berths (screeding)		*	*
Barge Bridge and Abutments	Haul and deposit gravel	*		
	Install bulkhead (pile driving)	*		
	Install mooring dolphins (pile driving)	*		
	Prepare barge bridge seabed pad		*	*
	Install / remove barge bridge		*	*
Sealift	Vessel transit to Prudhoe Bay		*	*
	Offload materials / modules at DH4		*	*

These activities would occur on and around West Dock, an existing causeway located on the northwest shore of Prudhoe Bay, Alaska, within the PBU, and operated by Hilcorp Alaska, LLC (Hilcorp Alaska). West Dock is a multipurpose facility, commonly used to offload marine cargo to support Prudhoe Bay oilfield development. The West Dock causeway, which extends approximately 2.5 miles (4 kilometers) into Prudhoe Bay from the shoreline, is a solid-fill gravel causeway structure constructed in multiple phases between 1974 and 1981. There are two existing loading docks along the causeway, referred to as Dock Head 2 (DH2) and Dock Head 3 (DH3), and a seawater treatment plant (STP) at the seaward terminus of the structure (Figure 2). A 650-foot (198-meter) breach with a single lane bridge was installed in the causeway between DH2 and DH3 during 1995 and 1996 due to concerns that the solid causeway was impacting coastal circulation and marine resources.

The proposed Alaska LNG GTP would be constructed with large pre-fabricated modules that can only be transported to the North Slope with barges (sealift). An accessible and well-functioning dock facility would be required in Prudhoe Bay to receive these large modular components and as such, upgrades to dock and causeway infrastructure at West Dock are required for offloading the modules, and for transporting the modules to the GTP construction site.

Development of the dock facility would require construction of a new dock head referred to as Dock Head 4 (DH4) with 12 mooring dolphins. The gravel causeway between the proposed DH4 site and the onshore road system is too narrow for module transport and must be widened in several areas. The existing bridge over the aforementioned breach is also too narrow for module transport and is not capable of supporting the weight of the project modules. A temporary barge bridge is therefore proposed to accommodate transport of the modules over the breach. New sheet pile and gravel abutments would be constructed along the east side of the existing bridge, and four mooring dolphins would be installed. Two barges would then be placed along these mooring dolphins and between the abutments to form a temporary bridge for module transport.

1.4. Applicable Noise Criteria

Under the MMPA, NMFS has defined levels of harassment for marine mammals. Level A harassment is defined as "…any act of pursuit, torment, or annoyance which 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 which 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."

For Level A harassment, the NOAA Technical Memorandum NMFS-OPR, and associated revisions, provide guidelines for assessing the onset of temporary threshold shifts (TTS) and permanent threshold shifts (PTS) from anthropogenic sound. These guidelines separate marine mammals into five functional hearing groups, consider source types as impulsive (e.g., seismic, pipe driving, sub-bottom profiler) or non-impulsive (tugs towing rigs, drilling, water jet, hydraulic grinder), and require analyses of the distance to the peak received sound pressure level (SPL, L_{pk}) as well as the 24-hr cumulative sound exposure level (SEL_{24h}) in order to more accurately estimate potential impacts.

The current Level B disturbance threshold for marine mammals is 160 decibels referenced to one microPascal (dB re 1 µPa) root mean square (rms) for impulsive sound and 120 dB re 1 µPa rms for non-impulsive sound. NMFS has also established an airborne disturbance threshold of 90 dB re 20 µPa (un-weighted) for harbor seals and 100 dB re 20 µPa for all other pinnipeds. The NMFS disturbance guidelines are summarized in Table 2. For purposes of this section, underwater SPLs are reported as dB re 1 µPa and all airborne thresholds are reported as dB re 20 µPa.

Table 2. Marine Mammal Injury and Disturbance Thresholds for Sound

Marine Mammals	Disturbance (Level A) Threshold		Injury (Level B) Threshold		Airborne (Level B) Threshold
	Impulsive	Non-Impulsive	Impulsive	Non-Impulsive	
Low-Frequency Cetaceans (bowhead, gray whale)	219 dB L_{pk} 183 dB SEL	199 dB SEL	160 dB rms	120 dB rms	N/A
Mid-Frequency Cetaceans (beluga whale)	230 dB L_{pk} 185 dB SEL	198 dB SEL	160 dB rms	120 dB rms	N/A
High-Frequency Cetaceans (true porpoises)	202 dB L_{pk} 155 dB SEL	173 dB SEL	160 dB rms	120 dB rms	N/A
Phocid Pinnipeds (true seals)	218 dB L_{pk} 185 dB SEL	201 dB SEL	160 dB rms	120 dB rms	90 dB
Otariid Pinnipeds (sea lions and fur seals)	232 dB L_{pk} 203 dB SEL	219 dB SEL	160 dB rms	120 dB rms	100 dB

1.4.1. Level A and B Harassment Zones

Distances to the harassment thresholds vary by functional hearing group, pile size, duration of installation, and pile-installation method. Table 3 provides distances to Level A underwater thresholds; Table 4 provides distances to Level B underwater thresholds; and Table 5 provides distances to Level B airborne thresholds. At the request of NMFS, these estimates for underwater sound are based on the use of practical spreading transmission loss (15 log R), which assumes 4.5 dB loss for every doubling of distance. Based on the shallow water in this area, it is likely that the rate of propagation will be greater than 15 log R, so these estimates to the thresholds are conservative.

Table 3. Calculated Distances[1] to Level A Underwater Thresholds

Activity	High Frequency Cetaceans			Mid-Frequency Cetaceans[1]			Low Frequency Cetaceans [2]			Phocids		
	Impulsive		Non-Impulsive	Impulsive		Non-Impulsive	Impulsive		Non-Impulsive	Impulsive		Non-Impulsive
	202 pk	155 SEL	173 SEL	230 pk	185 SEL	198 SEL	219 pk	183 SEL	199 SEL	218 pk	185 SEL	201 SEL
11.5-inch H pile (impact)	7.7.4	1,422.3	NA	0.1	42.5	NA	0.5	1,194.0	NA	0.6	639.0	NA
14-inch H pile (impact)	25.1	1,193.3	NA	0.3	35.6	NA	1.9	1,001.8	NA	2.2	536.1	NA
14-inch H pile (vibratory)	NA	NA	2.96	NA	NA	0.2	NA	NA	2.0	NA	NA	1.2
48-inch pipe pile (impact)	34.2	1,876.4	NA	0.5	56.0	NA	2.5	1,575.2	NA	2.9	843.0	NA
19.69-inch Sheet pile (vibratory)	NA	NA	24.6	NA	NA	1.5	NA	NA	16.7	NA	NA	10.1
25-inch Sheet pile (vibratory)	NA	NA	24.6	NA	NA	1.5	NA	NA	16.7	NA	NA	10.1

[1] Distances are represented in meters.

[2] Mid-frequency cetaceans include the beluga whale

[3] Low frequency cetaceans include the gray whale and the bowhead whale

Note: Peak (pk) sound levels are reported as dB re 1 µPa; sound exposure levels (SEL) sound levels are reported as dB re 1 μPa^2-s. Calculated assuming 15 log R.

Table 4. Calculated Distances to Level B Underwater Thresholds

Activity pile type (hammer type)	Impulsive 160 dB rms (meters)	Non-Impulsive 120 dB rms (meters)
11.5-inch H-pile (impact)	341.5	NA
14-inch H-pile (impact)	631.0	NA
14-inch H-pile (vibratory)	NA	1,000
48-inch pipe pile (impact)	2,154.4	NA
19.69-inch Sheet pile (vibratory)	NA	4,641.6
25-inch Sheet pile (vibratory)	NA	4,641.6

Distances are represented in meters.

Root mean square (rms) sound levels are reported as dB re 1 µPa.

