Alaska LNG

Application for Incidental Harassment Authorization for the Non-Lethal Harassment of Cetaceans and Pinnipeds: Alaska LNG Project 2015 Geophysical & Geotechnical Program in the Waters of Cook Inlet

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Abbreviations and Acronyms

ABBREVIATION	DEFINITION
Abbreviations for Units of Measurement	
cm	centimeters
cm^3	cubic centimeters
dB	decibels
ft	feet
Hz	hertz
in^3	cubic inches
kHz	kilohertz
kg	kilogram
km	kilometer
km^2	square kilometer
kts	knots
mi	mile
mi^2	square mile
mm	millimeters
ms	millisecond
rms	root mean square
µPa	micropascals
Other Abbreviations	
§	section or paragraph
4MP	marine mammal monitoring and mitigation plan
ACC	Alaska Coastal Current
ADEC	Alaska Department of Environmental Conservation
APDES	Alaska Pollutant Discharge Elimination System
Applicant	ExxonMobil Alaska LNG LLC
CH Area	Critical Habitat Area
CFR	Code of Federal Regulations
DPS	Distinct Population Stocks
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
G&G	geotechnical and geophysical
IHA	Incidental Harassment Authorization
LLC	Limited Liability Company
LNG	liquefied natural gas
Mainline	An approximately 800-mile-long, large-diameter gas pipeline
MMPA	Marine Mammal Protection Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
North Slope	Alaska North Slope
NPDES	National Pollution Discharge Elimination System
PBU	Prudhoe Bay Unit

ABBREVIATION	DEFINITION
PCPT	piezo-cone penetration testing
PSO	Protected Species Observers
PTS	permanent threshold shift
PTU	Point Thomson Unit
SSV	sound source verification
TTS	temporary threshold shift
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VGP	Vessel General Permit
ZOI	Zone of Influence

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EXECUTIVE SUMMARY

In support of the Alaska LNG Project, ExxonMobil Alaska LNG LLC is requesting an Incidental Harassment Authorization (IHA) from the National Marine Fisheries Service (NMFS) for their Cook Inlet 2015 Geophysical and Geotechnical (G&G) Program. Marine G&G surveys are proposed to be conducted in upper Cook Inlet during the open water season of 2015 to investigate the technical suitability of a pipeline study corridor across Cook Inlet and potential marine terminal locations near Nikiski. These surveys will include geophysical surveys, shallow geotechnical investigations, and geotechnical borings.

Geophysical surveys will be conducted using two geophysical vessels to deploy equipment including single beam and multibeam echo sounders, side-scan sonar, chirp and boomer subbottom profilers, a resistivity system, and a small airgun (0.983 L/60 in^3). Geotechnical borings will be conducted from a small jack-up platform that is positioned with a tug. Downhole geophysics will be conducted within geotechnical boreholes. Shallow geotechnical surveys include sediment grab samples, piezo-cone penetrometer testing [PCPT], and vibracoring deployed from a geophysical or support vessel.

Marine mammals that regularly inhabit Cook Inlet waters within the survey areas include the beluga whale (*Delphinapterus leucas*), harbor porpoise (*Phocoena phocoena*), and harbor seal (*Phoca vitulina*). These species are found there in low numbers and generally only during the summer fish runs (Nemeth et al. 2007, Boveng et al. 2012). The belugas belong to the Cook Inlet Stock, which is listed under the Endangered Species Act (ESA) as endangered. Killer whales (*Orcinus orca*) are occasionally observed in upper Cook Inlet where they have been observed attempting to prey on beluga whales (Shelden et al. 2003). Operation of some of the G&G program equipment will generate sound energy that has the potential to result in behavioral disturbances of the above-referenced marine mammals that could potentially rise to Level B harassment; however, other facets of the program are not expected to generate sound within the hearing range of the marine mammals identified in the proposed project area. Only those activities anticipated to generate sound within the hearing range of marine mammals of concern in Cook Inlet are evaluated in this IHA application.

In estimating the numbers of marine mammals that might be exposed to received sound levels exceeding NMFS Level B harassment thresholds, only certain G&G Program equipment was considered. The chirp and boomer subbottom profilers and the airgun are the only geophysical equipment considered; the vibracoring is the only geotechnical survey activity considered.

The estimates of the numbers of marine mammals that might be exposed to Level B harassment and the requested numbers of exposures are provided in Table E-1. The requested authorization as a percentage of the marine mammal stock is 1.0% or less in all cases, except for beluga whales, for which it is 4.81%. The requested authorization for

beluga whales does not account for the implementation of recommended mitigation measures, which should reduce the actual number of exposures.

Table E-1. Estimated Exposures and Requested Non-lethal, Incidental Level B harassment of Cook Inlet Marine Mammals.

Species	Estimated Exposures without Mitigation	Harassment Authorization Requested
Beluga Whale [1]	7	15
Killer Whale (Alaska Transient) [2]	<1	5
Harbor Porpoise [2]	3	15
Harbor Seal [2]	218	218

[1] Exposures based on 1-km cell densities in Goetz et al. (2012)
[2] Exposures based on average raw densities

Mitigation measures recommended to reduce exposure of marine mammals to sound energy generated by equipment in this program include stationing Protected Species Observers (PSOs) on the source vessels from which the chirper, boomer, airgun, and vibracorer will be deployed when that equipment is being utilized. The PSOs will assist the survey team in implementing mitigation measures such as establishing shut down safety zones and shutting down applicable sound sources when necessary to avoid harassment of beluga whales. Local subsistence communities will be consulted to identify and to reduce potential conflicts with subsistence hunting activities in the program work area to avoid unmitigable adverse impact on the species or stock for subsistence uses.

1.0 DESCRIPTION OF SPECIFIED ACTIVITY

1.1 PURPOSE OF THE PROPOSED ACTION

The Alaska Gasline Development Corporation, BP Alaska LNG LLC, ConocoPhillips Alaska LNG Company, ExxonMobil Alaska LNG LLC, and TransCanada Alaska Midstream LP plan to construct one integrated LNG Project (Project) 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. Proposed Project facilities include a Liquefaction Facility on the eastern shore of Cook Inlet in the Nikiski area of the Kenai Peninsula, which will be supplied by an approximately 1,287-km (800-mile), large diameter natural gas pipeline from the North Slope (Mainline). The Liquefaction Facility is comprised of an LNG Plant and Marine Terminal.

The Cook Inlet 2015 Geophysical and Geotechnical (G&G) Program will support detailed engineering of the Marine Terminal as well as an offshore section of the proposed Mainline pipeline corridor which crosses the Cook Inlet. The survey areas are depicted in Figure 1.

The G&G Program will use acoustical equipment to collect necessary data. Some of the equipment has the potential to acoustically harass marine mammals. Harassment is a form of "take" as defined under the Marine Mammal Protection Act (MMPA), and is subject to governance under the MMPA. Incidental and unintentional harassments are permitted with the issuance of an IHA from NMFS under Section 101(a)(5)(A) and (D) of the MMPA. MMPA regulations at 50 CFR 216.104 identify 14 specific items that must be addressed when applying for an IHA, which allow the NMFS to fully evaluate whether or not the proposed actions remain incidental and unintentional. The 14 items required by the regulations are addressed below to support this IHA application for the Cook Inlet 2015 G&G Program.

1.2 OVERVIEW OF ACTIVITY

The Cook Inlet 2015 G&G Program will include geophysical surveys, shallow geotechnical investigations, and geotechnical borings. Two separate areas will be investigated and are shown in Figure 1: the pipeline survey area and the Marine Terminal survey area (which includes an LNG carrier approach zone). The G&G Program survey areas (also referred to as the action area or action areas) are larger than the eventual pipeline route and the Marine Terminal site to ensure detection of all potential hazards, or to identify areas free of hazards. This provides siting flexibility should the pipeline corridor or Marine Terminal sites need to be adjusted to avoid existing hazards.

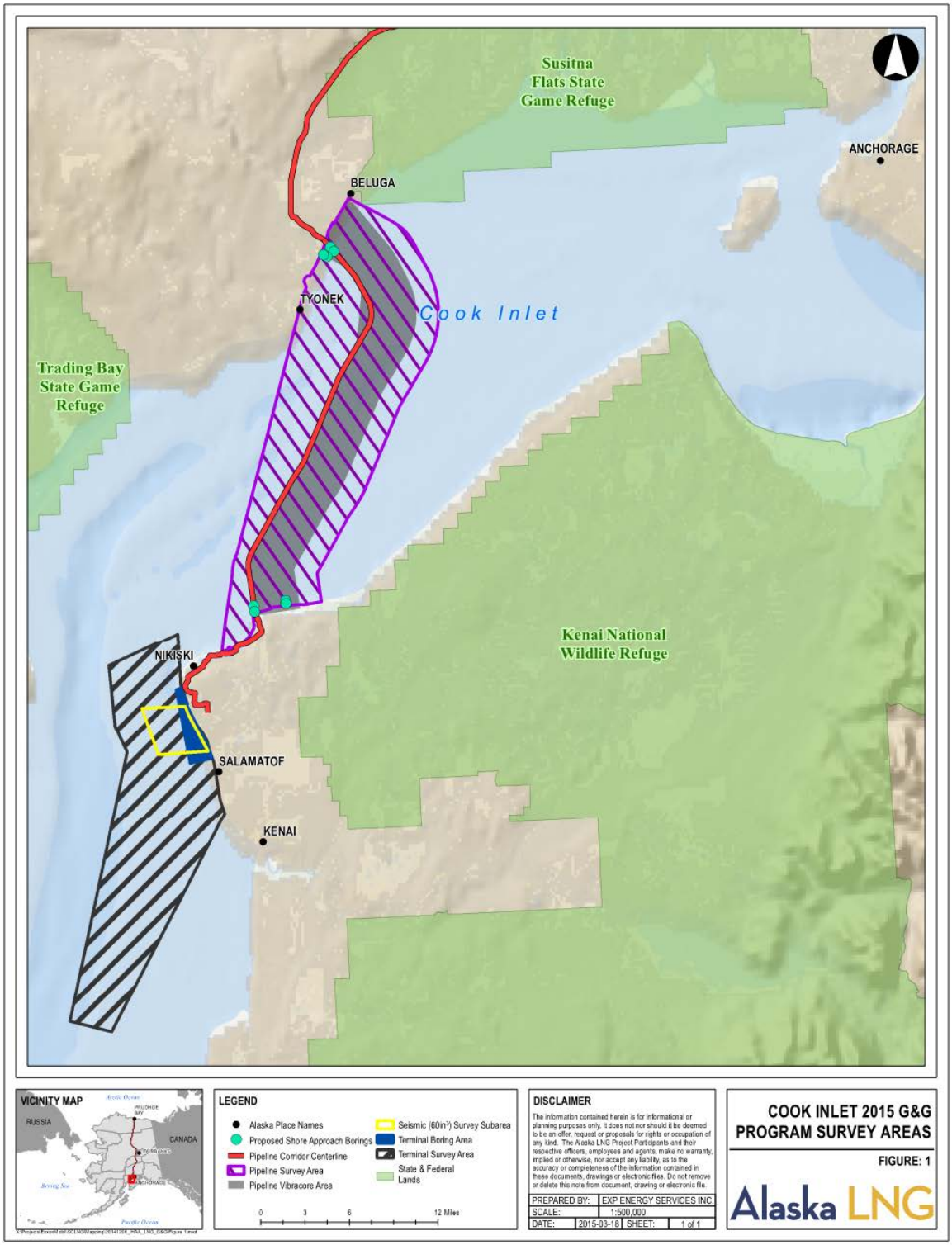


Figure 1. Cook Inlet 2015 G&G Program Survey Areas.

Pipeline Survey Area - The pipeline survey area (Figure 1) crosses Cook Inlet from Boulder Point on the Kenai Peninsula across to Shorty Creek about halfway between the village of Tyonek and the Beluga River. This survey area is approximately 45 km (28 mi) in length along the corridor centerline and averages about 13 km (8 mi) wide. The total survey area is 541 km^2 (209 mi^2). The pipeline survey area includes a subarea where vibracores will be conducted in addition to the geophysical surveys and shallow geotechnical investigations.

Marine Terminal Survey Area - The Marine Terminal survey area (Figure 1) encompassing 371 km^2 (143 mi^2) is located near Nikiski where potential sites and vessel routes for the Marine Terminal are being investigated. The Marine Terminal survey area includes two subareas: a seismic survey subarea where the airgun will be operated in addition to the other geophysical equipment, and a terminal boring subarea where geotechnical boreholes will be drilled in addition to the geophysical survey and shallow geotechnical investigations. The seismic survey subarea encompasses 25 km^2 (8.5 mi^2) and the terminal boring subarea encompasses 12 km^2 (4.6 mi^2).

1.3 PROJECT DETAILS

The planned geophysical surveys involve remote sensors including single beam echo sounder, multibeam echo sounder, sub-bottom profilers (chirp and boomer), 0.983 L (60 in^3) airgun, side scan sonar, geophysical resistivity meters, and magnetometer to characterize the bottom surface and subsurface. The planned shallow geotechnical investigations include vibracoring, sediment grab sampling, and piezo-cone penetration testing (PCPT) to directly evaluate seabed features and soil conditions. Geotechnical borings are planned at potential shoreline crossings and in the terminal boring subarea within the Marine Terminal survey area, and will be used to collect information on the mechanical properties of *in-situ* soils to support feasibility studies for construction crossing techniques and decisions on siting and design of pilings, dolphins, and other marine structures. Geophysical resistivity imaging will be conducted at the potential shoreline crossings. Shear wave velocity profiles (downhole geophysics) will be conducted within some of the boreholes. Further details of the planned operations are provided below.

1.3.1 Geophysical Surveys

The types of acoustical geophysical equipment planned for use in the Cook Inlet 2015 G&G Program are indicated, by survey area, in Table 1.

The magnetometer and resistivity system are not included in the table since they are not acoustical in nature and, thus, do not generate sound that might harass marine mammals, nor do they affect habitat.

Downhole geophysics is included in the table as a sound source, but is not considered further in this assessment as the energy source will not generate significant sound energy within the water column since the equipment will be located downhole within the geotechnical boreholes. The transmitter (source) and receiver are both housed within the same probe or

tool that is lowered into the hole on a wireline. The suspension log transmitter is an electromechanical device. It consists of a metallic barrel (the hammer) disposed horizontally in the tool and actuated by an electromagnet (solenoid) to hit the inside of tool body (the plate). The fundamental H1 mode is at about 4.5 KHz, and H2 is at 9 KHz. An extra resonance (unknown) mode is also present at about 15Khz. An analysis performed to estimate the expected sound level of the proposed borehole logging equipment scaled the sound produced by a steel pile driven by a hammer (given that both are cylindrical noise sources and produce impulsive sounds) and concluded that the sound level produced at 25m by the borehole logging equipment would be less than 142 dB. This is not considering the confining effect of the borehole which would lower the sound level even further (I&R, 2015).

