Endangered Species Act Section 7(a)(2) Biological Opinion

Action Agencies:	National Marine Fisheries Service's Office of Protected Resources, Permits and Conservation Division (NMFS PR1) U.S. Army Corps of Engineers, Alaska District
Activities Considered:	Issuance of Incidental Harassment Authorization under section 101(a)(5)(a) of the Marine Mammal Protection Act and Authorization under Nationwide Permits 5 and 6 under section 404 of the Clean Water Act to ExxonMobil Alaska LNG LLC for Alaska LNG Geophysical & Geotechnical Program in the Waters of Cook Inlet, 2015
Consultation Conducted By:	National Marine Fisheries Service, Alaska Region
Consultation Number:	AKR-2015-9474
Date Issued:	8/13/15
Issued By:	James W. Balsiger, Ph.D. Administrator, Alaska Region

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1.0. INTRODUCTION

1.1. Background

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA) (16 U.S.C. 1531 et seq.) requires each federal agency to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat of such species. When a federal agency's action "may affect" a protected species or its critical habitat, that agency is required to consult (50 CFR §402.14) with the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the species.

Under the Marine Mammal Protection Act (MMPA), Level B harassment is defined as: "any act of pursuit, torment, or annoyance which . . . has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering." Sections 101(a)(5)(A) and (D) of the MMPA direct the Secretary of Commerce to allow, upon request, the incidental (not intentional) taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review. An authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth.

The action that is the subject of this consultation is NMFS Office of Protected Resources – Permits and Conservation Division's (NMFS PR1) proposed issuance of an Incidental Harassment Authorization (IHA), under the MMPA, to take marine mammals by harassment (Level B), incidental to ExxonMobil Alaska LNG LLC's (EMALL) proposed Cook Inlet 2015 Geophysical and Geotechnical (G&G) Program. Marine mammals to be covered by the IHA would include: Cook Inlet beluga whale; killer whale; harbor porpoise; and harbor seal. Of these marine mammals, the Cook Inlet beluga whale is listed as an endangered species and therefore is the subject of this ESA section 7 consultation. PR1 determined that the project is not likely to adversely affect designated Cook Inlet beluga critical habitat. PR1 also determined that the project is not likely to adversely affect the humpback whale (*Megaptera novaeangliae*) or the western distinct population segment (DPS) Steller sea lion (*Eumetopias jubatus*) due to their rarity and extremely low density in the project area.

This opinion is also responsive to the U.S. Army Corps of Engineers (Corps) request for consultation on the authorization of this project under Nationwide Permits 5 and 6. The Corps has jurisdiction over the geotechnical aspects of the proposed G&G project, i.e.,

vibracoring, geotechnical borings, sediment grab samples, and Piezo-cone penetration testing.

1.2. Consultation History

- On February 4, 2015, NMFS PR1 received an application from EMALL for the taking of marine mammals incidental to a geotechnical and geophysical survey in Cook Inlet, Alaska.
- On May 18, 2015, NMFS AKR received a letter from the Corps designating EMALL as its non-federal representative for conducting section 7 consultation.
- NMFS PR1 determined that the application was adequate and complete on June 8, 2015.
- By memo dated June 15, 2015, NMFS PR1 requested formal consultation with NMFS AKR on the proposed issuance of an IHA under the MMPA to take marine mammals by harassment during Alaska LNG G&G program in Cook Inlet, Alaska in 2015. Along with the request for consultation, NMFS AKR received a biological assessment (Alaska LNG 2015a) and a copy of EMALL's IHA application (Alaska LNG 2015b).
- The proposed notice to issue an IHA for this project was published in the Federal Register on June 30, 2015 (80 FR 37466).

By memo dated June 15, 2015, NMFS PR1 requested formal consultation with NMFS AKR on the proposed issuance of an IHA under the MMPA to take marine mammals by harassment during Alaska LNG G&G Program in Cook Inlet, Alaska in 2015. Along with the request for consultation, NMFS AKR received a biological assessment (Alaska LNG 2015a) and a copy of EMALL's IHA application (Alaska LNG 2015b). The proposed notice to issue an IHA for this project was published in the Federal Register on June 30, 2015 (80 FR 37466).