Table 5. Calculated Distances to Level B Airborne Thresholds

Activity	Pinnipeds 100 dB rms (meters)
Impact pipe driving	16.8
Vibratory pipe driving	16.8
Vibratory sheet pile driving	11.2
Bulldozer	1.8
Backhoe	1.2

Distances are represented in meters.

Root mean square (rms) sound levels are reported as dB re 20 µPa.

1.5. Marine Mammal Monitoring and Mitigation Program

AGDC would implement a land-based marine mammal monitoring and mitigation program using experienced and trained Protected Species Observers (PSOs) during in-water construction activities. Marine mammal monitoring and mitigation methods have been designed to meet the expected requirements and objectives specified in the IHA permit that would be issued by NMFS. The 4MP would also incorporate other future stipulations in agreements between the AGDC and other agencies or groups.

As a result of the NMFS Peer Review Panel recommendations and meetings with the Alaska Eskimo Whaling Commission (AEWC), there are several changes to the 4MP: 1) a sound source verification (SSV) would be performed at the start of the project to characterize the propagation and distances to the NMFS thresholds for the different pile sizes, 2) three passive acoustic monitoring (PAM) recorders would be deployed for the duration of the construction season for purposes of marine mammal detection and measurement of project sound levels, 3) PSOs would start monitoring three days prior to start of pile installation and for three days following completion of pile installation, and 4) the Level A exclusion zone for seals was reduced to 1,640 feet (500 meters) based on the range of detectability for seals. The AGDC recognizes some details of the monitoring and mitigation plan may change upon receipt of the IHA from NMFS.

The specific objectives of the monitoring and mitigation program are to provide:

- The basis for avoiding and minimizing potential impacts to marine mammals;

- The information needed to estimate the number of takes of marine mammals by harassment;
- Data on the occurrence, distribution, and activities of marine mammals in the areas where project activities were conducted;
- Information to compare the distances, distributions, behaviors, and movements of marine mammals relative to the project activities; and
- Test the use of night vision and infrared technology for nighttime and low visibility monitoring.

Details on PSO qualifications, monitoring methodology, mitigation measures, and reporting are provided in the following sections.

2. MARINE MAMMAL MONITORING OVERVIEW

2.1. Monitoring Zones

NMFS has provided the following required shut down zones for the project (Table 6).

Table 6. Level A Exclusion and Level B Monitoring Zones

Activity	Level A Exclusion Zone (m)			Level B Monitoring Zone (m)
	Low Frequency Cetaceans	Mid Frequency Cetaceans	Phocids	
Impact of 11.5 or 14-inch H-pile	1,200	50	500	650
Impact of 48-inch pile	1,600	50	500	2,200
Vibratory of 14-inch pile	10	10	10	1,000
Vibratory of sheet piles	20	10	10	4,700

Distances are represented in meters.

The calculation of a Level A harassment/exclusion zone for impact pile driving incorporates the total number of daily strikes (i.e., the duration), while calculations of a Level B harassment zone does not. As a result, sometimes the Level A harassment zones end up larger than the Level B harassment zones for the same activity. In order for a permanent threshold shift to occur, an animal would have to stay in the zone at a particular distance for a duration of time to accumulate sufficient energy.

2.2. Monitoring Methods

2.2.1. Sound Source Verification

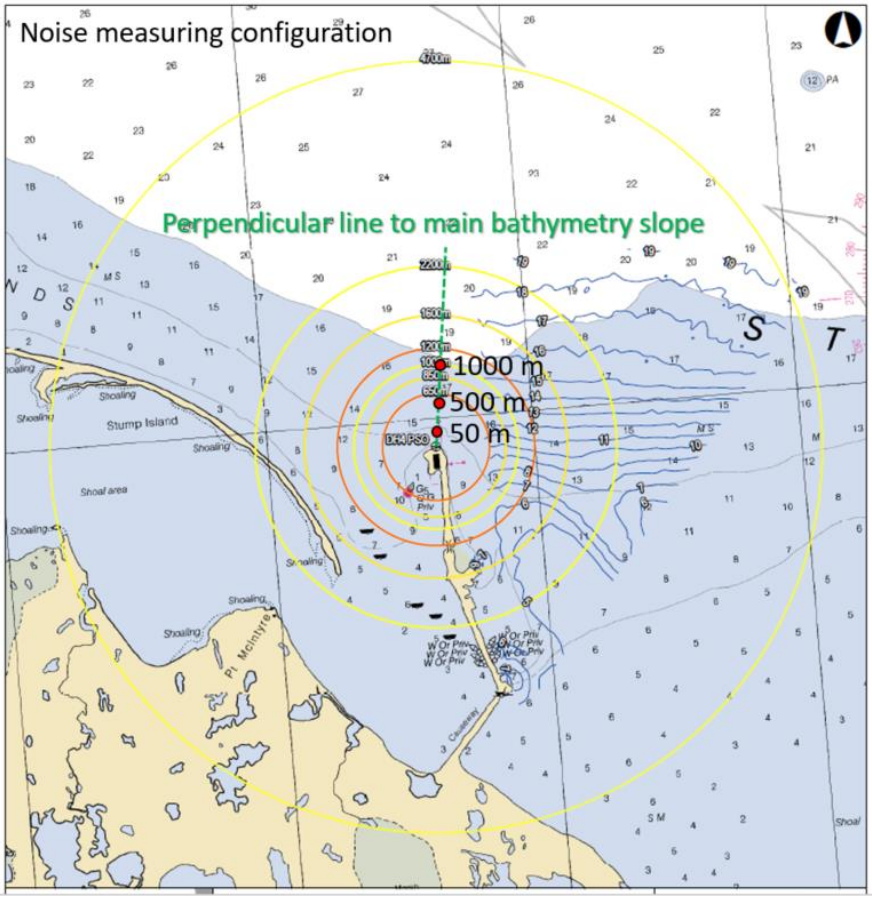
An SSV would be conducted at the start of the project to characterize sound levels associated with the different pile sizes and types. The contractor that would perform the assessment has not yet been selected. The contractor would prepare a detailed SSV plan that would be submitted to NMFS for approval.

Based on past SSV studies for pile driving in Alaska, it is expected that the acoustic contractor would use two types of hydroacoustic measurements to perform this SSV: fixed bottom-mounted recorders and

dipping hydrophones while drifting. The contractor would deploy at least two bottom-mounted recorders to measure near-field and far-field sound levels, as well as propagation rates.

The near-field recorder would be located within 164 feet (50 meters) of the pile driving source, preferably at 32.8 feet (10 meters) from the source to be consistent with other pile driving studies. The far-field recorder would be located at approximately 3,280 feet (1,000 meters) from the pile driving. A third recorder would be deployed at a distance near the expected Level B threshold. Figure 3 shows the configuration recommended by the NMFS Peer Review Panel.

Figure 3: Recommended Configuration of Acoustic Recorders for the Sound Source Verification



JASCO Applied Science's Autonomous Multichannel Acoustic Recorders (AMARs) have been deployed in Alaskan waters for SSV efforts. The Anchorage Port Modernization Project Test Pile Program deployed AMARs to measure sounds levels associated with pile installation. For this project, each AMAR unit consisted of two hydrophones and with recording systems set to different sensitivities in order to measure both high and low intensity sounds. The hydrophones were protected by a cage, which was covered with a shroud to minimize noise artifacts due to water flow. A mooring base plate rested on the seabed with the hydrophone cage mounted 2 feet (0.6 meters) above. The AMARs recorded continuously at 128,000 samples per second for a recording bandwidth of 1 Hertz (Hz) to 64 kiloHertz (kHz). The recording channel

had 24-bit resolution with a spectral noise floor of 20 dB re 1 $\mu Pa^2/Hz$. The same or similar equipment would likely be used for the SSV that would be conducted for this project.