Table 1. Planned locations for use of acoustic geophysical equipment in the Cook Inlet 2015 G&G Program.

Survey Equipment		Survey Area [2]	
Type	**Model [1]**	**Pipeline Crossing**	**Marine Terminal**
Single beam echo sounder	Echotrac CV-100	+	+
Multibeam echo sounder	Sonic 2024	+	+
Side-scan sonar	EdgeTech 4125	+	+
Sub-bottom profiler - chirp	EdgeTech 3200	+	+
Sub-bottom profiler - boomer	Applied Acoustics AA301	+	+
Downhole geophysics	Geomatics G-882	+	+
Airgun	0.983 L (60 in^3)	-	+

[1] A similar model may be used
[2] A (+) indicates the equipment will be used in the survey area. A (-) indicates the equipment will not be used in the survey area.

The other types of geophysical equipment proposed for the 2015 program will generate impulsive sound in the water column, are described below, and are evaluated further in this assessment as to potential impacts to marine mammals. Information on the acoustic characteristics of geophysical and geotechnical sound sources is summarized in Table 2, followed by a corresponding description of each piece of equipment to be used.

Table 2. Acoustical characteristics of geophysical and geotechnical equipment planned for use in the 2015 G&G Program.

Type	Model [1]	Operating Frequency (kHz)	Source Level [5] (dB re 1 µPa-m [rms])
Single beam echo sounder	Echotrac CV-100	>200 [2]	146 [6]
Multibeam echo sounder	Sonic 2024	>200 [2]	188 [6]
Side-scan sonar	EdgeTech 4125	400-1600 [2]	188 [6]
Sub-bottom profiler - chirp	EdgeTech 3200	2-16 [2]	202 [7]
Sub-bottom profiler - boomer	Applied Acoustics AA301	0.5-6 [2]	205 [7]
Airgun	0.983 L (60 in^3)	<1 [3]	206 [8]
Vibracore	Alpine	0.01-20 [4]	187 [4]

[1] A similar model may be used
[2] Source: Manufacturer brochure
[3] Source: Richardson et al. 1995
[4] Source: Chorney et al. 2011
[5] rms = root mean square
[6] Shores 2013
[7] Manufacturer provided peak value converted to rms (using a -10 dB offset)
[8] O'Neill et al. 2010

1.3.1.1 Single Beam Echo Sounders

Single beam echo sounders calculate water depth by measuring the time it takes for emitted sound to reflect off the seafloor bottom and return to the transducer. They are usually mounted on the vessel hull or a side-mounted pole. Echo sounding is expected to be conducted concurrently with subbottom profiling. Given an operating frequency of more than 200 kHz (Table 2), sound energy generated by the echo sounderswill be essentially beyond the hearing range of marine mammals (Wartzok and Ketten 1999, Southall et al. 2007, Reichmuth and Southall 2011, Castellote et al. 2014). Further, single beam echo sounders operate at relatively low energy levels (146 dB re 1 µPa-m [rms]). Thus, this equipment is not further evaluated in this application. The simultaneous operations of echo sounder with subbottom profiler should have no additive effect on marine mammals.

1.3.1.2 Multibeam Echo Sounders

Multibeam echo sounders emit a swath of sonar downward to the seafloor at source energy levels of 188 dB re 1 µPa-m (rms). The reflection of the sonar signal provides for the production of three dimensional seafloor images. These systems are usually side-mounted to the vessel. Echo sounding is expected to be conducted concurrently with subbottom profiling. Given the operating frequencies of the planned multibeam system (>200 kHz, Table 2), the generated underwater sound will be beyond the hearing range of Cook Inlet marine mammals (Wartzok and Ketten 1999, Kastelein et al. 2005, Southall et al. 2007, Reichmuth and Southall 2011, Castellote et al. 2014). Further, most sound energy is emitted directly downward from this equipment, not laterally. As with the single beam, the multibeam is not further evaluated because it exceeds the maximum hearing frequency of local marine mammals. The simultaneous operations of echo sounder with subbottom profiler should have no additive effect on marine mammals.

1.3.1.3 Side-scan Sonar

Side-scan sonar emits a cone-shaped pulse downward to the seafloor with source energy of about 188 dB re 1 µPa-m (rms). Acoustic reflections provide a two-dimensional image of the seafloor and other features. The side-scan sonar system planned for use during this program will emit sound energy at frequencies of 400 and 1600 kHz (Table 2), which are well beyond the normal hearing range of Cook Inlet marine mammals (Wartzok and Ketten 1999, Kastelein et al. 2005, Southall et al. 2007, Reichmuth and Southall 2011, Castellote et al. 2014). Side-scan sonar is not further evaluated in this application.

1.3.1.4 Sub-bottom Profiler - Chirp

The chirp sub-bottom profiler planned for use in this program is a precisely controlled "chirp" system that emits high-energy sounds with a resolution of one millisecond (ms) and is used to penetrate and profile the shallow sediments near the sea floor. At operating frequencies of 2 to 16 kHz (Table 2), this system will be operating at the lower end of the hearing range of beluga whales and well below the most sensitive hearing range of beluga whales (45-80 kHz, Castellote et al. 2014). The source level is estimated at 202 dB re 1 µPa-m (rms). The beam width is 24 degrees and the tilt angle is 90 degrees below the horizontal plane.

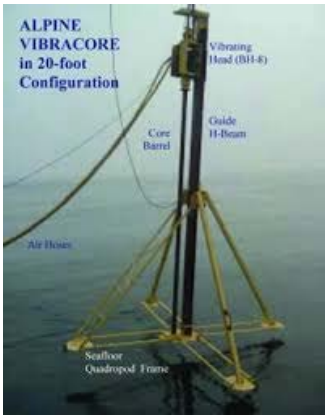
1.3.1.5 Sub-bottom Profiler - Boomer

A boomer sub-bottom profiling system with a penetration depth of up to 600 ms and resolution of 2 to 10 ms will be used to penetrate and profile the Cook Inlet sediments to an intermediate depth. The system will be towed behind the vessel. With a sound energy source level of about 205 dB re 1 µPa-m (rms) at frequencies of 0.5 to 6 kHz (Table 2), most of the sound energy generated by the boomer will be at frequencies that are well below peak hearing sensitivities of beluga whales (45-80 kHz; Castellote et al. 2014), but would still be detectable by these animals. The tilt angle is 90 degrees below the horizontal plane, but the equipment is omni-directional so the physical orientation is irrelevant.

1.3.1.6 Airgun

A 0.983 L (60 in^3) airgun will be used to gather high resolution profiling at greater depths below the seafloor. The published source level from Sercel (the manufacturer) for a 0.983 L (60 in^3) airgun is 216 dB re 1 µPa-m (equating to about 206 dB re 1 µPa-m (rms). These airguns typically produce sound levels at frequencies of less than 1 kHz (Richardson et al. 1995, Zykov and Carr 2012), or below the most sensitive hearing of beluga whales (45-80 kHz; Castellote et al. 2014), but within the functional hearing of these animals (>75 Hz; Southall et al. 2007). The airgun will only be used during geophysical surveys conducted in the smaller seismic survey subarea within the Marine Terminal survey area.

1.3.2 Geotechnical Surveys



1.3.2.1 Shallow Geotechnical Investigations - Vibracores

Vibracoring is conducted to obtain cores of the seafloor sediment from the surface down to a depth of about 6.1 m (20 ft). The cores are later analyzed in the laboratory for moisture, organic and carbonate content, shear strength, and grain size. Vibracore samplers consist of a 10-cm (4.0-in) diameter core barrel and a vibratory driving mechanism mounted on a four-legged frame, which is lowered to the seafloor. The electric motor driving mechanism oscillates the core barrel into the sediment where a core sample is then extracted. The duration of the operation varies with substrate

type, but generally the sound source (driving mechanism) is operable for only the one or two minutes it takes to complete the 6.1-m (20-ft) bore and the entire setup process often takes less than one hour.

Chorney et al. (2011) conducted sound measurements on an operating vibracorer in Alaska and found that it emitted a sound pressure level at 1-m source of 187.4 dB re 1 µPa-m (rms), with a frequency range of between 10 Hz and 20 kHz (Table 2). Vibracoring will result in the largest zone of influence (ZOI; area ensonified by sound energy greater than the 120 dB threshold) among the continuous sound sources. Vibracoring would also have a very small effect on the benthic habitat.

Vibracoring will be conducted at approximate intervals of one core every 4.0 km (2.5 mi) along the pipeline corridor centerline for a total of about 22 samplings total. Approximately 33 vibracores will also be collected within the Marine Terminal survey area. Only about three or four vibracorings per day are expected to be conducted over about 14 days of vibracoring activity, but given the expected duration per vibracore the total time the sound source would be operating is expected to be about 2.0 hours or less.

1.3.2.2 Geotechnical Borings

Geotechnical borings will be conducted within the Marine Terminal survey area and within the pipeline survey area near potential shoreline crossings. Geotechnical borings will be conducted by collecting geotechnical samples from borings 15.2 to 70.0 m (50-200 ft) deep using a rotary drilling unit mounted on a small jack-up platform. Geotechnical borings provide geological information at greater sediment depths than vibracores. These data are required to help inform proper designs and construction techniques for pipeline crossing and terminal facilities. The number of and general locations for the planned geotechnical boreholes are provided below in Table 3.

Table 3. Geotechnical borings planned for the Cook Inlet 2015 G&G Program[1].

Survey Area	Number of Borings	Boring Target Depth m (ft)	Diameter cm (in)	Drilling Fluids
Pipeline Survey Area	8	≤45.6 (≤150)	22.9 (9)	Secovis
Marine Terminal Boring Subarea	24	≤70.0 (≤200)	22.9 (9)	Secovis
	10	≤15.2 (≤50)	22.9 (9)	Secovis
All	42	NA	22.9 (9)	Secovis

[1] Some shallow geotechnical activity (sediment grab sampling) may be conducted from the geophysical source vessel

The jack-up platform is expected to be the Seacore *Skate 3* modular jack-up or a similar jack-up. The *Skate 3* modular platform is supported by four 76-cm (30-in) diameter legs. The borings will be drilled with a Comacchio MC-S conventional rotary geotechnical drill rig mounted on rubber skids. Four geotechnical boreholes will be drilled at each of the two shoreline crossings (8 total), and up to 34 boreholes will be drilled in the terminal boring subarea within the Marine Terminal survey area.

Sound source verifications of large jack-up drilling rigs in Cook Inlet (*Spartan 151* and *Endeavour*) have shown that underwater sound generated by rotary drilling from elevated platforms on jack-ups generally does not exceed the underwater ambient sound levels at the source (MAI 2011, I&R 2014). Underwater sound generated by these larger drill rigs was identified as being associated with their large hotel generators or with underwater deep-well pumps, neither of which type of equipment is used by the *Skate 3*. The *Skate 3* is equipped with only a small deck-mounted pump and generator. Sound source information is not available for the *Skate 3*, however, the rubber tracks of the skid and the narrow legs of the rig greatly limit the transmission of sound (via vibrations) from the drilling table into the water column. Underwater sound generated from the *Skate 3* from geotechnical borings is not expected to exceed 120 dB re 1 µPa-m (rms) at source; the borings are therefore not further evaluated as potential noise impact. However, the intrusive borings will affect benthic habitat and is later described.

1.3.2.3 Sediment Grab Samples

Grab sampling will involve using a Van Veen grab sampler that will be lowered with its "jaws" open to the seafloor from the geophysical vessel at which point the mechanical closing mechanism is activated, thus "grabbing" a sample of bottom sediment. The sampler is retrieved to the vessel deck and a sample of the sediments collected for environmental and geotechnical analysis, such as soil description and sieve analyses. Grab sampling does not produce significant underwater sound, but will have a small effect on the benthic habitat. Grab samples will be obtained as warranted to aid interpretation of geophysical data.

1.3.2.4 Piezo-cone penetration testing

Piezo-cone penetration testing (PCPT) involves placing a metal frame on the ocean bottom and then pushing an instrumented cone into the seafloor at a controlled rate, measuring the resistance and friction of the penetration. The results provide a measure of the geotechnical engineering property of the soil, including load bearing capacity and stratigraphy. The target depth is about 4.9 m (16 ft). PCPTs will be conducted at intervals of about one per 8.0 km (5.0 mi) along the pipeline corridor centerline and elsewhere in the pipeline survey area and Marine Terminal survey area. Precise target locations will be determined in the field and will be adjusted by onboard personnel after the preliminary geophysical data has been made available to select sample locations that better identify soil transition zones and/or other features. PCPT will have an inconsequential effect on benthic habitat.

1.3.3 Vessels

The geophysical surveys will be conducted from one of two source vessels with the smaller of the two used in more shallow, nearshore water conditions. Vibracoring will be conducted from a third vessel as noted in Table 4. Geotechnical borings will be conducted from a jack-up platform. The jack-up platform is not self-powered, and will be positioned over each sampling location by a tug.

The proposed numbers, types, and dimensions of vessels for this program are indicated in Table 4 below. The contracted vessels will either be these vessels or similar vessels with similar configurations.

Table 4. Vessels expected to be used in the Cook Inlet 2015 G&G Program.

Activity	Vessel Type & (number)	Example Vessel [2]	Length m (ft)	Width m (ft)	Horsepower
Geophysical surveys [1,2]	Source vessel (1)	*Qualifier 105*	32.0 (105)	9.1 (30)	1,200
	Source vessel (1)	*Westerly*	15.2 (50)	4.7 (15.5)	1,000
Vibracores [2]	Source vessel (1)	*Arctic Seal*	40.8 (134)	9.8 (32)	850
Geotechnical studies [2]	Jack-up platform (1)	*Skate 3*	18.3 (60)	12.2 (40)	NA
	Tug (1)	*Cosmic Wind*	15.9 (52)	6.1 (20)	1,100

[1] Some shallow geotechnical activity (sediment grab sampling) may be conducted from the geophysical source vessel
[2] Vessels not yet contracted, but may be these vessels or similar vessels

1.4 SAFETY ZONE RADII

Some of the equipment proposed to be used during the G&G Program has the potential to acoustically injure marine mammals in close proximity to the activity (defined as Level A harassment). The NMFS threshold for onset of Level A harassment is 180 dB for whales and 190 dB for seals (all rms). To avoid exposing marine mammals to these received sound levels, safety zones have been identified based on reported or proxy values for distances to the 180 and 190 dB isopleths.