2.0. DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

This opinion considers the effects of the authorization of an IHA to take marine mammals by harassment under the MMPA incidental to conducting a geophysical and geotechnical surveys in Cook Inlet, Alaska between August 14, 2015 and November 30, 2015. The activities outlined in this analysis have the potential to take marine mammals by "Level B" harassment as a result of marine habitat disturbance and sound energy introduced to the marine environment.

The ESA does not define "harassment" and NMFS has not defined this term through regulation pursuant to the ESA. The MMPA defines "harassment" as "any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine

mammal stock in the wild" (referred to as Level A harassment) or "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" (referred to as Level B harassment). For the purposes of this consultation, NMFS considers that a take by "harassment" occurs when an animal is exposed to certain sound levels described in section 2.4.

"Action area" means all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). For this reason, the action area is typically larger than the project area and extends out to a point where no measurable effects from the proposed action occur. The action area for this project includes two areas in Cook Inlet: a pipeline survey area and a marine terminal survey area (Figure 1), as further described in Section 2.3.

2.1. Background

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 Liquid Natural Gas Project with interdependent facilities for the purpose of liquefying supplies of natural gas from Alaska, in particular from the Point Thomson Unit and Prudhoe Bay Unit production fields on Alaska's North Slope, for export. Proposed facilities would include a liquefaction facility on the eastern shore of Cook Inlet in the Nikiski area of the Kenai Peninsula, which would be supplied by an approximately 1,287-km (800-mile), large diameter natural gas pipeline from the North Slope. The liquefaction facility is comprised of an LNG plant and a marine terminal.

2.2. General Description

The routing and detailed engineering of the Cook Inlet pipeline crossing have not been finalized. To inform selection of the appropriate route, the proposed geotechnical and geophysical (G&G) program will evaluate an approximately 45-km (28-mi) long by 13-km (8-mi) wide section across Cook Inlet. G&G surveys proposed to be conducted in 2015 would investigate the technical suitability of both the pipeline area across Cook Inlet and the proposed marine terminal location. Results from the 2015 study would be incorporated into detailed engineering designs of the final route selection.

The 2015 program would include geophysical surveys, shallow geotechnical investigations, and geotechnical borings to characterize the bottom surface and sub-surface. The proposed survey 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. The G&G surveys will use both remote acoustical sensors and direct sampling equipment (grab, coring, boring) to collect the necessary data.

The remote sensors to be used would include a single-beam echo sounder, multi-beam echo sounder, sub-bottom profilers (chirp and boomer), small airgun, side-scan sonar,

geophysical resistivity meters, and a magnetometer (see Table 1--The magnetometer and resistivity system are not included in the table as they do not generate sound). The planned shallow geotechnical investigations include vibracoring, sediment grab sampling, and piezo-cone penetration testing (PCPT) to directly evaluate seabed features and the soil conditions.

Geotechnical borings are planned at the potential shoreline crossings and in the terminal boring subarea within the marine terminal survey area; these 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 (to profile substrate structure) will be conducted at the potential shoreline crossings. Shear wave velocity profiles (downhole geophysics --to assess potential vulnerability to earthquakes) will be conducted within some of the boreholes.

The entire Cook Inlet 2015 G&G program is expected to last about 12 weeks (84 days) during the 2015 open water season, after August 7, 2015. During most (63) of these days, the chirp and boomer sub-bottom profiler will produce the loudest sound levels and may be used throughout the action area; small (60 in^3) airgun use will occur over about 7 days and only near the proposed marine terminal (see yellow polygon in

Figure 1). Vibracoring will be conducted from a second vessel and will occur intermittently over approximately 14 days along the pipeline corridor centerline and in the marine terminal area.

2.3. Location and Daily Coverage

The action area consists of two separate areas (

Figure 1) that will be surveyed as follows:

Pipeline Survey Area – The pipeline survey area 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. The pipeline survey area is approximately 45 km (28 mi) in length along the corridor centerline and averages about 13 km (8 mi) in width. The total pipeline survey area is 541 km^2 (209 mi^2) and contains one subarea, the pipeline vibracore area.

Marine Terminal – The marine terminal survey area, located near Nikiski, encompasses 371 km^2 (143 mi^2) and includes two subareas: an airgun survey subarea of 25 km^2 (8.5 mi^2) and a terminal boring area of 12 km^2 (4.6 mi^2).