The dipping hydrophone would be deployed from a vessel during pile driving at variable positions. A marine GPS would collect tracks with intervals of 2 seconds so that the contractor can correlate measured sound levels with distance from the pile driving. Ambient sound levels would also be recorded simultaneously and during periods of no pile driving activity.

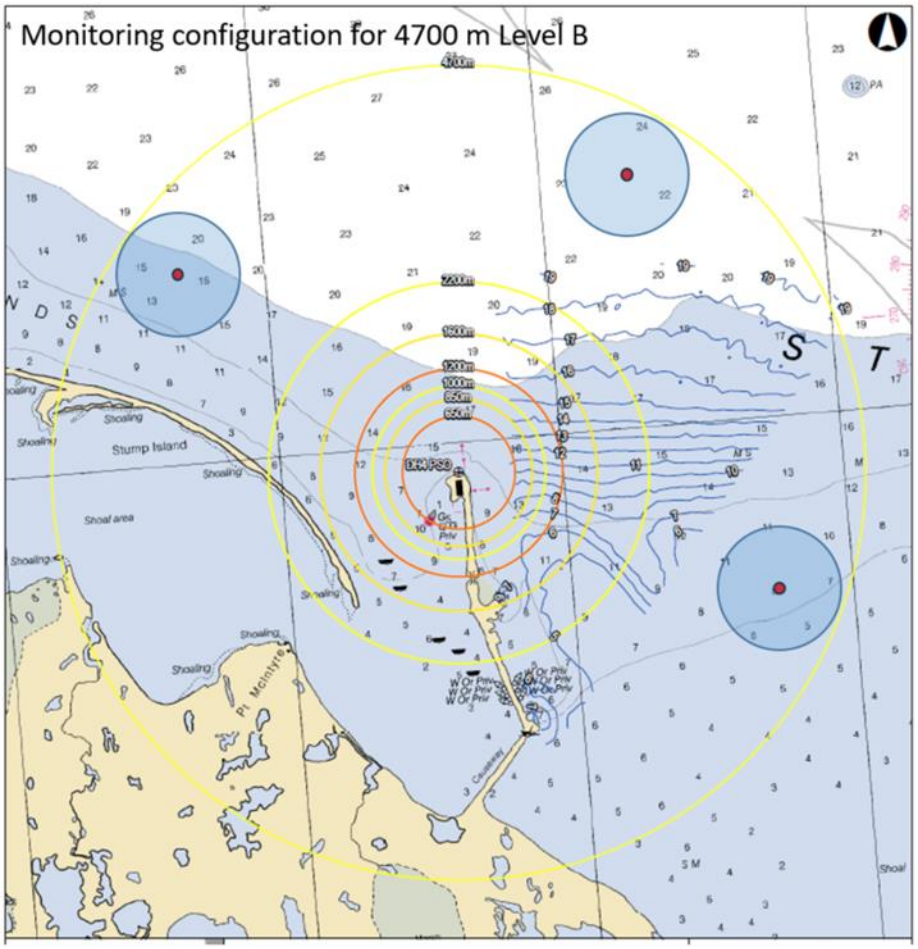
After retrieval, acoustic recordings would be processed to compute sound level statistics from the recorded data. The recorded signals would be filtered to remove both low-frequency and high-frequency noise outside of the range relevant to marine mammals. Software would be used to compute sound level statistics for ambient noise and pile installation noise.

Regression methods would be used to determine the distances to the sound level thresholds for marine mammal harassment for pile driving activities. For pile installation with the impact hammer, the peak sound level, SPL, and SEL would be computed for individual pile driving events, and cumulatively for each 24-hour period. For Level B harassment, the one-minute SPL data from each receiver range would be fit to an empirical propagation loss curve. Statistics of the peak sound levels and the 24-hour cumulative SEL, frequency-weighted for the functional hearing groups of interest, would be computed and distances at which thresholds for Level A harassment are reached would be quantified by linear interpolation between the receiver ranges.

2.2.2. Acoustic Monitoring

Three PAM recorders would be deployed at a distance of approximately 2.9 miles (4,700 meters; largest Level B zone) from West Dock in three different equidistant directions from West Dock. The PAM recorders would be deployed three days prior to the start of pile installation and would be retrieved three days following completion of pile installation. The system would be capable of detecting marine mammal species in the area (sample rate of at least 64 kHz). If the Level B zone is adjusted based on the SSV, the recorders would be adjusted to be at the adjusted Level B zone. Figure 4 shows the configuration recommended by the NMFS Peer Review Panel. When selected, the contractor that would perform the monitoring will prepare a detailed acoustic monitoring plan meeting the parameters outlined in this 4MP.

Figure 4: Recommended Configuration of Acoustic Recorders for Acoustic Monitoring



2.2.3. Daytime Monitoring

Two PSOs would monitor the required monitoring zones (Table 6) during in-water construction operations, specifically impact pile installation. In total, four PSOs would rotate throughout the day such that each PSO would observe for no more than 4 hours at a time and no more than 12 hours in a 24-hour period. To provide full coverage of the larger Level B zone during vibratory driving of sheet piles, two PSOs would be stationed at two locations at the same time with rotations. One station would be on the east side of the STP and one station would be on the west side of the STP. Figure 3 shows the DH4 location for PSOs, but only shows one location due to scale of the figure, as well as the different exclusion and monitoring zones for DH4 work.

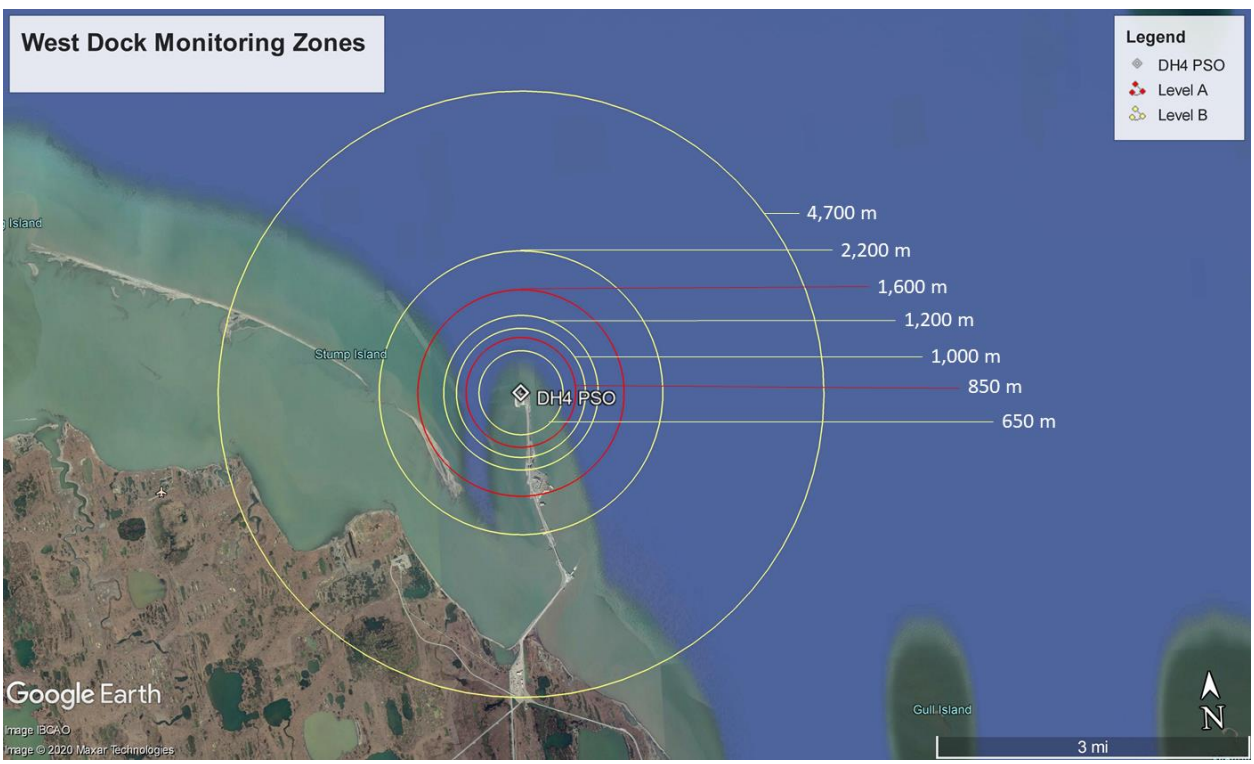
PSOs would be located at vantage points to monitor the monitoring zones, when conditions allow. Elevated platforms would be used to maximize potential for viewing marine mammals. The PSO observation site(s) would be determined prior to the commencement of construction activities.