The loudest sound source (within marine mammal hearing range, <200 kHz) to be used during surveys in the pipeline survey area is the boomer sub-bottom profiler, which is expected to generate received sound levels exceeding 180 dB outward to a radius of about 23 m (75 ft) (Table 5). This distance (and the distances calculated for all other equipment) was determined by applying equipment 1-m sound source levels to Collins et al.'s (2007) 18.4 Log r – 0.00188 spreading model developed for Cook Inlet.

The 0.983 L (60 in^3 airgun) airgun will generate the greatest sound energy levels during surveys in the seismic survey subarea within the Marine Terminal survey area, and is predicted to generate received sound levels of 180 dB outward to a distance of about 26 m (85 ft) from the source (Table 5).

Table 5. Safety Zone Radii for each G&G Program Equipment Type Generating Sound at Frequencies <200 kHz.

Survey Equipment	Safety Zone Radii [1]	
	Pinnipeds 190 dB radius m (ft)	Cetaceans 180 dB radius m (ft)
Sub-bottom Profiler - Chirp	5 (16)	6 (20)
Sub-bottom Profiler - Boomer	7 (23)	23 (75)
Airgun	8 (26)	26 (85)
Vibracore	0	3 (10)

[1] Calculated by applying Collins et al. (2007) spreading formula to source levels in Table 2

Qualified Protected Species Observers (PSOs) will be deployed aboard the geophysical survey source vessels to monitor the safety zones and to alert operators to operational mitigations at the approach of a marine mammal to these safety zones as practical, given that some zones (e.g., the 3-m [10-ft] cetacean safety zone associated with the vibracore) may not extend much outside the bottom surface area of the survey vessel (see Appendix A: *Marine Mammal Monitoring and Mitigation Plan*). Marine mammal monitoring will occur during the operation of all four equipment types shown in Table 5.

2.0 DATES, DURATION, AND SPECIFIED GEOGRAPHIC REGION

This IHA request covers activities to be conducted in Cook Inlet in the survey areas described in Section 1.0. Geophysical and geotechnical surveys that do not involve equipment that could acoustically harass listed marine mammals could begin as soon as April 2015, depending on the ice conditions. These surveys include echo sounders and side scan sonar surveys operating at frequencies above the hearing range of local marine mammals and geotechnical borings, which are not expected to produce underwater noise exceeding ambient. The remaining surveys, including use of sub-bottom profilers and the small airgun, would occur soon after receipt of the IHA. These activities would be scheduled in such a manner as to minimize potential effects to marine mammals, subsistence activities, and other users of Cook Inlet waters. It is expected that approximately 12 weeks (84 work days) are required to complete the G&G Program. The work days would not all be consecutive due to weather, rest days, and any timing restrictions. The Applicant will engage with NMFS should the program require additional time to complete.

3.0 SPECIES AND NUMBERS OF MARINE MAMMALS

Marine mammals that regularly inhabit upper Cook Inlet and Nikiski activity areas are the beluga whale (*Delphinapterus leucas*), harbor porpoise (*Phocoena phocoena*), and harbor seal (*Phoca vitulina*) (Table 6). However, these species are found there in relatively low numbers, and generally only during the summer fish runs (Nemeth et al. 2007, Boveng et al. 2012). Killer whales (*Orcinus orca*) are occasionally observed in upper Cook Inlet where they have been observed attempting to prey on beluga whales (Shelden et al. 2003). Based on

a number of factors, Shelden et al. (2003) concluded that the killer whales found in upper Cook Inlet to date are the transient type, while resident types occasionally enter lower Cook Inlet. Marine mammals occasionally found in lower Cook Inlet include humpback whales (*Megaptera novaeangliae*), gray whales (*Eschrichtius robustus*), minke whales (*Balaenoptera acutorostrata*), Pacific white-sided dolphins (*Lagenorhynchus obliquidens*), Dall's porpoise (*Phocoena dalli*), Steller sea lion (*Eumetopias jubatus*), and sea otter (*Enhydra lutris*; USFWS jurisdiction species). Because these latter species are not regular inhabitants of the G&G Program areas, they are not addressed further in this application.

Table 6. Marine Mammals Inhabiting the G&G Program Areas.

Species	Stock Estimate [1]	Comment
Beluga Whale	312	Cook Inlet Stock, ESA-listed as Endangered
Killer Whale	587	Alaska Transient Stock
Harbor Porpoise	31,046	Gulf of Alaska Stock
Harbor Seal	22,900	Cook Inlet/Shelikof Stock

[1] Source: Allen and Angliss (2014)

4.0 AFFECTED SPECIES STATUS AND DISTRIBUTION

Four species of marine mammals inhabit upper and lower Cook Inlet. Beluga whales concentrate in upper Cook Inlet during the summer, especially on the Susitna Delta, and then move south to the waters of the middle inlet for winter. Both harbor seals and harbor porpoise concentrate around the mouths of the upper Cook Inlet rivers during the summer, where, like beluga whales, they feed on migrating eulachon and salmon runs. Harbor porpoise and harbor seals can also be found throughout Cook Inlet during the summer and winter south of the annual ice cover. Only a few hundred of any of these three species seasonally inhabit the action areas. Only 312 beluga whales inhabit Cook Inlet (Allen and Angliss 2014), the Cook Inlet-wide estimate for harbor porpoise is only 136 animals (Dahlheim et al. 2000), and no more than 380 hauled out harbor seals were recorded in upper Cook Inlet on any given survey during NMFS aerial surveys conducted annually between 1993 and 2012 (Shelden et al. 2013). Killer whale presence in upper and lower Cook Inlet is more sporadic and consists of the occasional small group of transient killer whales in search of mammalian prey. Each species of marine mammal is discussed in greater detail below.

4.1 BELUGA WHALE (DELPHINAPTERUS LEUCAS)

The Cook Inlet beluga whale Distinct Population Stock (DPS) is a small geographically isolated population that is separated from other beluga populations by the Alaska Peninsula. The population is genetically (mtDNA) distinct from other Alaska populations suggesting that the Peninsula is an effective barrier to genetic exchange (O'Corry-Crowe et al. 1997) and that these whales may have been separated from other stocks at least since the last ice age. Laidre et al. (2000) examined data from over 20 marine mammal surveys conducted in the northern Gulf of Alaska and found that sightings of belugas outside Cook Inlet were

exceedingly rare, and these were composed of a few stragglers from the Cook Inlet DPS observed at Kodiak Island, Prince William Sound, and Yakutat Bay. Several marine mammal surveys specific to Cook Inlet (Laidre et al. 2000, Speckman and Piatt 2000), including those that concentrated on beluga whales (Rugh et al. 2000, 2005a), clearly indicate that this stock largely confines itself to Cook Inlet. There is no indication that these whales make forays into the Bering Sea where they might intermix with other Alaskan stocks.

The Cook Inlet beluga DPS was originally estimated at 1,300 whales in 1979 (Calkins 1989) and has been the focus of management concerns since experiencing a dramatic decline in the 1990s. Between 1994 and 1998 the stock declined 47% which has been attributed to overharvesting by subsistence hunting. Subsistence hunting was estimated to then have annually removed 10-15% of the population. Only five belugas have been harvested since 1999, yet the population has continued to decline (Allen and Angliss 2014), with the most recent estimate at only 312 animals (Allen and Angliss 2014). The NMFS listed the population as "depleted" in 2000 as a consequence of the decline, and as "endangered" under the Endangered Species Act (ESA) in 2008 when the population failed to recover following a moratorium on subsistence harvest. In April 2011, the NMFS designated critical habitat for the Cook Inlet beluga whale under the ESA (Figure 2).

Prior to the decline, this DPS was believed to range throughout Cook Inlet and occasionally into Prince William Sound and Yakutat (Nemeth et al. 2007). However the range has contracted coincident with the population reduction (Speckman and Piatt 2000). During the summer and fall, beluga whales are concentrated near the Susitna River mouth, Knik Arm, Turnagain Arm, and Chickaloon Bay (Nemeth et al. 2007) where they feed on migrating eulachon (*Thaleichthys pacificus*) and salmon (*Onchorhynchus* spp.) (Moore et al. 2000). The limits of CH Area 1 reflect the summer distribution (Figure 3). During the winter, beluga whales concentrate in deeper waters in the mid-inlet to Kalgin Island, and in the shallow waters along the west shore of Cook Inlet to Kamishak Bay. The limits of CH Area 2 reflect the winter distribution. Some whales may also winter in and near Kachemak Bay.

Goetz et al. (2012) modeled beluga use in Cook Inlet based on the NMFS aerial surveys conducted between 1994 and 2008. The combined model results shown in Figure 3 indicate a very clumped distribution of summering beluga whales, and that lower densities of belugas are expected to occur in most of the pipeline survey area (but not necessarily specific G&G survey locations; see Section 6.3) and the vicinity of the proposed Marine Terminal. However, beluga whales begin moving into Knik Arm around August 15 where they spend about a month feeding on Eagle River salmon. The area between Nikiski, Kenai, and Kalgin Island provides important wintering habitat for Cook Inlet beluga whales. Use of this area would be expected between fall and spring, with animals largely absent during the summer months when G&G surveys would occur (Goetz et al. 2012).

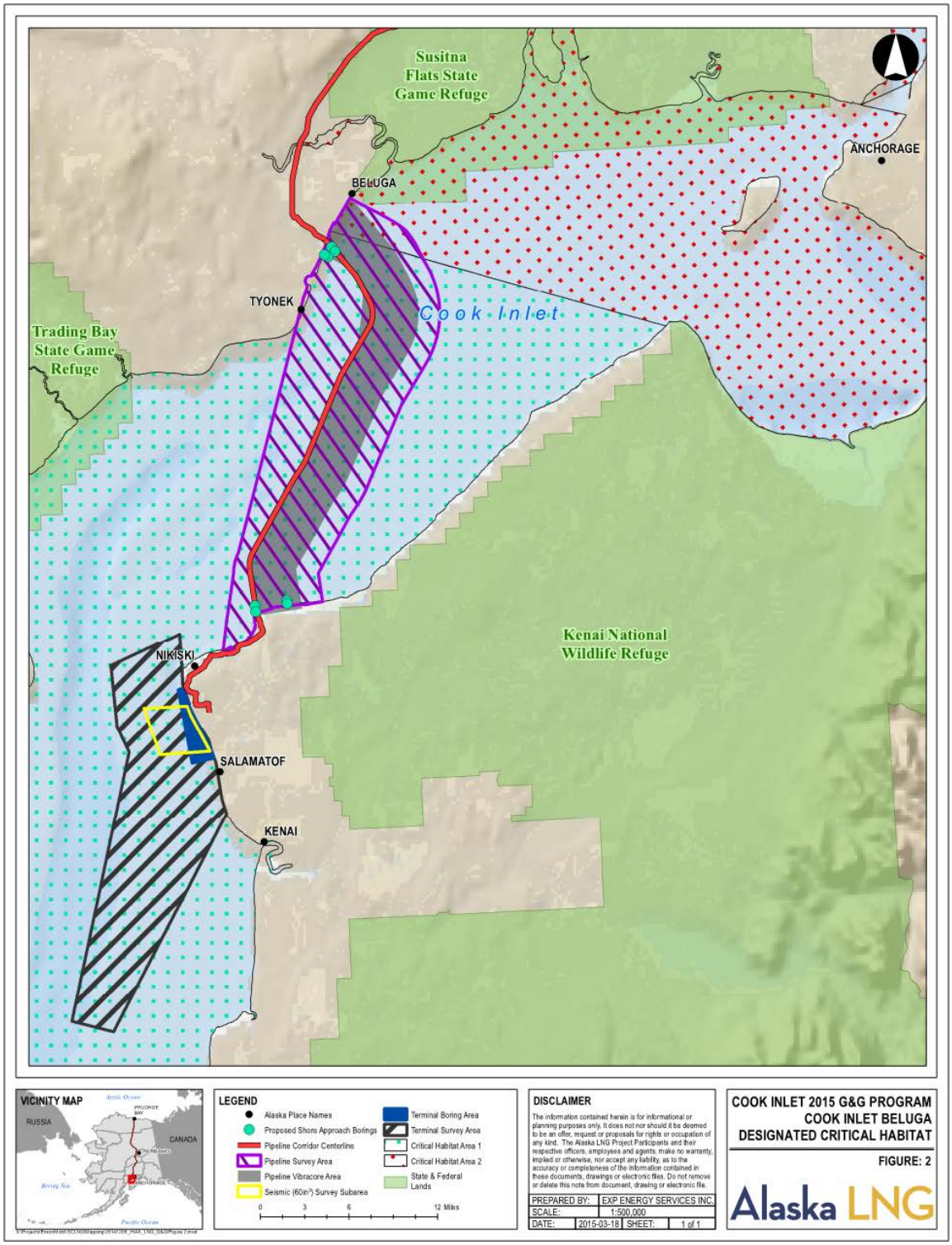


Figure 2. Cook Inlet Beluga Whale Designated Critical Habitat.