The applicant's best estimate is that the vessel with the sub-bottom profilers will cover 50 miles (80.47 km) per day. Daily coverage is not applicable to the vessel conducting vibracoring due to the nature of this activity (each instance of vibracore sampling is considered separately) or for the airgun, which will operate in a circumscribed sub-area within the marine terminal area (see section 5.2).

2.4. Detailed Description of Equipment

Relevant acoustic parameters for geophysical equipment planned for use in the Cook Inlet 2015 G&G Program include source levels of 146-206 dB re 1 µPa-m [rms] and operating frequencies of 0.01-1600 kHz (Table 1).

NMFS uses generic sound exposure thresholds to determine when an activity produces sound intensities that can affect marine mammals (70 FR 1871, January 11, 2005). These acoustic thresholds identify the levels at which different categories of noise (impulsive or continuous) have the potential to injure (Level A harassment) or the potential to disturb (Level B harassment) marine mammals. NMFS PR1 does not anticipate and is not proposing to authorize any Level A harassment for this project. The Level B harassment criterion for impulsive sounds is 160 decibels (dB) referenced to 1 microPascal (160 dB re 1 μPa_{rms} [hereafter, 160 dB]), and for continuous sounds, it is 120 dB referenced to 1 microPascal (120 dB re 1 μPa_{rms} [hereafter, 120 dB]). Of the equipment proposed to be used for the EMALL G&G survey project, the chirp and boomer sub-bottom profilers and the airgun produce sounds exceeding the 160 dB level for impulsive sounds, and the vibracore produces sounds that exceed the 120 dB standard for continuous sounds. Thus, operation of these equipment types could result in Level B harassment take of marine mammals. The echosounders and side-scan sonar also produce powerful sounds, but their frequencies are well above hearing abilities of ESA listed marine mammals in Cook Inlet.

Figure 1. Action area overlaid on Cook Inlet beluga whale critical habitat areas 1 and 2.

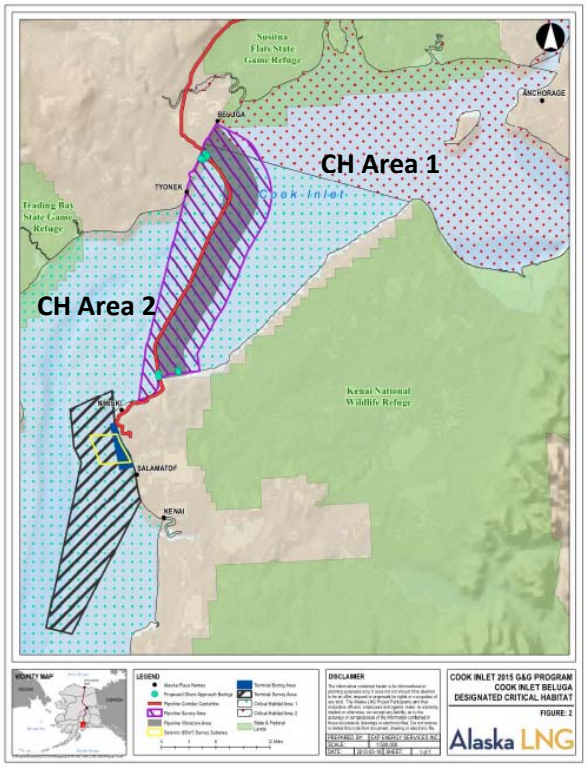


Table 1. Proposed locations for use and acoustic characteristics of acoustic equipment planned for use in the Cook Inlet G&G program.

Survey Equipment	Survey Area [1]		Acoustic Characteristics	
Type	Pipeline Crossing	Marine Terminal	Operating Frequency (kHz)	Source Level (dB re 1 µPa-m [rms])
Single beam echo sounder[2]	+	+	>200 [b]	146 [d]
Multibeam echo sounder[2]	+	+	>200 [b]	188 [d]
Side-scan sonar[2]	+	+	400-1600 [b]	188 [d]
Sub-bottom profiler - chirp	+	+	2-16 [2]	202 [e]
Sub-bottom profiler - boomer	+	+	0.5-6 [2]	205 [e]
Airgun 0.983 L (60 in^3)	-	+[4]	<1[a]	206 [f]
Vibracore	+	+	0.01-20 [c]	187 [c]
Downhole geophysics[3]	+	+	NA[4]	NA[4]

[1] A (+) indicates the equipment will be used in the survey area, a (-) indicates it will not.
[2] Equipment is described below but not further assessed because frequencies are beyond marine mammal hearing ranges.
[3] Equipment not further assessed in this document because the sound will not generate significant sound energy within the water column.
[4] Operated in seismic subarea only.
Sources: [a]Richardson *et al.*1995; [b]Manufacturer brochure; [c]Chorney *et al.* 2011; [d]Shores 2013; [e]Manufacturer provided peak value converted to rms (using a -10 dB offset); [f]O'Neill *et al.* 2010.