When work is occurring at DH4, PSOs would be stationed at the STP on an elevated platform to view towards the east, north, and west, as water depth to the south (towards shore) is too shallow for marine

mammals (Figure 5). The highest estimated Level A distance for low frequency cetaceans is 5,166 feet (1,575 meters); those species are not expected to be inside the barrier islands due to the shallow water depths. The phocid Level A distance is 2,766 feet (843 meters); seals can generally be detected at this range although NMFS considers the effective detection range for seals to be 1,640 feet (500 meters). The highest estimated Level B distance is 2.9 miles (4,642 meters) for vibratory driving of sheet piles and 1.3 miles (2,154 meters) for impact pile driving. The Level B zones for impact pile driving are generally viewable with high powered binoculars and sufficient viewing height. The greater Level B zone for vibratory pile driving is generally not viewable for pinnipeds or smaller cetaceans from an elevated land-based platform. PSOs may be stationed on a vessel to increase viewing range or NMFS may use an "assumed take" calculation to account for marine mammals not detected by PSOs.

When work is occurring at the barge bridge, PSOs would be stationed at the north edge of the bridge. The bridge is elevated enough to provide good viewing. This area is very shallow, so it is unlikely there would be marine mammals in the Level A or B harassment area during this work. Figure 5shows the barge bridge PSO location, the zones would be shifted to be centered on the barge bridge location.

Figure 5: PSO location and monitoring zones from Dock Head 4



PSOs would monitor the shutdown zones and surrounding waters during pile driving activities and for 30 minutes prior to soft-start or in-water pile installation, as well as 30 minutes after pile driving cessation. If necessary, PSOs would initiate shutdown procedures as described in Section 2.7.3.

The observation station(s) would be equipped with 7x50 reticle binoculars, a spotting scope, and means of data entry (laptop, tablet, hard copy forms or another acceptable data entry device). During daylight hours, PSOs would systematically scan the water surface alternating between the naked eye, reticle binoculars, and spotting scope.

2.2.4. Nighttime and Low Visibility Monitoring

Consistent with expectations for working in the Arctic, AGDC has added a research component to the monitoring program. For construction activities occurring during the winter months or during other periods of darkness, we propose the PSOs monitor with night vision devices (NVDs) and/or infrared (IR) sensors. NVDs utilize image intensifying technology by amplifying ambient light from the moon or stars, for example. The devices are typically portable, lightweight, and significantly more cost-effective than infrared camera systems. NVDs may be handheld or mounted to headgear, and they may be monocular or binocular units. As an offshore marine mammal mitigation tool, NVDs have had limited success. Data indicate that visual observations during daylight hours are much more effective than monitoring efforts conducted with NVDs (Harris et al. 1997, 1998; Moulton and Lawson 2002; Hartin et al. 2011), however the extensive dark hours on the North Slope in the winter means work must be conducted outside of daylight hours.

Infrared sensors have successfully detected the warm bodies of ice seals glowing brightly against the cold sea ice (Conn et al. 2014; Young et al. 2019). Marine mammals in the water may be more difficult to detect due to their blubber layer. However, Weissenberger and Zitterbart (2012) were able to detect walrus that surfaced within 0.93 miles (1.5 kilometers) of the survey vessel, and large whale blows at distances of 5 miles (8 kilometers) with an infrared camera system. The average infrared detection distance for walrus was 0.5 mile (805 meters) and 1.5 miles (2,400 meters) for cetaceans. Compared to visual observations, sea state and visibility impeded infrared detectability to about the same extent. For cetacean species in Atlantic Canada, thermal-infrared imagery captured approximately 70% of sightings documented by PSOs within 1.9 miles (3 kilometers) of the shore-based observation site when the sea state was ≤ 6 (Holst et al. 2017).

The night vision and IR technology has improved since these studies were conducted and certain parameters of this project may be conducive to testing out the effectiveness of using this technology to improve monitoring in this area. In particular, PSOs would be based on a stable, elevated platform with ambient light from surrounding industry while scanning relatively small monitoring zones instead of on a moving vessel. Further, the species of most likely to be present during project work during either ice cover or open water season are seals, which are either hauled out ice, land, or at the surface of the water.

NVDs were used during the 2019 Hilcorp Alaska Lower Cook Inlet Seismic Survey, after which PSOs reviewed each device's effectiveness regarding visibility and ease of use. PSOs were provided ambient light and IR monocular scopes, and ambient-light binoculars. While the monocular scopes were the most effective for viewing the monitoring zones, they were the least ergonomically practical, and the binoculars had a restrictively narrow field of view. The most significant feedback was that none of the NVDs were ergonomically ideal for overnight use. For the Alaska LNG project, we will strive to provide high-quality,

comfortable ambient-light and IR-capable binoculars for PSO overnight use. Binoculars are commonly used for daytime marine mammal monitoring programs, and their use at night would allow for the highest degree of consistency with natural daylight observation patterns.

2.2.4.1. Objectives

Our primary objective for the nighttime and low visibility evaluation is to characterize NVD capability parameters for this project's location and lighting conditions. In particular, we aim to explore the following:

1) object detection at varying in-water distances using ambient light and IR devices;
2) animal detection and identification by comparing visibility from handheld NVDs to stationary device recordings; and
3) qualitative reviews of each device from a PSO perspective in categories including ergonomics, feasibility, safety, and detection and identification confidence.

2.2.4.2. Methods

Our evaluation would be performed in the field where variable conditions exist, including: light, weather, and PSO-dependent qualities (e.g., vision strength, fitness level, and observing experience). PSOs would be stationed at DH4 for all NVD assessments, and would monitor from a stable, elevated platform with ambient light from surrounding industry on a rotational schedule as described in Section 2.2. PSOs would be provided NVD binoculars that include infrared illuminators (similar to Figure 6), which would allow for comparison between night vision technology and night vision technology enhanced with IR capability.

Figure 6: Night Vision Binoculars with Infrared Illuminator
(Model shown is Night Owl NOXB-5 Explorer Pro 5X)

2.2.4.3. Preliminary Testing

Prior to the project start, PSO personnel would obtain NVD binoculars and conduct preliminary field testing to confirm visibility and ergonomic success. PSO personnel would assess the subjective comfort of each NVD compared to Fujinon 7 x 50 binoculars, which are among standard equipment issued to PSOs for daytime observation. Comfort would be assessed by the following: eye-to-device contact point (e.g., material quality, potential for friction against skin, feasibility for using clear safety glasses with eye piece), eye-strain relative to the duration tested, and equipment weight. Additionally, a brief object detection test would be performed, during which PSO personnel will observe traffic cones placed at 32.8-feet (10-meter) intervals up to 164 feet (50 meters) in a parking lot, at hourly intervals between civil twilight and night. The location of the parking lot would be selected based on ambient light conditions that are similar to those at DH4. PSO personnel would evaluate detection success for each traffic cone, and rate visibility when toggling between ambient and IR modes.

Objective 1

PSOs would assess object detection at distance intervals from the observing platform. AGDC would facilitate the placement of single polyform A-series buoys at 820-feet (250-meter) intervals north of DH4 up to 2.92 miles (4,700 meters). Upon every hour from civil twilight to night, PSOs on watch would view the buoys with each NVD device mode and independently record success or failure for detection at each distance. This detection verification process would occur approximately every three days in order to explore visibility under varying weather conditions.