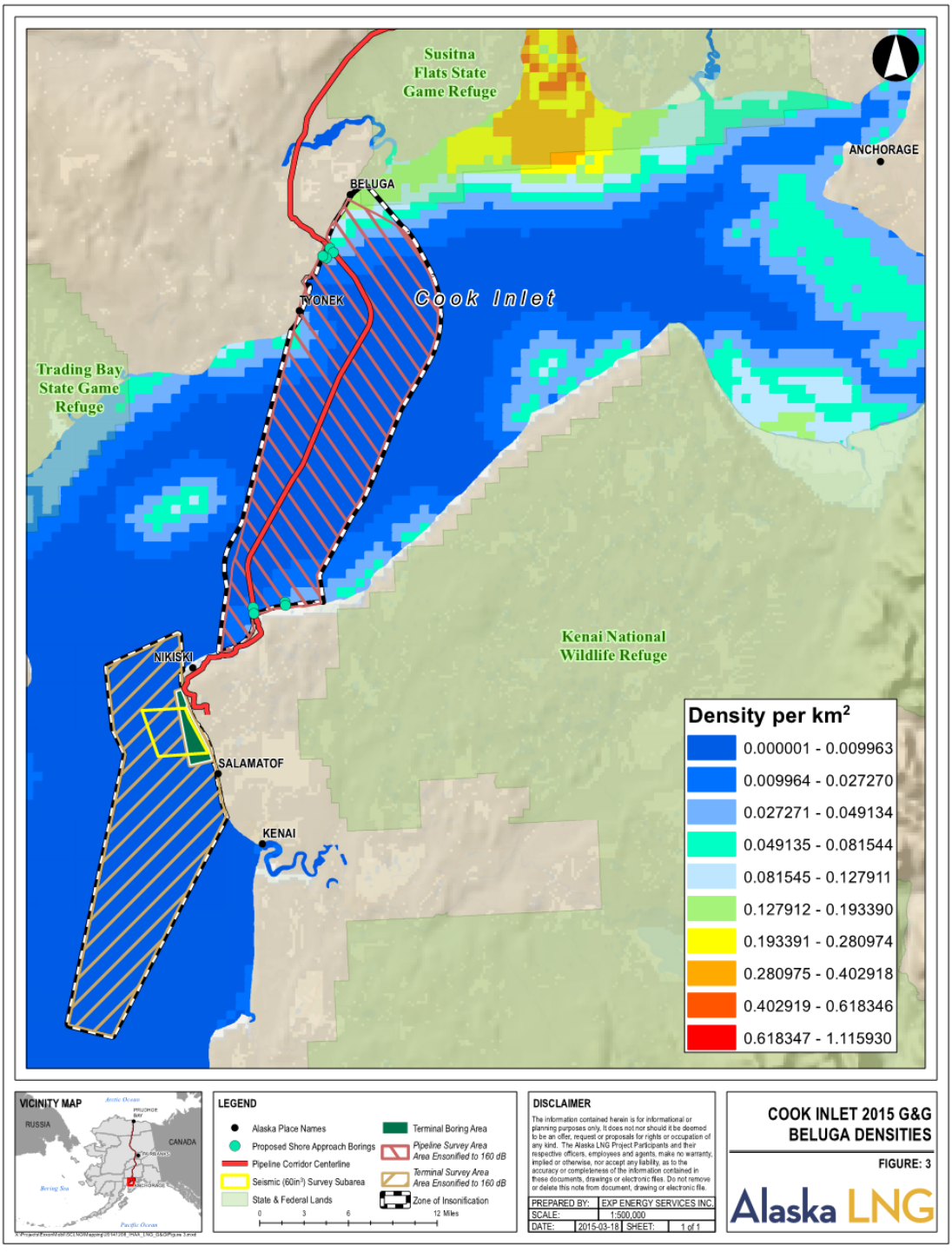


Figure 3. Maximum Ensonified Areas (ZOIs) Associated with the Pipeline and Marine Terminal Survey Areas.

4.2 KILLER WHALE (*ORCINUS ORCA*)

Two different stocks of killer whales inhabit the Cook Inlet region of Alaska: the Alaska Resident Stock and the Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock (Allen and Angliss 2014). The Alaska Resident stock is estimated at 2,347 animals and occurs from Southeast Alaska to the Bering Sea (Allen and Angliss 2014). Resident whales feed exclusively on fish and are genetically distinct from transient whales (Saulitis et al. 2000).

The transient whales feed primarily on marine mammals (Saulitis et al. 2000). The transient population inhabiting the Gulf of Alaska shares mitochondrial DNA haplotypes with whales found along the Aleutian Islands and the Bering Sea, suggesting a common stock, although there appears to be some subpopulation genetic structuring occurring to suggest the gene flow between groups is limited (see Allen and Angliss 2014). For the three regions combined, the transient population has been estimated at 587 animals (Allen and Angliss 2014).

Killer whales are occasionally observed in lower Cook Inlet, especially near Homer and Port Graham (Shelden et al. 2003, Rugh et al. 2005a). The few whales that have been photographically identified in lower Cook Inlet belong to resident groups more commonly found in nearby Kenai Fjords and Prince William Sound (Shelden et al. 2003). Prior to the 1980s, killer whale sightings in upper Cook Inlet were very rare. During aerial surveys conducted between 1993 and 2004, killer whales were observed on only three flights, all in the Kachemak and English Bay area (Rugh et al. 2005a). However, anecdotal reports of killer whales feeding on belugas in upper Cook Inlet began increasing in the 1990s, possibly in response to declines in sea lion and harbor seal prey elsewhere (Shelden et al. 2003). These sporadic ventures of transient killer whales into beluga summering grounds have been implicated as a possible contributor to the decline of Cook Inlet belugas in the 1990s, although the number of confirmed mortalities from killer whales is small (Shelden et al. 2003). If killer whales were to venture into upper Cook Inlet in 2015, they might be encountered during the G&G Program.

4.3 HARBOR PORPOISE (*PHOCOENA PHOCOENA*)

Harbor porpoise are small (approximately 1.2 m [4 ft] in length), relatively inconspicuous toothed whales. The Gulf of Alaska Stock is distributed from Cape Suckling to Unimak Pass and was most recently estimated at 31,046 animals (Allen and Angliss 2014). They are found primarily in coastal waters less than 100 m (328 ft) deep (Hobbs and Waite 2010) where they feed on Pacific herring (*Clupea pallasii*), other schooling fishes, and cephalopods.

Although they have been frequently observed during aerial surveys in Cook Inlet, most sightings of harbor porpoise are of single animals, and are concentrated at Chinitna and Tuxedni bays on the west side of lower Cook Inlet (Rugh et al. 2005a). Dahlheim et al. (2000) estimated the 1991 Cook Inlet-wide population at only 136 animals. Also, during marine mammal monitoring efforts conducted in upper Cook Inlet by Apache from 2012 to

2014, harbor porpoise represented less than 2% of all marine mammal sightings. However, they are one of the three marine mammals (besides belugas and harbor seals) regularly seen in upper Cook Inlet (Nemeth et al. 2007), especially during spring eulachon and summer salmon runs. Because harbor porpoise have been observed throughout Cook Inlet during the summer months, including mid-inlet waters, they represent species that might be encountered during G&G Program surveys in upper Cook Inlet.

4.4 HARBOR SEAL (*PHOCA VITULINA*)

At over 150,000 animals state-wide (Allen and Angliss 2014), harbor seals are one of the more common marine mammal species in Alaskan waters. They are most commonly seen hauled out at tidal flats and rocky areas. Harbor seals feed largely on schooling fish such as Alaska pollock (*Theragra chalcogramma*), Pacific cod (*Gadus macrocephalus*), salmon, Pacific herring, eulachon, and squid. Although harbor seals may make seasonal movements in response to prey, they are resident to Alaska and do not migrate.

The Cook Inlet/Shelikof Stock, ranging from approximately Anchorage down along the south side of the Alaska Peninsula to Unimak Pass, has been recently estimated at a stable 22,900 (Allen and Angliss 2014). Large numbers concentrate at the river mouths and embayments of lower Cook Inlet, including the Fox River mouth in Kachemak Bay (Rugh et al. 2005a). Montgomery et al. (2007) recorded over 200 haulout sites in lower Cook Inlet alone. However, only a few dozens to a couple hundred seals seasonally occur in upper Cook Inlet (Rugh et al. 2005a), mostly at the mouth of the Susitna River where their numbers vary with the spring eulachon and summer salmon runs (Nemeth et al. 2007, Boveng et al. 2012). Review of NMFS aerial survey data collected from 1993-2012 (Shelden et al. 2013) finds that the annual high counts of seals hauled out in Cook Inlet ranged from about 100-380, with most of these animals hauling out at the mouths of the Theodore and Lewis Rivers. There are certainly thousands of harbor seals occurring in lower Cook Inlet, but no references have been found showing more than about 400 harbor seals occurring seasonally in upper Cook Inlet. In 2012, up to 100 harbor seals were observed hauled out at the mouths of the Theodore and Lewis rivers (located about 16 km [10 mi] northeast of the pipeline survey area) during monitoring activity associated with Apache's 2012 Cook Inlet seismic program, and harbor seals constituted 60 percent of all marine mammal sightings by Apache observers during 2012 to 2014 survey and monitoring efforts (L. Parker, Apache, pers. comm.). Montgomery et al. (2007) also found that seals elsewhere in Cook Inlet move in response to local steelhead (*Onchorhynchus mykiss*) and salmon runs. Harbor seals may be encountered during G&G surveys in Cook Inlet.

5.0 TYPE OF INCIDENTAL HARASSMENT AUTHORIZATION REQUESTED

The incidental harassment authorization requested is for Level B harassment (from impulsive sound pressure levels exceeding 160 dB re 1 µPa [rms] and continuous sound pressure levels

exceeding 120 dB re 1 µPa [rms]) associated with the planned Cook Inlet 2015 G&G Program activities in the pipeline survey area across upper Cook Inlet and in the planned Marine Terminal survey area near Nikiski. Actual Level B exposures will depend upon numbers of marine mammals occurring within relevant 120 or 160 dB zones of influence ZOIs at the time of activity. No Level A injury exposures (exposure to sound energy >180 dB re 1 µPa [rms] for cetaceans and >190 dB re 1 µPa [rms] for pinnipeds) are expected with the proposed mitigation measures in place (see Section 1.3 and Appendix A) and the limited area of ensonification (resulting in very small safety zones).

6.0 HARASSMENT ESTIMATES FOR MARINE MAMMAL

6.1 BASIS FOR ESTIMATING NUMBERS OF MARINE MAMMALS THAT MIGHT BE HARASSED

Exposure to impulsive sound levels greater than 160 dB re 1 µPa (rms) or continuous sound pressure level exceeding 120 dB re 1 µPa (rms) are the thresholds for non-lethal, incidental Level B harassment of marine mammals pursuant to Section 101(a)(5)(D) of the MMPA (NMFS 2005). Level B harassment is defined under the MMPA 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 but which does not have the potential to injure a marine mammal or marine mammal stock in the wild."

The estimates of the numbers of each species of marine mammals that could be exposed to sound from the G&G Program were determined by multiplying the calculated density of each species by the area that will be ensonified to levels exceeding 120 dB re 1 µPa (rms) for continuous geotechnical sound (vibracore) and 160 dB re 1 µPa (rms) for impulsive geophysical sound. All four types of survey equipment addressed in the application will be operated from the geophysical source vessels that will either be moving steadily across the ocean surface (chirper, boomer, airgun), or from station to station (vibracoring). Thus, it is assumed that any given area will be ensonified by any specific equipment more than one day, and that a given area will not be repeatedly ensonified, or ensonified for an extended period.

6.1.1 Ensonified Area

The ZOI is the area ensonified by a particular sound source greater than threshold levels (120 dB for continuous and 160 dB for impulsive). The radius of the ZOI for a particular equipment was determined by applying the source sound pressure levels described in Table 6 to Collins et al.'s (2007) attenuation model of 18.4 Log(r) – 0.00188 derived from Cook Inlet. For those equipment generating loud underwater sound within the audible hearing range of marine mammals (<200 kHz), the distance to threshold ranges between 184 m (604 ft) and 2.54 km (1.58 mi), with ZOIs ranging between 0.106 and 20.26 km^2 (0.041-7.82 mi^2) (Table 7).

Table 7. Summary of Distances to the NMFS Thresholds and Associated ZOIs.

Survey Equipment	Distance to 160 dB Isopleth [1] m (ft)	Distance to 120 dB Isopleth [1] km (mi)	160 dB ZOI km^2 (mi^2)	120 dB ZOI km^2 (mi^2)
Sub-bottom Profiler (Chirp)	184 (604)	N/A	0.106 (0.041)	N/A
Sub-bottom Profiler (Boomer)	263 (863)	N/A	0.217 (0.084)	N/A
Airgun	300 (984)	N/A	0.283 (0.109)	N/A
Vibracore	N/A	2.54 (1.58)	N/A	20.26 (7.82)

[1] Calculated by applying Collins et al. (2007) spreading formula to source levels in Table 2

Vibracoring will be limited to the vibracore area within the pipeline survey area and the nearshore region of the Marine Terminal survey area, thus the ensonified area associated with vibracoring with a radius of 2.54 km (1.58 mi) would not extend much beyond the geophysical survey corridors (including where the chirper and boomer surveys would occur). Thus, the maximum ZOI for each area would be based on a 300-m radius associated with both the boomer subbottom profiler and the small airgun, and determined as the survey area plus a 300-m (984-ft) buffer around the survey area, or 387 km^2 (149 mi^2) for the Marine Terminal survey area and 572 km^2 (221 mi^2) for the pipeline survey area.

6.1.2 Marine Mammal Densities

Density estimates were derived for harbor porpoises, killer whales, and harbor seals from NMFS 2002-2012 Cook Inlet survey data as described below in Section 6.1.2.1 and shown in Table 8. The beluga whale exposure estimates were calculated using density estimates from Goetz et al. (2012) as described in Section 6.1.2.2.

6.1.2.1 Harbor Porpoise, Killer Whale, Harbor Seal

Density estimates were calculated for all marine mammals (except beluga whales) by using aerial survey data collected by NMFS in Cook Inlet between 2002 and 2012 (Rugh et al. 2002, 2003, 2004a, 2004b, 2005a, 2005b, 2005c, 2006, 2007; Shelden et al. 2008, 2009, 2010; Hobbs et al. 2011, Shelden et al. 2012) and compiled by Apache, Inc. (Apache IHA application 2014). To estimate the average raw densities of marine mammals, the total number of animals for each species observed over the 11-year survey period was divided by the total area of 65,889 km^2 (25,540 mi^2) surveyed over the 11 years. The aerial survey marine mammal sightings, survey effort (area), and derived average raw densities are provided in Table 8.

Table 8. Raw Density Estimates for Cook Inlet Marine Mammals Based on NMFS Aerial Surveys.

Species	No. of Animals	NMFS Survey Area km^2 (mi^2)	Mean Raw Density animals/km^2 (animals / mi^2)
Harbor Porpoise	249	65,889 (25,440)	0.0038 (0.0098)
Killer Whale [1]	42	65,889 (25,440)	0.0006 (0.0017)
Harbor Seal	16,117	65,889 (25,440)	0.2446 (0.6335)

[1] Density is for all killer whales regardless of the stock although all killer whales in the upper Cook Inlet are thought to be transient

These raw densities were not corrected for animals missed during the aerial surveys as no accurate correction factors are currently available for these species; however, observer error may be limited as the NMFS surveyors often circled marine mammal groups to get an accurate count of group size. The harbor seal densities are probably biased upwards given that a large number of the animals recorded were of large groups hauled out at river mouths, and do not represent the distribution in the waters where the G&G activity will actually occur.