Objective 2

Two IR video cameras similar to the model pictured in Figure 7would be stationed at DH4 facing northeast and northwest in order to capture the entire forward visible range. The IR video cameras would be activated at civil twilight and deactivated at dawn. PSOs would simultaneously observe the monitoring zones using the provided NVDs. At the end of nighttime watch, the time recorded for each sighting would be cross-referenced against the video footage for marine mammal identification confirmation.

Figure 7: Digital infrared Video Recorders (Model shown is Ordro AC7)

Objective 3

After the first full night of observation, PSOs would be provided a questionnaire pertaining to the functionality and ergonomics of the NVDs. PSOs would be asked to rate each NVD in categories including: overall comfort, eye strain, marine mammal detectability, marine mammal identification success, and effectiveness of platform ambient light.

2.3. Observer Qualifications and Training

The PSO team would be comprised of an experienced Field Lead PSO and three experienced PSOs. The Field Lead PSO would be required to have significant marine mammal monitoring experience with previous construction experience in Alaska and PSOs would have previous marine mammal experience. PSOs would be familiar with the marine mammals of the area and would complete a project-specific training session on operational activities, marine mammal monitoring protocol, permit stipulations and mitigation measures, and data collection protocol. PSOs may also substitute Alaska Native traditional knowledge for experience. The training session would be provided shortly before the anticipated start of the season and conducted by marine mammologists with extensive crew lead experience from previous marine mammal monitoring programs in the Alaskan Arctic. Prior to start of the monitoring program, NMFS would be provided CVs of each PSO for approval.

Primary objectives of the training include:

- Review of the 4MP for this project, including any amendments adopted or specified by NMFS, or other agreements in which the AGDC may elect to participate
- Review of marine mammal sighting, identification, and distance estimation methods
- Review operation of specialized equipment (e.g., reticle binoculars, spotting scopes)
- Review of data recording and data entry systems, including procedures for recording data on marine mammal sightings, environmental conditions, project activities and mitigation measures, and entry error control
- Review of mitigation procedures

At a minimum, PSOs would meet the following qualifications:

- Demonstrated ability to conduct field observations and collect data according to assigned protocols
- Ability to collect the required marine mammal observation data
- Documented marine mammal monitoring experience or training, or an undergraduate degree in biological science or a related field
- Visual acuity (correction is permissible) sufficient to allow detection and identification of marine mammals (binoculars may be necessary for species identification)
- Sufficient training, orientation, or experience with construction operations to conduct observations safely
- Ability to communicate with project personnel about marine mammals observed in the area

- Ability to coordinate shutdown procedures with the Construction Project Manager (PM), when necessary
- PSOs would be independent observers and would not be engaged in construction activities
- PSOs must have writing skills sufficient to prepare a report of observations including but not limited to the number and species of marine mammals observed; dates and times when in-water construction activities were conducted; dates, times, and reason for implementation of mitigation (or why mitigation was not implemented when required); and marine mammal behavior.

The Field Lead PSO would also have the following qualifications:

- Previous experience working in Alaska, preferably the Arctic, as a PSO
- Previous experience managing a PSO field team
- Previous experience coordinating with industrial activities, with a requirement for construction activities

2.4. Equipment

Monitoring equipment includes:

- Portable radios and cell phones for communication
- Hand-held binoculars (7X magnification or better) with built-in reticles
- Spotting scope (25X magnification or better)
- Electronic data collection system and necessary hardware
- NVDs and IR equipment for nighttime monitoring and evaluation

PSOs would also have the PSO handbook with definitions for data entry, maps of the project area and monitoring zones, and contact lists on hand electronically or hard copy at the observation station(s).

2.5. PSO Handbook

A PSO handbook with specifics of the Alaska LNG Project would be prepared and distributed to PSOs during training. The handbook would provide guidance and reference information to trained PSOs and would contain maps, illustrations, photographs, copies of important documents, and descriptive text. The following topics would be covered in the PSO Handbook:

- Summary description of the project, marine mammals and underwater sound energy, the 4MP, the NMFS IHA, and other regulations/permits/agencies
- Monitoring and mitigation objectives and procedures, including Level A and Level B harassment zones (Table 6)
- Responsibilities of staff and construction crew regarding the 4MP
- Instructions for staff and construction crew regarding the 4MP
- Data recording procedures, including codes and coding instructions, common coding mistakes
- Use of specialized field equipment (e.g., reticle binoculars, spotting scope)

- Reticle binocular distance scale
- Table of wind speed, Beaufort wind force, and sea state codes
- Data storage and backup procedures
- List of marine mammal species that might be encountered and identification, behavior, and natural history information
- Safety precautions while on-site
- Crew and/or personnel discord, conflict resolution among PSOs and crew
- Drug and alcohol policy and testing
- Scheduling of watches
- Communications
- List of field gear provided
- Suggested literature or literature cited
- Field reporting requirements and procedures

2.6. Communications

A clear chain of command and communication system would be in place to help PSOs, the construction crew, and any other personnel onsite understand roles and responsibilities. Anticipated roles are highlighted below, although titles may change:

- ***Alaska LNG Construction Project Manager (Construction PM):*** The Construction PM communicates directly with the Field Lead PSO each day before pile installation begins. The Construction PM would communicate to the Field Lead PSO the plan for that day, including start and stop times, the number of piles, sizes of piles, and method of installation. The Field Lead PSO would use this information to determine the appropriate harassment zones for that day. Mitigation action items would be discussed and adjusted, as needed, based on conditions.
- ***Field Lead PSO:*** In addition to daily operational communications with the Construction PM and typical PSO duties, the Field Lead would perform quality assurance and quality control (QA/QC) on data at the end of the day.
- ***PSO:*** PSOs are responsible for monitoring for marine mammals, collecting required data, QA/QC of their data, and reporting to the Field Lead PSO. PSOs are also responsible for understanding the mitigation measures and initiating implementation, as necessary, with the Construction PM.

2.7. Data Collection

Data regarding environmental conditions, marine mammal sightings, communications, and project activities would be collected electronically using a rugged hardware system (i.e., Toughbook or tablet) with data collection software (i.e., Excel or ArcGIS-based system). Hardcopy paper forms would be available as a backup, in case there are technical difficulties with equipment. Data collected on paper forms would consist of the same variables that are collected electronically.

Excellent record keeping and documentation is an essential part of this program. It is the responsibility of the observer to detail and document environmental and sighting data objectively, accurately, and professionally. High quality data are required for a number of reasons. Clear and concise data records ensure accurate data interpretation and facilitate post-season data QA/QC, analyses, and reporting. Survey data would also contribute to existing scientific knowledge, inform management decisions, and determine permit stipulations.

The data that would be collected are separated into three major categories: effort, sightings, and mitigation. The data fields are detailed in the following text and definitions and entry values are provided in Appendix A.

2.7.1. Effort

The PSOs would document monitoring effort, environmental conditions, and types of project activities. PSOs would document the start and stop times of monitoring. Environmental conditions would be documented at the beginning and end of every monitoring period and approximately every half hour, or as conditions change. Data collected would include PSO names, location of the observation station, time and date of observation, weather conditions, air temperature, sea state, cloud cover, visibility, glare, and ice coverage (if applicable). The PSOs would document the type of project activities, including type of pile installation, number of piles driven, as well as the time of startup (or soft start) and shutdown. PSOs would also document other, non-project-related activities that could disturb marine mammals in the area, such as the presence of vessels or aircraft.

2.7.2. Sightings

Marine mammals observed would be documented. The data collected would include a unique sighting ID number, start and end time of the sighting, species sighted, number of individuals (group size), age class (when discernible), sex class (when discernible), behavior and movement, distance at first observation, closest observed distance from project activities, and type of in-water project activity at the time of sighting. The PSO would also note any observed marine mammal behavioral changes or reactions that may be due to project activities.