6.1.2.2 Beluga Whale

Goetz et al. (2012) modeled aerial survey data collected by the NMFS between 1993 and 2008 and developed specific beluga summer densities for each 1-km^2 cell of Cook Inlet. The results provide a more precise estimate of beluga density at a given location than simply multiplying all aerial observations by the total survey effort given the clumped distribution of beluga whales during the summer months. To develop a density estimate associated with planned action areas (i.e., Marine Terminal and pipeline survey areas), the ensonified area associated with each activity was overlain a map of the 1-km density cells, the cells falling within each ensonified area were quantified, and an average cell density was calculated. The summary of the density results is found in Table 9. The associated ensonified areas and beluga density contours relative to the action areas are shown in Figure 3.

Table 9. Mean Raw Densities of Beluga Whales within the Action Areas Based on Goetz et al. (2012) Cook Inlet Beluga Whale Distribution Modeling.

Action Area	Number of Cells	Mean Density (animals/km^2)	Density Range (animals/km^2)
Marine Terminal Survey Area	386	0.000166	0.000021 – 0.001512
Pipeline Survey Area	571	0.011552	0.000275 – 0.156718

6.1.3 Activity Duration

The Cook Inlet 2015 G&G Program is expected to require approximately 12 weeks (84 days) to complete. During approximately 63 of these days, the chirp and boomer sub-bottom profiler will produce the loudest sound levels. Airgun use will occur during approximately 7 days and will occur only near the proposed Marine Terminal. The airgun activity will occur during the summer when beluga whale use of Cook Inlet is primarily concentrated near the Susitna Delta, approximately 65 km (40 mi) north of the airgun survey area. Vibracoring,

with its large ZOI, will occur intermittently over approximately 14 days. The Applicant will engage with NMFS should the program require additional time to complete.

6.2 EXPOSURE CALCULATIONS

The numbers of marine mammals that might be exposed to sound pressure levels exceeding NMFS Level B harassment threshold levels due to G&G surveys, without mitigation, were determined by multiplying the average raw density for each species by the maximum ZOI (the survey area plus a 300-m [984 ft] buffer representing the radius of both the boomer and airgun sound pressure levels to the 160-dB isopleth) for each action area. The results are shown in Table 10.

Table 10. Number of Marine Mammals Potentially Exposed to Received Sound Levels Exceeding Level B Thresholds.

Species	Mean Raw Density animals/km^2 (animals/mi^2)	Area	Max. ZOI km^2 (mi^2)	Exposures
Beluga Whale	0.000166 (0.000064)	Terminal	387 (149)	0.06
	0.011552 (0.004460)	Pipeline	572 (221)	6.61
Total				**6.66**
Harbor Porpoise	0.0038 (0.0098)	Terminal	387 (149)	1.47
	0.0038 (0.0098)	Pipeline	572 (221)	2.17
Total				3.64
Killer Whale	0.0006 (0.0016)	Terminal	387 (149)	0.23
	0.0006 (0.0016)	Pipeline	572 (221)	0.34
Total				**0.57**
Harbor Seal	0.2446 (0.6335)	Terminal	387 (149)	94.66
	0.2446 (0.6335)	Pipeline	572 (221)	139.91
Total				**234.57**

[1] ZOI radius calculated by applying Collins et al. (2007) spreading formula to source levels in Table 2

6.3 INCIDENTAL HARASSMENT AUTHORIZATIONS REQUESTED

Estimated marine mammal exposures in Table 10 do not account for proposed mitigation measures. These measures include shutting down or delaying the start of airgun operations when one or several marine mammals approach ZOIs for Level A harassment, delaying start of airgun, subbottom profiler, and vibracore operations when ESA-listed Cook Inlet beluga whales are approaching the Level B harassment zone, or shutting down the airgun for ESA-listed Cook inlet beluga whales approaching the Level B harassment zone (see Appendix A: *Marine Mammal Monitoring and Mitigation Plan*). Mitigation measures include protocols to "clear" ZOIs before start of activities. However, because the effectiveness of these measures in unpredictable, and beluga whales generally travel in large groups, the Applicant is

requesting authorization for incidental, non-lethal harassment of 15 beluga whales, or approximately twice the number of estimated exposures without mitigation (Table 11).

Table 11. Estimated Exposures and Requested Non-lethal, Incidental Level B "Harassment" of Marine Mammals.

Species	Estimated Exposures without Mitigation	Harassment Authorization Requested
Beluga Whale [1]	7	15
Killer Whale (Alaska Transient) [2]	<1	5
Harbor Porpoise [2]	4	20
Harbor Seal [2]	235	235

[1] Based on 1-km cell densities in Goetx et al. 2012 model
[2] Based on average raw densities

The requested authorizations for killer whale and harbor porpoise harassment are 5 and 20 animals, respectively, or five times the exposure estimates. These are also precautionary figures given that killer whales and harbor porpoise often occur in groups (potential for multiple takes by a single encounter), and that the harbor porpoise density estimate may be low relative to the action area. The harassment authorization requested for harbor seals is probably high as the density estimate is probably biased upwards due to large numbers of hauled out seals observed during the NMFS aerial survey flights, plus harbor seals at sea are usually found in groups of two or less. However, because single harbor seals often remain near marine operations where they might be recorded as exposed multiple times, the high requested authorization values may be appropriate.

Any exposure to marine mammals from the G&G Program would be short-term and localized because the source vessels during the geophysical activities (chirper, boomer, airgun) will be constantly moving. Similarly, since the vibracoring activity would occur at a fixed location, marine mammals would be initiating the approach to the activity and could divert around it. In addition, the actual sound activity during the vibracoring would last only one or two minutes. The mostly likely response from marine mammals exposed to the proposed low sound source G&G activities would be to move away.

The requested exposures are relatively small, representing 1.0% or less of the estimated stock in all cases, except for beluga whales where it is 4.81% (Table 12). However, the requested authorization for beluga whales does not account for mitigation measures, which should limit the actual number of exposures to fewer than the requested number.

Table 12. Requested Non-lethal, Incidental Level B Harassments as Percentage of the Stock.

Species	Abundance[1]	Requested Harrassments	Percent Population
Beluga Whale	312	15	4.81%
Killer Whale (Alaska Transient)	587	5	0.85%
Killer Whale (Alaska Resident)	2,347	5	0.21%

Harbor Porpoise	31,046	5	0.04%
Harbor Seal	22,900	25	0.95%

[1]Abundance sources: Allen and Angliss (2014)

7.0 ANTICIPATED IMPACT OF THE ACTIVITY

7.1 INTRODUCTION

This section summarizes the potential impacts of sounds generated by Cook Inlet 2015 G&G Program activities. Potential impacts are reported based upon available literature. The primary potential impact from the proposed G&G Program to local marine mammals is acoustical harassment from short-term vibracore operations, followed by short-duration small airgun operation. Sound pressure levels generated from these survey activities might disrupt normal behaviors of marine mammals where received levels exceed 120 dB re 1 µPa (vibracore) or 160 dB re 1 µPa (airgun and sub-bottom profilers).

The potential effects of the small airgun, sub-bottom profilers, and the vibracorer could include masking, behavioral responses, and temporary hearing impairment of marine mammals. Masking occurs when loud sounds interfere with marine mammal vocalizations or the ability to hear natural sounds in their environment (Richardson et al. 1995), which limit their ability to communicate or avoid predation or other natural hazards. Masking is most evident when the dominant frequencies of industrial sound overlaps that of vocalization and hearing ranges of local marine mammals, and when the duration of the sound is prolonged.

Behavioral responses can include tolerance to industrial sound, or disturbance leading to behavioral modifications including diving patterns, habitat abandonment to avoid acoustical sound, and cessation of feeding or social interactions. Disturbance reactions, however, are dependent upon the behavioral state of the animal at the time of exposure (e.g., motivation, experience, activity such as feeding vs resting), which is difficult to predict (Richardson et al. 1995).

Sound has the potential to impair hearing in marine mammals by inducing temporary threshold shift (TTS) or permanent threshold shift (PTS) hearing loss (Weilgart 2007) if the sound is within the animal's hearing range, is loud enough, and the animal is exposed to the sound for a sufficient period of time. The level of temporary hearing loss is therefore dependent on sound frequency, intensity, and duration. Similar to masking, hearing loss reduces the ability for marine mammals to forage efficiently, maintain social cohesion, and avoid predators (Weilgart 2007). TTS is a mild, short-term hearing impairment than can occur due to exposure to loud sound levels (Kryter 1985). It is not physically damaging, and recovery is rapid, but the onset of TTS does indicate exposure levels are beginning to approach those that are damaging (Southall et al. 2007). TTS is possible from the G&G Program activities if a marine mammal were very close to a sound source.

PTS occurs when continuous sound exposure causes hairs within the inner ear system to die. This can occur due to moderate durations of very loud sound pressure levels, or long-term continuous exposure of moderate sound pressure levels. However, PTS is not an issue with the proposed G&G activities. Airgun and sub-bottom profiler operations occur from moving vessels, which limits marine mammal exposure to the few minutes during which the vessel passes. Vibracoring is a more fixed activity, but its operation lasts for only several minutes.

Information related to marine mammal behavioral responses to industrial stimuli are discussed in the following sections based on available literature. The discussions are focussed on those activities used in this program that have the potential to acoustically harass marine mammals.

7.2 EFFECTS OF SMALL AIRGUN

7.2.1 Masking

Marine mammal communication is not expected to be disrupted except when industrial sound frequencies overlap frequencies used by marine mammals in communication. Small airguns typically produce sound at frequencies less than 1 kHz (Richardson et al. 1995, Zykov and Carr 2012).

Beluga whales have a well-developed and well-documented sense of hearing. White et al. (1978) measured the hearing of two belugas whales and described hearing sensitivity between 1 kHz and 130 kHz, with best hearing between 30 kHz to 50 kHz. Awbrey et al. (1988) examined their hearing in octave steps between 125 Hz and 8 kHz, with average hearing thresholds of 121 dB re1 µPa at 125 Hz and 65 dB re 1 µPa at 8 kHz. Johnson et al. (1989) further examined beluga hearing at low frequencies, establishing that the beluga whale hearing threshold at 40 Hz was 140 dB re 1 µPa. Ridgway et al (2001) measured hearing thresholds at various depths down to 984 ft (298 m) at frequencies between 500 Hz and 100 kHz. Beluga whales showed unchanged hearing sensitivity at this depth. Lastly, Finneran et al. (2005) measured the hearing of two belugas, describing their auditory thresholds between 2 kHz and 130 kHz. In summary, these studies indicate that beluga whales hear from approximately 40 Hz to 130 kHz, with maximum sensitivity from approximately 10 to 70 kHz (Wartzok and Ketten 1999). It is important to note that these audiograms represent the best hearing of beluga whales, measured in very quiet conditions. These quiet conditions are rarely present in the wild, where high levels of ambient sound may exist, especially in Cook Inlet where strong tidal currents can produce ambient sound levels well above 100 dB (Lammers et al. 2013).

Kastelein et al. (2002) measured the hearing range of the harbor porpoise and reported the full hearing range to be 0.25 to 180 kHz, the most sensitive range 16 to 140 kHz, and the maximum sensitivity hearing range to be 100 to 140 kHz. The frequency content of harbor porpoise echolocation clicks overlaps the above maximum sensitivity hearing range, and has

been reported as 120 to 130 kHz (Verboom and Kastelein 1995) and 125 to 148 kHz (Mohl and Anderson 1973).

Beluga and killer whales are Type II vocalizers in that they tend to occur in social groups and much of the purpose of their vocalizations is to communicate with other group members. Both species communicate with a variety of sounds, but most especially with whistles in the 0.1 to 35 kHz range. Their vocalizations generally occur at frequencies at the lower end of their maximum sensitivity hearing range, but given that the communication is probably with nearby group members, maximum hearing sensitivity is unnecessary. In contrast, harbor porpoises are less social and inhabit complex nearshore environments (Type I vocalizers). Their vocalizations include low frequency (2 kHz) clicks and high frequency (100 to 160 kHz) pulses more designed to detect prey and hazards than to communicate (Schevill et al. 1969, Mohl and Anderson 1973, Kamminga 1988,).

Harbor seals, much like killer whales, have maximum hearing sensitivity in the 10 to 30 kHz range (Wartzok and Ketten 1999), but like harbor porpoise, they vocalize low frequency (100 to 400 Hz) grunts and high frequency (8 to 150 kHz) clicks. Underwater vocal communication is probably limited to very close range.

In summary, all four marine mammals likely to be encountered during the G&G Program have maximum hearing sensitivity well above the low frequency sound levels expected to be generated by the proposed small airgun. Except for low frequency grunts by harbor porpoise, these species also vocalize at frequencies well above airguns. Operation of the small airgun is unlikely to mask local marine mammal communication.

7.2.2 Behavioral Response

Researchers have noted behavioral changes in captive beluga whales and other odontocetes when exposed to very loud impulsive sound similar to seismic airguns (Finneran et al. 2000, 2002), and field observations in the Beaufort Sea reported evidence of belugas avoiding large array seismic operations (Miller et al. 2005). Further, Romano et al. (2004) exposed a captive beluga whale to airgun sound levels and found that the whale produced stress-level hormones with increasing sound pressure levels, and some hormone levels remained high as long as an hour after exposure (but these hormone levels were far less than those produced during beluga whale chase and capture events). Although the above observations occurred during beluga exposure to sound pressure levels above those that would be produced by the much smaller 70 in^3 airgun proposed, they do demonstrate that beluga are susceptible to sound-induced stress and may avoid high sound levels as result, leading to limited use of the available habitat.

There is little information on harbor porpoise reaction to G&G activities, but they probably show a tolerance to sound levels similar to other odontocetes given their most sensitive hearing is largely above frequencies characterizing the G&G Program equipment. However, Lucke et al. (2009) recently exposed harbor porpoise to high impulsive sound levels and

found a behavioral aversion to impulsive sounds as low as 174 dB re 1 µPa (peak-peak), indicating a greater sensitivity to impulsive sound than beluga whales. Other studies (Stone 2003, MacLean and Koski 2005, Bain and Williams 2006, Stone and Tasker, 2006) have also observed harbor seal avoidance to airgun operations. Harbor porpoise are likely to avoid the planned G&G Program activities.