PSOs would use binoculars and rangefinders to estimate distance to the marine mammal and proximity to the harassment zones. The initial distance of the sighting and closest point of approach would be recorded as the PSO tracks the path of animal. Behaviors, including potential reactions to project activities or other human activities in the area, would be recorded during each sighting. Potential indicators of a negative response to noise include abrupt dives or dispersal, change in swimming speed or direction, and an animal approaching and then departing the area. Other activities that the marine mammal could be responding to would also be documented when possible.

2.7.3. Mitigation

Communications between the PSO and Construction PM related to mitigation requests, as well as implemented mitigation measures, would be documented. Times would be recorded when: a soft start begins, pile installation reaches full energy, an animal is observed to enter the Level A and/or Level B

harassment zones, the PSO has requested a shutdown, an animal has exited the harassment zone, the PSO notifies the Construction PM that the area has been cleared for operations to resume, and operations resume. The PSO would document shutdown and non-shutdown decisions with reasons for each decision.

2.8. Mitigation Measures

2.8.1. In-Water Activity Mitigation Measures

The majority of DH4 construction and associated activities are planned for the open water season (June-October); however, no pile driving would occur during the Nuiqsut whaling season (August 25-September 15). In summary:

1. Seasonal Pre-Activity Monitoring: PSOs would begin observing for marine mammals three days prior to the start of in-water installation.
2. Daily Pre-Activity Monitoring: PSOs would begin observing for marine mammals 30 minutes before soft-start or in-water pile installation.
    a. If a marine mammal is sighted within the Level A harassment zones, a soft start would not begin until the PSO has determined that the animal has exited the zone or has not been re-sighted for 30 minutes.
    b. If a marine mammal is sighted within the Level B harassment zone after the 30-minute monitoring period but before soft start, the Contractor would either begin soft start with documentation of take, or delay the soft start to avoid take. Soft start or pile driving would not start if a marine mammal is within the Level A harassment zone.
3. Soft Start: A soft start technique would be used at the beginning of each impact pile installation or if there has been cessation of pile driving for a period of 30 minutes or longer to allow marine mammals to exit the area before pile driving reaches full energy.
    a. For impact pile driving, an initial set of three strikes from the hammer at about 40 percent energy is followed by a 30-second waiting period, and then two subsequent three-strike sets. Impact pile driving at full power may commence, provided marine mammals remain absent from the monitoring zone.
4. Shutdown Zones: Based on the estimated sound levels determined for pile installation, shut down zones were established for each functional hearing group (Table 6). Effort would be made to shut down before a marine mammal enters the shutdown zone, however, Level A take of a species would not occur unless the individual crosses into the respective Level A isopleth as defined in Table 3.
5. Shutdown Procedures: The PSOs would continuously monitor the Level A and Level B harassment zones during pile installation and would have direct contact with the designated Construction PM to coordinate shutdowns, as necessary.

a. For impact pile driving, the estimated Level A harassment zone (SEL) for seals is greater than the Level A exclusion zone. Seals observed in or near the Level A exclusion zone would be documented as Level A harassment unless it can be demonstrated that the animal did not incur Level A harassment by not remaining in the Level A zone sufficiently long enough to exceed the SEL threshold. The Level A harassment zone would be proportionately monitored (such as a wedge of a circle) where that wedge is at least 10 percent of the total zone (i.e., a 36-degree wedge).

b. If a marine mammal appears likely to enter the Level B harassment zone, the PSO would notify the Construction PM, who would either immediately shut down pile driving (using safe shutdown procedures) before the marine mammal enters the zone, avoiding a Level B take, or document the marine mammal as a Level B take upon entry into the zone. PSOs would document the reason to shut down or not shut down.

   If the decision is made to continue pile installation while a marine mammal is within the Level B harassment zone, that pile segment may be completed, unless the animal approaches and is likely to enter the Level A harassment zone. At that point, the Construction PM would immediately shut down pile driving operations (using safe shutdown procedures). Pile installation would be shut down to avoid take for marine mammal species for which take is not authorized.

c. Following a lapse of pile driving for more than 30 minutes, the PSO would authorize soft start procedures for impact pile driving after confirming that marine mammals have not been observed in the Level B harassment zone for at least 30 minutes immediately prior to resumption of operations.

d. Following a shutdown of less than 30 minutes due a marine mammal sighting in the Level B harassment zone, pile installation may commence when the PSO confirms that the marine mammal was observed exiting the zone or has not been observed in the zone for 30 minutes (for cetaceans) or 15 minutes (for pinnipeds).

e. In the event of shutdown or delay of activity resulting from marine mammals in the shutdown zone, their behavior will be monitored and documented until they leave the designated zone.

6. Shutdown for Weather/Low Visibility: Pile installation would only occur when the Level A and Level B harassment zones can be adequately monitored. The night vision/infrared equipment would not be used to initiate work at night until it is demonstrated that the equipment can effectively monitor for marine mammals throughout the entire exclusion zone.

7. Daily Post-Activity Monitoring: PSOs would observe marine mammals for 30 minutes after pile driving is completed for the day.

8. Seasonal Post-Activity Monitoring: PSOS would observe marine mammals for three days following completion of in-water installation.

9. Pile driving would not be conducted during the Nuiqsut whaling season (August 25-September 15).

If the entire Level B harassment zone is not visible, AGDC would determine if in-water pile installation would continue or shut down. Conditions such as low light, darkness, high sea state, fog, ice, rain, glare, or other conditions may prevent effective marine mammal monitoring of the entire Level B harassment zone. In some cases, NMFS may allow for an "assumed take" when the Level B zone is not visible so that work can continue. If the number of takes is not approaching the allowable number, the AGDC may elect to continue work during that period to complete the work needed for that day. Conversely, if the number of takes is approaching the allowable number, the AGDC may elect to stop work during that period. Pile installation would not be reinitiated until the entire Level B harassment zone is visible. If shutdown occurs for 30 minutes or more, startup procedures would be implemented prior to resumption of pile installation. This includes the 30-minute monitoring period to clear the zone and soft start procedures. The PSOs would document instances when shutdown is due to environmental conditions.

To avoid the potential for collision with a marine mammal during in-water work involving use of vessels (e.g., barges, tugboats, work boats, and skiffs), if a marine mammal approaches within 165 feet (50 meter) of the vessel, operations shall cease and vessels shall reduce speed to the minimum level required to maintain steerage and safe working conditions.

The Field Lead PSO and the Construction PM would maintain a running tally of Level B takes that occur for each species. If the maximum authorized number of Level B takes is reached or exceeded for the authorized period, in-water pile installation would be shut down immediately using safe shutdown procedures. In addition, NMFS would be notified immediately and a revised plan would be developed before in-water pile installation is resumed. To assist PSOs and construction crews, a protocol for the specific steps that should be used to communicate, decide, execute, and document a shutdown and re-start would be developed at the pre-field training session based on the issued IHA, final monitoring zones, and communication preferences. This protocol would be displayed and made available to appropriate personnel in hard copy or electronically.

2.8.2. Ice-Covered Season Mitigation Measures

Seabed preparation at the barge bridge would be conducted over grounded ice during the winter months. Grounded ice conditions are expected to occur at the breach on or before February 1 and seabed prep would begin as soon as ice conditions allow to minimize potential impacts on marine mammals. Ringed seals typically establish birthing lairs after March 1, and the commencement of construction activities before this date would prevent pregnant seals from constructing lairs in disturbed areas. Ringed seal density is low in areas where water depths are less than 10 feet (3 meters), and it is very unlikely that ringed seals would be encountered in the grounded ice work area.