Pinnipeds in general appear somewhat tolerant of underwater industrial sounds, partially because they can escape underwater pressure levels by exposing their head above the water surface, and they are less sensitive to lower frequency sound pressure levels. In her review of the known effects of sound on marine mammals, Weilgart (2007) largely confined her discussion on cetaceans and only once mentioned a possible negative effect on pinnipeds. Richardson et al. (1995) were not aware of any detailed data on reactions of seals to, for example, seismic sound energy, and expected them to tolerate or habituate to underwater seismic sound energy, especially if food sources were present. However, Calambokidis and Osmek (1998) did find harbor seal and California sea lion sighting distances to be longer in the presence of seismic activity in Puget Sound.

Most information on the reaction of pinnipeds to boats relate to disturbance of hauled out animals. There is little information on the reaction of these pinnipeds to ships while in the water other than some anecdotal information that sea lions are often attracted to boats (Richardson et al. 1995).

7.2.3 Hearing Impairment

Finneran et al. (2002) exposed a single beluga whale to single impulsive sound at a received level equivalent to 228 dB re 1 µPa (peak-peak), which resulted in a 6 dB TTS at 30 kHz. Within 4 minutes, the threshold returned to near the pre-exposure level. Later, Finneran et al. (2005) suggested that a sound exposure level of 195 dB is the likely threshold for onset of TTS.

Lucke et al. (2009) recently exposed harbor porpoise to high impulsive sound levels and found that TTS was induced at received sound pressure levels of about 200 dB re 1 µPa (peak-peak) with behavioral aversion to impulsive sounds as low as 174 dB re 1 µPa (peak-peak), indicating a greater sensitivity to impulsive sound than beluga whales.

There are no specific data on TTS thresholds for killer whales or harbor seals, although there are indirect evidence that thresholds for harbor seals may be less than odontocetes, although seals are generally less reactive (NMFS 2010). Recent information (Wood et al. 2012) suggests that for harbor seals and harbor porpoise, TTS may occur upon exposure to airgun pulses with received levels of 190 dB re 1 µPa (rms). However, for a marine mammal to receive sound levels at 190 dB re 1 µPa (rms) it would have to occur within 20 m (6 ft) of the small airgun, which is unlikely given the shutdown measure to be implemented. TTS onset due to exposure to the small airgun proposed for use in this application is not a concern.

7.3 EFFECTS OF SUB-BOTTOM PROFILERS

7.3.1 Masking

Both the chirper and boomer sub-bottom profilers produce impulsive sound exceeding 160 dB re 1 µPa-m (rms). The louder boomer operates at a source value of 205 dB re 1 µPa-m (rms), but with a frequency between 0.5 and 6 kHz, which is lower than the maximum sensitivity hearing range of any the local species (belugas – 40-130 kHz;, killer whales – 7-30 kHz; harbor porpoise – 100-140 kHz; and harbor seals – 10-30 kHz; Wartzok and Ketten 1999, Southall et al. 2007, Kastelein et al. 2002). While the chirper is not as loud (202 dB re 1 µPa-m [rms]), it does operate at a higher frequency range (2-16 kHz), and within the maximum sensitive range of all of the local species except beluga whales. However, the radius to the 160 dB threshold is only 184 m (604 ft), indicating that the ability for the chirper to mask marine mammal communication is limited to the immediate vicinity of the source vessel. Thus, as with the small airgun, the sub-bottom profilers are not likely to interfere with the communication of local marine mammals.

7.3.2 Behavioral Response

The behavioral response of local marine mammals to the operation of the sub-bottom profilers is expected to be similar to that of the small airgun. The odontocetes are likely to avoid the sub-bottom profiler activity, especially the naturally shy harbor porpoise, while the harbor seals might be attracted to them out of curiosity. However, because the sub-bottom profilers operate from a moving vessel, and the maximum radius to the 160 dB harassment threshold is only 263 m (863 ft), the area and time that this equipment would be affecting a given location is very small.

7.3.3 Hearing Impairment

It is unlikely that the sub-bottom profilers produce sound levels strong enough to cause hearing impairment or other physical injuries even in an animal that is (briefly) in a position near the source (Wood et al. 2012). The likelihood of marine mammals moving away from the source make if further unlikely that a marine mammal would be able to approach close to the transducers.

7.4 EFFECTS OF VIBRACORING

7.4.1 Masking

Chorney et al. (2011) conducted sound measurements on an operating vibracorer in Alaska and found that it emitted a sound pressure level at 1-m source of 188 dB re 1 µPa-m (rms), with a frequency range of between 10 Hz and 20 kHz. While the frequency range overlaps the lower ends of the maximum sensitivity hearing ranges of harbor porpoises, killer whales, and harbor seals, and the continuous sound extends 2.54 km (1.6 mi) to the 120 dB threshold, the vibracorer will operate about the one or two minutes it takes to drive the core pipe 7 m

(20 ft) into the sediment, and approximately twice per day. Therefore, there is very little opportunity for this activity to mask the communication of local marine mammals.

7.4.2 Behavioral Response

There are no data on the behavioral response to vibracore activity. The closest analog to vibracoring might be exploratory drilling, although there is a notable difference in magnitude between an oil and gas drilling operation and collecting sediment samples with a vibracorer. Regardless, Thomas et al. (1990) played back drilling sound to four captive beluga whales and found no statistical difference in swim patterns, social groups, respiration and dive rates, or stress hormone levels before and during playbacks. There is no reason to believe that beluga whales or any other marine mammal exposed to vibracoring sound would behave any differently, especially since vibracoring occurs for only one or two minutes.

7.4.3 Hearing Impairment

The vibracorer operates for only one or two minutes at a time with a 1-m source of 187.4 dB re 1 µPa-m (rms). It is neither loud enough nor operates for a long enough duration to induce either TTS or PTS.

Stress, Stranding, and Mortality Safety zones will be established to prevent acoustical injury to local marine mammals, especially injury that could indirectly lead to mortality. Also, G&G sound is not expected to cause resonate effects to gas-filled spaces or airspaces in marine mammals based on the research of Finneran (2003) on beluga whales showing that the tissue and other body masses dampen any potential effects of resonance on ear cavities, lungs, and intestines. Chronic exposure to sound could lead to physiological stress eventually causing hormonal imbalances (NRC 2005). If survival demands are already high, and/or additional stressors are present, the ability of the animal to cope decreases, leading to pathological conditions or death (NRC 2005). Potential effects may be greatest where sound disturbance can disrupt feeding patterns including displacement from critical feeding grounds. However, all G&G exposure to marine mammals would be of duration measured in minutes.

Specific sound-related processes that lead to strandings and mortality are not well documented, but may include (1) swimming in avoidance of a sound into shallow water; (2) a change in behavior (such as a change in diving behavior) that might contribute to tissue damage, gas bubble formation, hypoxia, cardiac arrhythmia, hypertensive hemorrhage, or other forms of trauma; (3) a physiological change such as a vestibular response leading to a behavioral change or stress-induced hemorrhagic diathesis, leading in turn to tissue damage; and, (4) tissue damage directly from sound exposure, such as through acoustically mediated bubble formation and growth or acoustic resonance of tissues (Wood et al. 2012). Some of these mechanisms are unlikely to apply in the case of impulse G&G sounds, especially since airguns and sub-bottom profilers produce broadband sound with low pressure rise. Strandings to date which have been attributed to sound exposure related to date from military exercises

using narrowband mid-frequency sonar with a much greater likelihood to cause physical damage (Balcomb and Claridge 2001, NOAA and USN, 2001, Hildebrand 2005).

The low intensity, low frequency, broadband sound associated with airguns and sub-bottom profilers, combined with the shut down safety zone mitigation measure for the airgun would prevent physical damage to marine mammals. The vibracoring would also be unlikely to have the capability of causing physical damage to marine mammals because of its low intensity and short duration.

8.0 ANTICIPATED IMPACTS ON SUBSISTENCE USES

Tyonek is the only tribal village in upper Cook Inlet area with a tradition of hunting marine mammals (beluga whales and harbor seals), while the Cook Inlet area villages of Kenai and Salamatof, located near the proposed Marine Terminal, have traditionally hunted seals. Nikiski, the closest village to the proposed Marine Terminal facilities is not a traditional native village, although native subsistence hunters do reside there. Tyonek is the village in the Cook Inlet area which is most associated with traditionally hunting beluga whales. However, a series of moratoriums have been placed on the Cook Inlet beluga subsistence harvest beginning in 1999, following significant harvest pressure in the mid-1990s that saw annual removals of 10 to 15 percent of the population (Mahoney and Shelden 2000) and resulted in a population decline from an estimated 1,300 whales in 1979 (Calkins 1989) to a recent estimate of 312 animals (Allen and Angliss 2014). Tyonek subsistence hunters were not involved with the high harvest activity in the 1990s (this was largely conducted by Anchorage-based hunters), and their harvest numbers remained low (Stephen R. Braund & Associates and Huntington Consulting [SRBA and HC] 2011). Village harvest between 1980 and 2000 generally averaged less than one beluga whale (Fall et al. 1984, SRBA and HC 2011). Although only five beluga whales have been harvested since 1999 (Hobbs et al. 2008, Allen and Angliss 2014), the population has continued to decline. No future subsistence harvest is planned until after the 5-year population average has grown to at least 350 beluga whales. No beluga harvest is authorized for 2015 when the G&G Program would occur.

Tyonek's annual recorded seal harvest since the 1980s has averaged about one animal (Fall et al. 1984, Wolfe et al. 2009). Many of the seals that are harvested are done incidentally to salmon fishing or moose hunting (Fall et al. 1984, Merrill and Orpheim 2013), often near the mouths of the Susitna Delta Rivers (Fall et al. 1984) north of the pipeline survey area. Kenai and Salamatof hunters more commonly harvest harbor seals, with Kenai reporting an average of about 13 per year between 1992 and 2008 (Wolfe et al. 2009) (Salamatof's harvest was not reported). According to Fall et al. (1984), many of the seals harvested by hunters from these villages were taken on the west side of Cook Inlet (outside the G&G Program action areas) during hunting excursions for moose and black bears. Because of the position of Kenai and Salamatof in the upper reaches of lower Cook Inlet, sea otters and Steller sea lions are rarely harvested, although this might change as these animal populations continue to expand.

Portions of the survey areas for the Cook Inlet 2015 G&G Program are within approximately 6.9-15.9 km (4.3-9.9 mi) of the communities of Tyonek, Nikiski, Salamatof, and Kenai. Although marine mammals remain an important subsistence resource in Cook Inlet, the actual number of animals harvested annually by hunters from these villages is low, and are primarily limited to harbor seals. Much of the harbor seal harvest occurs incidental to other fishing and hunting activities, and at areas outside of the proposed action areas such as the Susitna Delta or the west side of lower Cook Inlet. Thus, the G&G Program will not affect local populations of harbor seals such that they would be unavailable for subsistence harvest in 2015.

The Applicant has previously engaged with the Tyonek, Kenai and Nikiski communities and will continue to do so. The Applicant plans to meet with leadership at the Native Village of Tyonek, the Village of Salamatof and the Kenaitze Indian Tribe, all federally recognized tribes within the affected communities, prior to commencement of the G&G Program activities. The purpose of these meetings is to convey project plans (activities, timing) and to solicit additional information on subsistence use and community concerns. If a conflict with subsistence use is identified, the project will meet with the affected party and develop a course of resolution. Based on subsistence information collected up to 2008, and the general tolerance of pinnipeds to industrial sounds, the impact of the G&G Program is unlikely to affect harbor seal populations sufficient to render them less available for subsistence harvest in the future, especially as the village closest to the proposed G&G activities (Tyonek) has recently harvested on average only about one seal per year. The Cook Inlet 2015 G&G Program will therefore not have an unmitigatable adverse impact on the availability of the species or stock for subsistence uses.

9.0 ANTICIPATED IMPACTS ON HABITAT

The G&G Program survey areas are primarily within upper Cook Inlet, although the Marine Terminal survey area is located near Nikiski just south of the East Foreland (technically in Lower Cook Inlet). Cook Inlet is a large subarctic estuary roughly 299 km (186 mi) in length and averaging 96 km (60 mi) in width. It extends from the city of Anchorage at its northern end and flows into the Gulf of Alaska at its southernmost end. For descriptive purposes, Cook Inlet is separated into unique upper and lower sections, divided at the East and West Forelands, where the opposing peninsulas create a natural waistline in the length of the waterway, measuring approximately 16 km (10 mi) across (Mulherin et al. 2001).

Upper Cook Inlet comprises the area between Point Campbell (Anchorage) down to the Forelands, and is roughly 95 km (59 mi) in length and 24.9 km (15.5 mi) in width (Mulherin et al. 2001). Five major rivers (Knik, Matanuska, Susitna, Little Susitna, and Beluga) deliver freshwater to upper Cook Inlet, carrying a heavy annual sediment load of over 40 million tons of eroded materials and glacial silt (Brabets 1999). As a result, upper Cook Inlet is relatively shallow, averaging 18.3 m (60 ft) in depth. It is characterized by shoals, mudflats, and a wide coastal shelf, less than 17.9 m (59 ft) deep, extending from the eastern shore. A

deep trough exists between Trading Bay and the Middle Ground Shoal, ranging from 35 to 77 m (114-253 ft) deep (NOAA Nautical Chart 16660). The substrate consists of a mixture of coarse gravels, cobbles, pebbles, sand, clay, and silt (Bouma et al. 1978, Rappeport 1982).

Upper Cook Inlet experiences some of the most extreme tides in the world, demonstrated by a mean tidal range from 4.0 m (13 ft) at the Gulf of Alaska end to 8.8 m (29 ft) near Anchorage (U.S. Army Corps of Engineers 2013). Tidal currents reach 3.9 kts per second (Mulherin et al. 2001) in upper Cook Inlet, increasing to 5.7-7.7 kts per second near the Forelands where the inlet is constricted. Each tidal cycle creates significant turbulence and vertical mixing of the water column in the upper inlet (U.S. Army Corps of Engineers 2013), and are reversing, meaning that they are marked by a period of slack tide followed an acceleration in the opposite direction (Mulherin et al. 2001).

Because of scouring, mixing, and sediment transport from these currents, the marine invertebrate community is very limited (Pentec 2005). Of the 50 stations sampled by Saupe et al. 2005 for marine invertebrates in Southcentral Alaska, their upper Cook Inlet station had by far the lowest abundance and diversity. Further, the fish community of upper Cook Inlet is characterized largely by migratory fish – eulachon and Pacific salmon – returning to spawning rivers, or outmigrating salmon smolts. Moulton (1997) documented only 18 fish species in upper Cook Inlet compared to at least 50 species found in lower Cook Inlet (Robards et al. 1999).

Lower Cook Inlet extends from the Forelands southwest to the inlet mouth demarked by an approximate line between Cape Douglas and English Bay. Water circulation in lower Cook Inlet is dominated by the Alaska Coastal Current (ACC) that flows northward along the shores of the Kenai Peninsula until it turns westward and is mixed by the combined influences of freshwater input from upper Cook Inlet, wind, topography, tidal surges, and the coriolis effect (Field and Walker 2003, MMS 1996). Upwelling by the ACC brings nutrient-rich waters to lower Cook Inlet and contributes to a biologically rich and productive ecology (Sambrotto and Lorenzen 1986). Tidal currents average 2-3 kt per second and are rotary in that they do not completely go slack before rotating around into an opposite direction (Gatto 1976, Mulherin et al. 2001). Depths in the central portion of lower Cook Inlet are 60-80 m (197-262 ft) and decrease steadily toward the shores (Muench 1981). Bottom sediments in the lower inlet are coarse gravel and sand that grade to finer sand and mud toward the south (Bouma 1978).

Coarser substrate support a wide variety of invertebrates and fish including Pacific halibut, Dungeness crab (*Metacarcinus magister*), tanner crab (*Chionoecetes bairdi*), pandalid shrimp (*Pandalus* spp.), Pacific cod, and rock sole (*Lepidopsetta bilineata*), while the soft-bottom sand and silt communities are dominated by polychaetes, bivalves and other flatfish (Field and Walker 2003). Sea urchins (*Strongylocentrotus* spp.) and sea cucumbers are important otter prey and are found in shell debris communities. Razor clams (*Siliqua patula*) are found all along the beaches of the Kenai Peninsula. In general, the lower Cook Inlet marine invertebrate community is of low abundance, dominated by polychaetes, until reaching the

mouth of the inlet (Saupe et al. 2005). Overall, the lower Cook Inlet marine ecosystem is fed by midwater communities of phytoplankton and zooplankton, with the latter composed mostly of copepods and barnacle and crab larvae (Damkaer 1977, English 1980).

G&G Program activities that could potentially impact marine mammal habitats include sediment sampling (vibracore, boring, grab sampling) on the sea bottom, placement of the jack-up platform spud cans, and acoustical injury of prey resources.

However, there are few benthic resources in the survey area that could be impacted by collection of the small samples (Saupe et al. 2005).

Acoustical effects to prey resources are also limited. Christian et al. (2004) studied seismic energy impacts on male snow crabs (*Chionoecetes* sp.) and found no significant increases in physiological stress due to exposure to high sound pressure levels. No acoustical impact studies have been conducted to date on the above fish species, but studies have been conducted on Atlantic cod (*Gadus morhua*) and sardine (*Clupea* sp). Davis et al. (1998) cited various studies found no effects to Atlantic cod eggs, larvae, and fry when received levels were 222 dB. Effects found were to larval fish within about 5.0 m (16 ft), and from air guns with volumes between 49,661 and 65,548 cm^3 (3,000 and 4,000 in^3). Similarly, effects to sardine were greatest on eggs and 2-day larvae, but these effects were greatest at 0.5 m (1.6 ft), and again confined to 5.0 m (16 ft). Further, Greenlaw et al. (1988) found no evidence of gross histological damage to eggs and larvae of northern anchovy (*Engraulis mordax*) exposed to seismic air guns, and concluded that noticeable effects would result only from multiple, close exposures. Based on these results, much lower energy impulsive geophysical equipment planned for this program would not damage larval fish or any other marine mammal prey resource.

Potential damage to the Cook Inlet benthic community will be limited to the actual surface area of the four spud cans that form the "foot" of each 0.762-m (30-in) diameter leg, the 42 0.1524-m (6-in) diameter borings, and the 55 0.0762-m (3-in) diameter vibracore samplings (plus several grab and PCPT samples). Collectively, these samples would temporarily damage about a hundred square meters of benthic habitat relative to the size (nearly 21,000 km^2/8,108 mi^2) of Cook Inlet. Overall, sediment sampling and acoustical effects on prey resources will have a negligible effect at most on the marine mammal habitat within the G&G Program survey area. Some prey resources might be temporarily displaced, but no long-term effects are expected.

The Cook Inlet 2015 G&G Program will result in a number of minor discharges to the waters of Cook Inlet. Discharges associated with the geotechnical borings will include: 1) the discharge of drill cuttings and drilling fluids and 2) the discharge of deck drainage (runoff of precipitation and deck wash water) from the geotechnical drilling platform. Other vessels associated with the G&G surveys will discharge wastewaters that are normally associated with the operation of vessels in transit including deck drainage, ballast water, bilge water, non-contact cooling water, and gray water.

The discharges of drill cuttings, drilling fluids, and deck drainage associated with the geotechnical borings will be within limitations authorized by the Alaska Department of Environmental Conservation (ADEC) under the Alaska Pollutant Discharge Elimination System (APDES). The drill cuttings consist of natural geologic materials of the seafloor sediments brought to the surface via the drill bit/drill stem of the rotary drilling operation, will be relatively minor in volume, and deposit over a very small area of Cook Inlet seafloor. The drilling fluids which are used to lubricate the bit, stabilize the hole, and viscosify the slurry for transport of the solids to the surface will consist of seawater and guar gum. Guar gum is a high-molecular weight polysaccharide (galactose and mannose units) derived from the ground seeds of the plant *Cyampsis gonolobus*. It is a non-toxic fluid also used as a food additive in soups, drinks, breads, and meat products.

Vessel discharges will be authorized under the U.S. Environmental Protection Agency's (EPA's) National Pollutant Discharge Elimination System (NPDES) Vessel General Permit (VGP) for Discharges Incidental to the Normal Operation of Vessels. Each vessel will have obtained authorization under the VGP and will discharge according to the conditions and limitations mandated by the permit. As required by statute and regulation, the EPA has made a determination that such discharges will not result in any unreasonable degradation of the marine environment, including:

- significant adverse changes in ecosystem diversity, productivity and stability of the biological community within the area of discharge and surrounding biological communities,
- threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms, or
- loss of aesthetic, recreational, scientific or economic values which is unreasonable in relation to the benefit derived from the discharge.

9.1 EFFECTS ON BELUGA CRITICAL HABITAT

Potential effects on beluga habitat would be limited to noise effects on prey (discussed in Section 4.2.3.5); direct impact to benthic habitat from jack-up platform leg placement, and sampling with grabs, coring, and boring; and small discharges of drill cuttings and drilling mud associated with the borings. ESA section 3(5)(A)(i) defines critical habitat to include those "specific areas within the geographical area occupied by the species at the time it is listed…on which are found those physical or biological features…(I) essential to the conservation of the species and (II) which may require special management considerations or protection." Joint NMFS/FWS regulations for listing endangered and threatened species and designating critical habitat at section 50 CFR 424.12(b) state that the agency ''shall consider those physical and biological features that are essential to the conservation of a given species and that may require special management considerations or protection'' also referred to as ''Essential Features'' or ''Primary Constituent Elements''.

When establishing critical habitat for the Cook Inlet beluga whale, NMFS identified the following as the Primary Constituent Elements; an analysis of the potential effects of the survey program on these elements follows.

1. Intertidal and subtidal waters of Cook Inlet with depths <30 feet (9.1 m) (MLLW) and within 5 miles (8.0 km) of high and medium flow accumulation anadromous fish streams;

2. Primary prey species consisting of four (4) species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole;

3. The absence of toxins or other agents of a type or amount harmful to beluga whales;

4. Unrestricted passage within or between the critical habitat areas; and

5. The absence of in-water noise at levels resulting in the abandonment of habitat by Cook Inlet beluga whales.

1. <u>Intertidal and subtidal waters of Cook Inlet with depths <30 feet (9.1 m) (MLLW) and within 5 miles (8.0 km) of high and medium flow accumulation anadromous fish streams</u>

Portions of the survey areas include waters of Cook Inlet that are <9.1 m (30 ft) in depth and within 8.0 km (5.0 mi) of anadromous streams. Several anadromous streams (Three-mile Creek, Indian Creek, and two unnamed streams) enter the Cook Inlet within the survey areas. Other anadromous streams are located within 8.0 km (5.0 mi) of the survey areas. The survey program will not prevent beluga access to the mouths of these streams and will result in no short-term or long-term loss of intertidal or subtidal waters that are <9.1 m (30 ft) in depth and within 8.0 km (5.0 mi) of anadromous streams. Minor seafloor impacts will occur in these areas from grab samples, PCPTs, vibracores, or geotechnical borings but will have no effect on the area as beluga habitat once the vessel or jack-up platform has left. The survey program will have no effect on this Primary Constituent Element.

2. <u>Primary prey species – Pacific salmon, Pacific eulachon, Pacific cod, saffron cod, yellowfin sole</u>

The above beluga prey species could potentially be affected by: the sound generated by geophysical and geotechnical equipment, physical disturbance of the fish habitat, discharges associated with vessels or geotechnical borings.

As discussed above in Section 9.0, acoustical effects to marine mammals prey resources, including Pacific salmon, Pacific eulachon, Pacific cod, saffron cod, yellowfin sole are limited and would be negligible, if they occur. The effect of seismic airguns on fish, fish larvae and eggs, and benthic invertebrates have been studied and have been found to be

minimal. Based on these results, the much lower-energy impulsive geophysical equipment planned for this program would not damage eggs or larval fish of these primary prey species or any other marine mammal prey resource.

Direct physical disturbance of the benthic habitats will be limited to the surface area of the foot of the legs on the jack-up platform, the borehole, grab samples, PCPTs, and vibracores, and is expected to total about 100 m^2 (1,076 ft^2) representing an exceedingly small portion of the benthic habitat available to these species in the nearly 21,000-km^2 (8,108 mi^2) Cook Inlet. Indirect impacts on benthic and water-column habitats would also occur from the discharges of drill cuttings and drilling mud. Modeling of the discharges indicates that most of the discharged materials at a borehole site would be deposited within a short distance of the discharge location. Turbidity would extend further and would normalize within minutes of cessation of the discharge. Physical evidence of the direct and indirect benthic impacts would be expected to be ameliorated naturally in a relatively short time in the high energy environment of the Cook Inlet. The survey areas are not known to contain any especially important spawning areas for these species. Salmon and eulachon are anadromous and spawn in freshwater; only adult Pacific cod are found in the upper Cook Inlet. Given the small area affected, the temporary nature of the effects, and the high energy environment of the Cook Inlet, the Cook Inlet 2015 G&G Program will have no noticeable effect on this Primary Constituent Element.

3. The absence of toxins or other agents of a type or amount harmful to beluga whales

No toxins will be discharged or otherwise introduced into waters of the Cook Inlet by the Cook Inlet 2015 G&G Program. Small volumes of drilling mud associated with the geotechnical borings will be discharged to the Cook Inlet; however, the drilling mud consists of ambient seawater and guar gum, a non-toxic polysaccharide commonly used as a food additive. The program will have no effect on this Primary Constituent Element.

4. Unrestricted passage within or between the critical habitat areas

Belugas may avoid areas ensonified by the geophysical or geotechnical activities that generate sound with frequencies within the beluga hearing range and at levels above threshold values. This includes the chirp subbottom profiler with a radius of 184 m (604 ft), the boomer subbottom profiler with a radius of 263 m (863 ft), the airgun with a radius of 300 m (984 ft) and the vibracores with a radius of 2.54 km (1.58 mi). The subbottom profilers and the airgun will be operated from a vessel moving at speeds of about 4 kt. The operation of a vibracore has a duration of approximately 1-2 minutes. All of these activities will be conducted in relatively open areas of the Cook Inlet within Critical Habitat Area 2. Given the size and openness of the Cook Inlet in the survey areas, and the relatively small area and mobile / temporary nature of the zones of ensonification, the generation of sound by the G&G activities is not expected to result in any restriction of passage of belugas within or between critical habitat areas. The jack-up platform from which the geotechnical borings will be conducted will be attached to the seafloor with legs, and will be in place at a given

location for up to 4-5 days, but given its small size (Table 4) would not result in any obstruction of passage by belugas. The program will have no effect on this Primary Constituent Element.

5. The absence of in-water noise at levels resulting in the abandonment of habitat by Cook Inlet beluga whales

Operation of the geophysical or geotechnical activities generate sound with frequencies within the beluga hearing range and at levels above threshold values, and may result in temporary displacement of belugas. This includes the chirp subbottom profiler with a radius of 184 m (604 ft), the boomer subbottom profiler with a radius of 263 m (863 ft), the airgun with a radius of 300 m (984 ft) and the vibracores with a radius of 2.54 km (1.58 mi). The subbottom profilers and the airgun will be operated from a vessel moving at speeds of about 4 kt. The operation of a vibracore has a duration of approximately 1-2 minutes. Any displacement of belugas would be momentary as the sound sources are either mobile or very brief in duration. No abandonment of the habitat by belugas would be expected. The survey program will have no effect on this Primary Constituent Element.

10.0 ANTICIPATED EFFECTS OF HABITAT IMPACTS ON MARINE MAMMALS

Based on the conclusions of Section 9 above, no loss or direct modification of marine mammal habitat is expected. Potential impacts to prey resources are considered minor or negligible, and no long-term effects would occur. The acoustic environment created by the G&G activities could, however, result in habitat displacement for any marine mammal that chose to avoid sound levels above ambient. The maximum area that could be ensonified in a given day would be equivalent to the ZOI of two vibracorings, or 40.5 km^2 (15.6 mi^2). This area represents about 1.9% of the 20,943 km^2 (8,086 mi^2) Cook Inlet. Thus, while the G&G activity will likely result in some level of habitat displacement, it is probably negligible given the habitat available and the summer distribution of local marine mammals.

11.0 MITIGATION MEASURES

To mitigate potential acoustical impacts to local marine mammals, Protected Species Observers (PSOs) will operate aboard the vessels from which the chirper, boomer, airgun, and vibracorer will be deployed. The PSOs will implement the mitigation measures described in the *Marine Mammal Monitoring and Mitigation Plan* (Appendix A). These mitigations include: 1) establishing safety zones to ensure marine mammals are not injured by sound pressure levels exceeding Level A injury thresholds; 2) shutting down the airgun when required to avoid harassment of beluga whales; and 3) timing survey activity to avoid concentrations of beluga whales on a seasonal basis.