The majority of DH4 construction and associated activities are a planned for the open water season (June-October). However, if work is not completed during this time due to logistical or other constraints, a contingency time period the following year for dolphin installation is March through April and May 1 through June 30 for construction of the barge bridge abutments. Should pile installation occur during this

contingency time period, an experienced Alaska Native subsistence advisor would survey areas within a buffer zone of DH4 where water depth is greater than 10 feet (3 meters) to identify potential ringed seal structures before activity begins. Structures would be avoided by a minimum of 500 feet (150 meters) and workers would have completed wildlife interaction avoidance training as part of their orientation program. The DH4 location has a depth of -12 feet (-3.7 meters) mean lower low water (MLLW) and, like the breach, grounded ice is expected during the winter. This combined with the initiation of any winter work before March 1 greatly reduces the likelihood of encountering ringed seals during winter pile driving.

If pile driving is needed during this contingency period, a single overwintering PAM recorder would be deployed at the end of the open water season for seal detection. The recorder would be located in between the 1.4 miles (2,200 meters) and 2.9 miles (4,700 meters) zones, perpendicular to the pile driving site. The location would be submitted to NSB, AEWC, and NMFS, and approved by NMFS prior to deployment.

2.9. Subsistence Mitigation Measures

Mitigation measures proposed to reduce impacts to subsistence users are provided in the following list. These mitigation measures include those that are considered industry standard as well as those that were raised by community members at the aforementioned meetings.

- Alaska LNG has developed a detailed Plan of Cooperation (POC), provided as Appendix B to the IHA application, as part of this Project in accordance with the MMPA which identifies and documents potential conflicts and associated measures that will be taken to minimize any adverse effects on the availability of marine mammals for subsistence use.
- Outcomes of POC meetings will be documented.
- Alaska LNG continues to document its contacts with the North Slope subsistence communities, as well as the substance of its communications with subsistence stakeholder groups. This documentation is included in the AGDC stakeholder database.
- Alaska LNG will routinely engage with local communities and subsistence groups. These groups will be consulted on mitigation measures to limit impacts prior to construction activities. Multiple user groups are often consulted simultaneously in larger coalition meetings such as the Arctic Safety Waterways Committee meetings. Local communities and subsistence groups identified by Alaska LNG include:
    - (AEWC
    - Whaling Captains Associations for Kaktovik, Nuiqsut, and Utqiaġvik
    - Arctic Safety Waterways Committee
    - Arctic Coalition of Marine Mammals
    - The Ice Seal Committee
    - The Alaska Beluga Whale Committee

  - The Alaska Nannut Co-Management Council
  - Indigenous People's Council for Marine Mammals
  - The NSB Department of Wildlife
  - The NSB Planning Department
  - Kuukpik Corporation
  - Inupiat Community of the Arctic Slope
- Alaska LNG will develop a Communication Plan and will implement this plan before initiating construction operations to coordinate activities with local subsistence users, as well as Village Whaling Captains' Associations, to minimize the risk of interfering with subsistence hunting activities, and keep current as to the timing and status of the bowhead whale hunt and other subsistence hunts.
- A project informational mailer with a request for community feedback (traditional mail, e-mail, phone) will be sent to community members prior to construction.
- Following the construction season, Alaska LNG intends to have a post-season co-management meeting with the commissioners and committee heads to discuss results of mitigation measures and outcomes of the preceding season. The goal of the post-season meeting is to build upon the knowledge base, discuss successful or unsuccessful outcomes of mitigation measures, and possibly refine plans or mitigation measures if necessary.
- The AEWC works annually with industry partners to develop a Conflict Avoidance Agreement (CAA). This agreement implements mitigation measures that allow industry to conduct their work in or transiting the vicinity of active subsistence hunters, in areas where subsistence hunters anticipate hunting, or in areas that are in sufficient proximity to areas expected to be used for subsistence hunting that the planned activities could potentially adversely affect the subsistence bowhead whale hunt through effects on bowhead whales while maintaining the availability of marine mammals for subsistence hunters. One important aspect of the CAA are time and area closures. Alaska LNG would negotiate and sign a CAA with the AEWC during the year of the in-water work. Such agreements are voluntary and are not mandated by regulation. Alaska LNG is also committing to the following restrictions on pile driving in anticipation of the Nuiqsut whaling season, understanding the exact whaling dates may change:
  - Pile driving activities at West Dock would not occur during sensitive periods in an effort to eliminate noise and vessel traffic
  - Vessels will be kept landward of Cross Island during the Nuiqsut whaling (August 25-September 15).

3. REPORTING

The results of the monitoring program, including estimates of takes, would be presented in weekly, monthly, and technical reports (90-day and final). The reports would summarize project operations, monitoring effort, species and numbers of marine mammals sighted, exposures, and implementation of mitigation measures. The technical reports (90-day and final, Section 3.3) would address the requirements established by NMFS in the IHA, and would be provided to NMFS and AGDC. Unless specified in the IHA, weekly and monthly reports would be submitted to AGDC only.

3.1. SSV Report

The SSV report would be submitted to NMFS within 72 hours of completion along with any requested adjustments to the monitoring zones. Until approved, AGDC would continue to work using the existing zones.

3.2. Weekly Reports

Each weekly report would contain the following information:

- Monitoring effort (date, start time, end time)
- Summary of environmental conditions (sea state, visibility, glare, etc.)
- Marine mammal sightings (species, number of individuals)
- Age classification (when discernible)
- Behaviors and potential reactions (correlated with project activities or monitoring zones)
- Marine mammal takes by species
- In-water activities before and during marine mammal sightings
- Project shutdowns (date, duration, reason for shutdown)

3.3. Monthly Reports

A monthly report would be submitted to provide a summary of weekly report information and identify any trends or ongoing issues.

3.4. Technical Reports: 90-Day Monitoring and Final Reports

The results of the marine mammal monitoring program, including estimates of “take by harassment”, would be presented in the 90-day and final technical reports. Reports would address the requirements established by NMFS and would include:

- The final SSV report and any adjustments.
- Summaries of the acoustic monitoring effort – numbers of marine mammal acoustic detections by species and received sound levels from project activities
- Summaries of monitoring effort – total hours and distribution of marine mammals throughout the study period accounting for sea state, visibility, and other factors affecting detectability of marine mammals

- Summary of project activities – types of piles and hammers, duration, and number of pile strikes (when possible)
- Analyses of the effects of various factors influencing detectability of marine mammals, such as sea state, number of observers, and fog/glare
- Species composition, occurrence, and distribution of marine mammal sightings, including date, group size, and age classification (when discernable)
- Analyses of the effects of the Alaska LNG Project:
    - Sighting rates of marine mammals during periods with and without project activities (and other variables that could affect detectability)
    - Initial sighting distances versus project activity
    - Closest point of approach versus project activity
    - Observed behaviors and types of movements versus project activity
    - Numbers of sightings/individuals seen versus project activity
    - Distribution around the action area versus project activity
    - Summary of implemented mitigation measures
    - Estimates of "take by harassment"
- If applicable, a summary of any injured or dead marine mammals discovered
- All datasheets and raw sighting data will be submitted as a separate file the to the Final Report

3.5. Notification of Injured or Dead Marine Mammals

In the event that the AGDC discovers an injured or dead marine mammal and the Field Lead PSO determines that the cause of the injury or death is unknown, the AGDC would immediately report the incident to the same list of authorities with the same information described above. Pile installation may continue while NMFS reviews the circumstances of the incident. NMFS would work with the AGDC to determine whether modifications to the activities are appropriate.