Before chirper, boomer, airgun, or vibracoring operations begin, the PSOs will "clear" both the Level A and Level B ZOIs of marine mammals by intensively surveying these ZOIs prior to activity to confirm that marine mammals are not seen in the applicable area. All three geophysical activities will be shut down in mid-operation at the approach to any marine mammal to the Level A safety zone, and at the approach of an ESA-listed beluga whale to the Level B harassment zone for the airgun. (The geotechnical vibracoring lasts only one or two minutes; shut down would likely be unnecessary.) Finally, the G&G Program will be planned to avoid high beluga whale density areas. This would be achieved by conducting surveys at the Marine Terminal and the southern end of the pipeline survey area when beluga whales are farther north, feeding near the Susitna Delta, and completing activities in the northern portion of the pipeline survey area when the beluga whales have begun to disperse from the Susitna Delta and other summer concentration areas.

12.0 PLAN OF COOPERATION

Given that Cook Inlet is not considered a traditional Arctic subsistence area, the Applicant will not be preparing a formal Plan of Cooperation. However, hunters from villages in Cook Inlet do continue to conduct subsistence hunting and fishing, and the Applicant plans to engage with applicable communities and local tribes in Cook Inlet to reduce the chance of adverse impacts to subsistence activities by identifying and mitigating potential conflicts of use during the Cook Inlet G&G Program. Subsistence community engagement is discussed in Section 8.0.

13.0 MONITORING AND REPORTING

Monitoring and reporting potential acoustical impacts to local marine mammals are addressed in the *Marine Mammal Monitoring and Mitigation Plan* attached as Appendix A.

14.0 SUGGESTED MEANS OF COORDINATION

Observations of marine mammals recorded during the G&G Program will be reported to the Anchorage Office of NMFS (following protocols as described in Appendix A: *Marine Mammal Monitoring and Mitigation Plan*).

Representatives of the Applicant will coordinate with applicable agencies such as NMFS, USFWS, Bureau of Safety and Environmental Enforcement, the USACE, the State of Alaska, and the Bureau of Ocean Energy Management in the assessment of measures that can be taken to reduce impacts from planned activities. The Applicant will also reach out to and coordinate with communities that conduct subsistence activities in the area.

Given the very low likelihood of observing cetaceans and pinnipeds during the Cook Inlet G&G survey activities, especially considering the actions (such as timing) that will be taken to avoid encounters and the short duration of most of the most sound intensive activities,

developing a specific research program in association with this program would be impractical. However, there are a number of ongoing research programs being conducted by NMFS and the Alaska Department of Fish and Game. The Applicant will reach out to these researchers in the event that there might be opportunities to coordinate or collaborate.

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APPENDIX A: MARINE MAMMAL MONITORING AND MITIGATION PLAN

Marine Mammal Monitoring and Mitigation Plan For Alaska LNG Project's Cook Inlet 2015 G&G Program

1.0 INTRODUCTION

In support of the Alaska LNG Project, ExxonMobil Alaska LNG LLC (Applicant) is requesting an Incidental Harassment Authorization (IHA) from the National Marine Fisheries Service (NMFS) for the Cook Inlet 2015 Geological and Geotechnical (G&G) Program.

The marine mammal monitoring and mitigation plan (4MP) for the Cook Inlet 2015 G&G Program is described below. The Applicant understands that updates to the 4MP may be required to meet requirements established by NMFS in the Incidental Harassment Authorization (IHA).

To avoid Level A harassment and to minimize Level B harassment of marine mammals, the Applicant will employ NMFS-approved Protected Species Observers (PSO) to implement mitigation measures and monitor sound-generating activities for IHA compliance, including monitoring shut down zones and implementing shut down procedures as necessary. PSOs will be positioned on the geophysical source vessels during the geophysical activities and the geotechnical vibracoring activity.

2.0 PROPOSED SAFETY AND HARASSMENT MONITORING RADII

The IHA issued by NMFS will establish harassment and safety zones appropriate for cetaceans and pinnipeds in reference to Zones of Influence (ZOI) surrounding the active G&G equipment for which the IHA is being requested. PSOs will record non-listed marine mammals occurring inside the Level B harassment zone, and will initiate shut downs to avoid harassment of beluga whales and any other ESA-listed marine mammals.

The Level A safety zone radii for those activities producing noise exceeding 180 and 190 dB re 1 µPa (rms) are provided in Table 1. The method for deriving these radii is found in Section 1.2 of the associated IHA application. Each of these noise sources will be shut down at an approach of a pinniped to the 190-dB zone or for a cetacean approaching the 180-dB zone.

Table 1. Safety Zone Radii for each G&G Equipment Type Generating Sound at Frequencies <200 kHz.

	Safety Zone Radii	
Survey Equipment	**Pinnipeds 190-dB radius m (ft)**	**Cetaceans 180-dB radius m (ft)**
Sub-bottom Profiler - Chirp	5 (16)	6 (20)
Sub-bottom Profiler - Boomer	7 (23)	23 (75)
0.983 L (70 in^{3}) Airgun	8 (26)	26 (85)
Vibracore	0	3 (10)

3.0 SOUND SOURCE VERIFICATION

Sound source verification (SSV) measurements have already been conducted for nearly all of the G&G equipment (or similar equipment) proposed for this project (see Section 1.2 of the IHA application). No additional SSV measurements are planned.

4.0 VESSEL-BASED VISUAL MONITORING

The purpose of the 4MP and PSOs is to meet compliance with regulations set in place by NMFS. The IHA application describes measures to ensure potential disturbance of and effects to marine mammals is minimized and documented. This will be accomplished through a vessel-based visual monitoring program. PSOs will implement this program as specified in the NMFS-issued IHA and in this 4MP. The primary purposes of the vessel-based PSO program are:

- Monitor: Observe the appropriate harassment and safety zones for marine mammals, estimate the numbers of marine mammals exposed to sound and their reactions (where applicable), and document those incidents as required.
- Mitigate: Implement methodologies to include; clearing and ramp-up measures; observe for and detect marine mammals within, or which are about to enter, the applicable safety radii or harassment zones; implement necessary shut down, power-down, and/or speed/course alteration mitigation procedures when applicable; and advise operational crews of mitigation procedures.

PSOs will conduct monitoring during daylight periods (weather permitting) during G&G activities, and during most daylight periods when G&G activities are temporarily suspended.

Vessel-based visual monitoring is designed to provide:

- The basis for real-time mitigation, as necessary and required by the IHA;

- Information used to determine "Level B takes" of marine mammals by harassment as required by NMFS;
- Data on occurrence, distribution, and activities of marine mammals from areas where operations are conducted; and
- Data for the analysis of marine mammal distribution, movement and behavior relative to program activities.

5.0 PROTECTED SPECIES OBSERVERS

The Applicant will hire qualified and NMFS-approved PSOs. These PSOs will be stationed aboard the geophysical survey source or support vessels during subbottom profiling, air gun, and vibracoring operations. A single senior PSO will be assigned to oversee all 4MP mandates and function as the on-site person-in-charge (PIC) implementing the 4MP.

Generally, two PSOs will work on a rotational basis during daylight hours with shifts of 4 to 6 hours. Work days for an individual PSO will not exceed 12 hours in duration. Sufficient numbers of PSOs will be available and provided to meet requirements.

5.1 PSO ROLES AND RESPONSIBILITIES

Roles and responsibilities of all PSOs include the following:

- Accurately observe and record sensitive marine mammal species;
- Follow monitoring and data collection procedures; and
- Ensure mitigation measures are followed.

PSOs will be stationed at the best available vantage point on the source vessels. PSOs will scan systematically with the unaided eye and 7x50 reticle binoculars. As necessary, new PSOs will be paired with experienced PSOs to ensure that the quality of marine mammal observations and data recording are consistent.

All field data collected will be entered by the end of the day into a custom database using a notebook computer. Weather data relative to viewing conditions will be collected hourly, on rotation, and when sightings occur and include the following:

- Sea state;
- Wind speed and direction;
- Sun position; and

- Percent glare.

The following data will be collected for all marine mammal sightings:

- Bearing and distance to the sighting;
- Species identification;
- Behavior at the time of sighting (e.g., travel, spy-hop, breach, etc.);
- Direction and speed relative to vessel;
- Reaction to activities – changes in behavior (e.g., none, avoidance, approach, paralleling, etc.);
- Group size;
- Orientation when sighted (e.g., toward, away, parallel, etc.);
- Closest point of approach;
- Sighting cue (e.g., animal, splash, birds, etc.);
- Physical description of features that were observed or determined not to be present in the case of unknown or unidentified animals;
- Time of sighting;
- Location, speed, and activity of the source and mitigation vessels, sea state, ice cover, visibility, and sun glare; and positions of other vessel(s) in the vicinity, and
- Mitigation measure taken – if any.

If ESA-listed marine mammals (e.g., beluga whales) are observed approaching the Level B harassment zone for the air gun, the air gun will be shut down. The PSOs will ensure that the harassment zone is clear of marine mammal activity before vibracoring will occur. Given that vibracoring lasts only about a minute or two, shutdown actions are not practicable.

All observations and shut downs will be recorded in a standardized format and data entered into a custom database using a notebook computer. Accuracy of all data will be verified daily by the PIC or designated PSO by a manual verification. These procedures will reduce errors, allow the preparation of short-term data summaries, and facilitate transfer of the data to statistical, graphical, or other programs for further processing and archiving.

6.0 MITIGATION MEASURES

Several mitigation measures will be initiated by the PSOs to avoid Level B Harassment of ESA-listed marine mammals. These include:

- slowing down of the towing operation at the approach of listed marine mammals (e.g., beluga whales), thereby reducing cavitation noise and the size of the harassment zone;
- shutting down airgun equipment at the approach of a listed species to the harassment ZOI; and
- "clearing" the harassment ZOI of marine mammals before commencing vibracoring.

7.0 REPORTING

7.1 WEEKLY FIELD REPORTS

Weekly reports will be submitted to NMFS no later than the close of business (Alaska Time) each Thursday during the weeks when in-water G&G activities take place. The reports will cover information collected from Wednesday of the previous week through Tuesday of the current week. The field reports will summarize species detected, in-water activity occurring at the time of the sighting, behavioral reactions to in-water activities, and the number of marine mammals exposed to harassment level noise.

7.2 MONTHLY FIELD REPORTS

Monthly reports will be submitted to NMFS for all months during which in-water G&G activities take place. The reports will be submitted to NMFS no later than five business days after the end of the month. The monthly report will contain and summarize the following information:

Dates, times, locations, heading, speed, weather, sea conditions (including Beaufort Sea state and wind force), and associated activities during the G&G Program and marine mammal sightings.

- Species, number, location, distance from the vessel, and behavior of any sighted marine mammals, as well as associated G&G activity (number of shut downs), observed throughout all monitoring activities.
- An estimate of the number (by species) of: (i) pinnipeds that have been exposed to the geophysical activity (based on visual observation) at received levels greater than or

equal to 160 dB re 1 µPa (rms) and/or 190 dB re 1 µPa (rms) with a discussion of any specific behaviors those individuals exhibited; and (ii) cetaceans that have been exposed to the geophysical activity (based on visual observation) at received levels greater than or equal to 160 dB re 1 µPa (rms) and/or 180 dB re 1 µPa (rms) with a discussion of any specific behaviors those individuals exhibited.

- An estimate of the number (by species) of pinnipeds and cetaceans that have been exposed to the geotechnical activity (based on visual observation) at received levels greater than or equal to 120 dB re 1 µPa (rms) with a discussion of any specific behaviors those individuals exhibited.
- A description of the implementation and effectiveness of the: (i) terms and conditions of the Biological Opinion's Incidental Take Statement; and (ii) mitigation measures of the IHA. For the Biological Opinion, the report shall confirm the implementation of each Term and Condition, as well as any conservation recommendations, and describe their effectiveness, for minimizing the adverse effects of the action on ESA-listed marine mammals.

7.3 90-DAY TECHNICAL REPORT

A report will be submitted to NMFS within 90 days after the end of the project or at least 60 days before the request for another Incidental Harassment Authorization for the next open water season to enable NMFS to incorporate observation data into the next Authorization. The report will summarize all activities and monitoring results (*i.e.*, vessel-based visual monitoring) conducted during in-water G&G surveys. The Technical Report will include the following:

- Summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals).
- Analyses of the effects of various factors influencing detectability of marine mammals (*e.g.*, sea state, number of observers, and fog/glare).
- Species composition, occurrence, and distribution of marine mammal sightings, including date, water depth, numbers, age/size/gender categories (if determinable), group sizes, and ice cover.
- Analyses of the effects of survey operations.
- Sighting rates of marine mammals during periods with and without G&G survey activities (and other variables that could affect detectability), such as: (i) initial

sighting distances versus survey activity state; (ii) closest point of approach versus survey activity state; (iii) observed behaviors and types of movements versus survey activity state; (iv) numbers of sightings/individuals seen versus survey activity state; (v) distribution around the source vessels versus survey activity state; and (vi) estimates of Level B harassment based on presence in the 120 or 160 dB harassment zone.

7.4 NOTIFICATION OF INJURED OR DEAD MARINE MAMMALS

In the unanticipated event that the specified activity leads to an injury of a marine mammal (Level A harassment) or mortality (*e.g.*, ship-strike, gear interaction, and/or entanglement), the Applicant would immediately cease the specified activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the Alaska Regional Stranding Coordinators. The report would include the following information:

- Time, date, and location (latitude/longitude) of the incident;
- Name and type of vessel involved;
- Vessel's speed during and leading up to the incident;
- Description of the incident;
- Status of all sound source use in the 24 hours preceding the incident;
- Water depth;
- Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, and visibility);
- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

Activities would not resume until NMFS is able to review the circumstances of the event. The Applicant would work with NMFS to minimize reoccurrence of such an event in the future. The G&G Program would not resume activities until formally notified by NMFS via letter, email, or telephone.

In the event that the G&G Program discovers an injured or dead marine mammal, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (*i.e.*, in less than a moderate state of decomposition as described in the next paragraph), the Applicant would immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinators. The report would include the same information identified in the paragraph above. Activities would be able to continue while NMFS reviews the circumstances of the incident. NMFS would work with the Applicant to determine if modifications in the activities are appropriate.

In the event that the G&G Program discovers an injured or dead marine mammal, and the lead PSO determines that the injury or death is not associated with or related to the activities authorized in the IHA (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), the Applicant would report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinators, within 24 hours of the discovery. The Applicant would provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network.