In the unanticipated event that pile installation clearly causes the take of a marine mammal for which authorization has not been granted, such as a serious injury or mortality, the AGDC would immediately cease pile installation and report the incident to:

- Chief of the Permits and Conservation Division
- Office of Protected Resources
- NMFS and its designees
- Alaska Regional Stranding Coordinators

The report would include the following information:

- Date, time, and location (latitude/longitude) of the incident
- Detailed description of the incident
- Description of vessel involved (if applicable), including the name, type of vessel, and vessel speed before and during the incident
- Status of sound source use in the 24 hours preceding the incident

- Environmental conditions (wind speed and direction, wave height, cloud cover, and visibility)
- Description of marine mammal observations in the 24 hours preceding the incident
- Species identification, description, and fate of animal(s) involved
- Photographs or video footage of animals or equipment (if available)

Pile installation shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS shall work with the AGDC to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. The Alaska LNG Project may not resume activities until notified by NMFS via letter, email, or telephone.

4. REFERENCES

Conn, P.B, J.M. Ver Hoef, B.T. McClintock, E.E., Moreland, J.M. London, M.F. Cameron, S.P. Dahle, and P.L. Boveng. 2014. Estimating multispecies abundance using automated detection systems: ice-associated seals in the Bering Sea. Methods in Ecology and Evolution 5:1280–1293.

Harris, R.E., G.W. Miller, R.E. Elliott and W.J. Richardson. 1997. Seals [1996]. p. 4-1 to 4-42 In: W.J. Richardson (ed.), Northstar marine mammal monitoring program, 1996: marine mammal and acoustical monitoring of a seismic program in the Alaskan Beaufort Sea. LGL Rep. 2121-2. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for BP Explore. (Alaska) Inc., Anchorage, AK, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 245 p.

Harris, R.E., A.N. Balla-Holden, S.A. MacLean and W.J. Richardson. 1998. Seals [1997]. p. 4-1 to 4-54 In: W.J. Richardson (ed.), Marine mammal and acoustical monitoring of BP Exploration (Alaska's) open-water seismic program in the Alaskan Beaufort Sea, 1997. LGL Rep. TA2150-3. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for BP Explore. (Alaska) Inc., Anchorage, AK, and U.S. National Marine Fisheries. Service, Anchorage, AK, and Silver Spring, MD, 318 pp.

Holst, M., H. Smith, D. Zitterbart, M. Flau, O. Boebel, and V. Moulton, LGL Limited, environmental research associates, Canada (2017): Optimizing a rotating thermal-IR system to automatically detect marine mammals in Atlantic Canada, 22nd Biennial Society for Marine Mammalogy Conference on the Biology of Marine Mammals, Halifax, Nova Scotia, Canada, 22 October 2017 - 27 October 2017.

Hartin K.G., L.N. Bisson, S.A. Case, D.S. Ireland, and D. Hannay. (eds.) 2011. Marine mammal monitoring and mitigation during site clearance and geotechnical surveys by Statoil USA E&P Inc. in the Chukchi Sea, August–October 2011: 90-day report. LGL Rep. P1193. Rep. from LGL Alaska Research Associates Inc., LGL Ltd., and JASCO Research Ltd. for Statoil USA E&P Inc., National Marine Fisheries Service, and U.S. Fish and Wildlife Service, 202 pp, plus appendices.

Moulton, V.D., J.W. Lawson. 2002. Seals, 2001. p. 3-1 to 3-48 In: W.J. Richardson (ed.), Marine mammal and acoustical monitoring of WesternGeco's open water seismic program in the Alaskan Beaufort Sea, 2001. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for WesternGeco, Houston, TX, and National Marine Fisheries Service, Anchorage, AK, and Silver Spring, MD. LGL Rep. TA 2564-4.

Weissenberger, J. and D.P. Zitterbart. 2012. Surveillance of Marine Mammals in the Safety Zone Around an Air Gun Array with the Help of a 360° Infrared Camera System. SPE SPE-158038-PP.

Young, B.G., D.J. Yurkowski, J.B., Dunn, and S. Ferguson.2019. Comparing Infrared Imagery to Traditional Methods for Estimating Ringed Seal Density. Wildlife Society Bulletin 43(1):121–130.

APPENDIX A

Marine Mammal Effort, Sighting, and Mitigation Data Fields

Table A-1: Effort Data Fields

Data Field	Definition and Values
Date	Day, month, year of the record
Time	Time of observation
Observation Site	Location where observations are being conducted
Observer	Observer first and last name
Watch	Level of effort (watch start, continuous watch, watch end, off watch)
Activity	Current operational activity (type of pile installation and number of piles driven)
Duration	Start and stop times of startup and shutdown processes
Beaufort Sea State	Sea surface conditions (0 to 12)
Glare	Severity (none, light, moderate, severe) and location (clockface)
Visibility	Distance visible for marine mammal detection
Air temp	Degrees Celsius
Ice coverage	Type (no ice present, new, brash, or pancake ice and floes) and amount (0-100%) of ice cover
Precipitation	Precipitation type (rain, light rain, drizzle, snow, fog)
Cloud Cover	Cloud percent (0-100%)
Light	Light, twilight, dark
Sightability	Overall evaluation of environmental conditions as related to detectability of a marine mammal (excellent, good, fair, poor)
Notes	Additional comments not otherwise captured

Table A-2: Sighting Data Fields

Data Field	Definition and Values
Date	Day, month, year of this record
Initial Time	Time of initial sighting
Final Time	Time which sighting was last observed
Latitude	Sighting latitude
Longitude	Sighting longitude
Observer	Observer first and last name
Sighting ID	Unique sighting ID number for each sighting
Species	Species Identification (Bowhead Whale, Gray Whale, Beluga Whale, Ringed Seal, Spotted Seal, Bearded Seal)
Group Size	Number of individuals observed
Juveniles	Number of juveniles present (if discernible)
Number Calves/Pup/Neonate	Number Calves/Pup/Neonates present (if discernible)
Sighting Cue	Feature first observed (head, fluke, dorsal fin, body, splash, blow, birds, other)
Optics Type	Naked eye, binoculars, spotting scope
Reticle	Reticle value from binoculars
Distance	Distance to sighting (km)
Closest Point of Approach (CPA)	Closest distance animal observed
Where At	From the perspective of a clock face, the location of the sighing relative to the observer
Where To	From the perspective of a clock face, the direction the animal is heading
Behavior 1	Primary behavior (avoiding predation, blowing, bow riding, breaching, bubbling, calving, dead, diving, feeding observed, feeding suspected, fluking, haulout, lobtail, looking, mating observed, mating suspected, milling, other, resting, side scanning, sinking, snorkeling, socializing, spyhopping, startling, surface active, swimming, tail slapping, tail waving, travelling, unknown, vocalizing)
Behavior 2	Secondary behavior (avoiding predation, blowing, bow riding, breaching, bubbling, calving, dead, diving, feeding observed, feeding suspected, fluking, haulout, lobtail, looking, mating observed, mating suspected, milling, other, resting, side scanning, sinking, snorkeling, socializing, spyhopping, startling, surface active, swimming, tail slapping, tail waving, travelling, unknown, vocalizing)
Reaction	Potential reaction to project activities (none, avoidance, approach, change direction, change speed, dive, splash, unknown)
Pace	Pace of movement (moderate, none, slow, unknown, vigorous)
Activity	Current operational activity (type of pile installation and number of piles driven)
Notes	Additional comments not otherwise captured

Table A-3: Mitigation Data Fields

Data Field	Definition and Values
Date	Day, month, year of this record
Soft Start Time Start	Time soft start begins
Soft Start Time End	Time soft start ends
Shutdown Request Time	Time shutdown requested by PSO
Shutdown Implemented Time	Time shutdown implemented
Shutdown/Non-Shutdown	Decision made by Construction POC and reason
Level B Zone Entry	Time which sighting entered Level B exposure zone
Level B Zone Exit	Time which sighting exited Level B exposure zone
Level A Zone Entry	Time which sighting entered Level A exposure zone
Level A Zone Exit	Time which sighting exited Level A exposure zone
Clearing Start Time	Time PSO started clearing the harassment zones for initiation of pile driving
Clearing Completed Time	Time PSO determined the area was clear and contacted the Construction POC