We recognize that acoustic thresholds and responses to sounds vary among individual marine mammals and depend on a variety of factors, including characteristics of the noise, previous experiences, natural avoidance behaviors, and activity (feeding, migrating, etc.) at the time of noise exposure. NMFS is in the process of reviewing and evaluating whether these acoustic thresholds delimit when harassment (as defined by the MMPA) actually occurs. Until that process is completed, we continue to rely on those thresholds as there is evidence that they are conservative and they presently represent the best available science.

2.4.1. Geophysical Surveys

The types of acoustic geophysical equipment planned for use in the Cook Inlet 2015 G&G program are described below.

2.4.1.1. Single-Beam Echo Sounder

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. Given an operating frequency of more than 200 kHz (Table 1), sound energy generated by this equipment will be beyond the hearing range of marine mammals in the action area (Houser *et al.*2001; NMFS 2015; Southall *et al*. 2007; Reichmuth and Southall 2011; Castellote *et al.* 2014). Further, single-beam echo sounds operate at relatively low energy levels (146 dB re 1 µPa-m [rms]) and attenuate rapidly. Therefore, acoustic output from this equipment is expected to have insignificant, if any, effect on marine mammals.

2.4.1.2. Multi-beam Echo Sounder

Multi-beam 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 (3-D) seafloor images. These systems are usually side-mounted on the vessel. Given an operating frequency of more than 200 kHz (Table 1), sound energy generated by this equipment will be beyond the hearing range of marine mammals in the action area (Houser *et al.*2001; Southall *et al*. 2007; Reichmuth and Southall 2011; Kastelein *et al.* 2005; Castellote *et al.* 2014). Additionally, most sound energy is emitted directly downward from this equipment, not laterally. Therefore, acoustic output from this equipment is expected to have insignificant, if any, effect on marine mammals.

2.4.1.3. Side-scan Sonar

Side-scan sonars emit a cone-shaped pulse downward to the seafloor at a source energy of about 188 dB re 1 µPa-m (rms). Acoustic reflections provide a two-dimensional (2-D) image of the seafloor and other features. The equipment may be hull-mounted or towed behind the vessel. The side-scan sonar system planned for use during this program will emit sound energy at frequencies of 400 and 1,600 kHz (Table 1), well beyond the normal hearing range of Cook Inlet marine mammals (Houser *et al.*2001; Southall *et al*. 2007; Reichmuth and Southall 2011; Kastelein *et al.* 2005; Castellote *et al.* 2014). Therefore, acoustic output from this equipment is considered to have insignificant, if any, effect on marine mammals.

2.4.1.4. Sub-bottom Profiler – Chirp

The chirp sub-bottom profiler planned for use in this program is a precisely controlled "chirp" system with a resolution of 1 millisecond (ms) used to penetrate and profile the shallow sediments within a few meters of the seafloor; it is designed to be towed behind a vessel. This equipment emits high-energy (202 dB re 1 µPa-m [rms]**)** sounds at frequencies of 2 to 16 kHz. At its operating frequencies (Table 1), this system will emit sounds at the lower end of the hearing range of beluga whales (Castellote *et al.* 2014) and within the hearing range Steller sea lions (Reichmuth and Southall 2011; Kastelein *et al.*

2005) and humpback whales (Houser *et al.*2001; Helweg *et al.*2000). The chirp rate of this equipment is approximately 6 times per second, and it would be used on average 10 hours per day, for a total of 63 days. Of these operating days, 37 will be along the pipeline corridor and 26 will be in the marine terminal area.

2.4.1.5. Sub-bottom Profiler – Boomer

A boomer sub-bottom profiling system with a penetration depth of up to 50 m and resolution of 2-10 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 1), 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 low frequencies of this equipment are well within the effective hearing range of humpback whales (Richardson *et al*. 1995) and at the lower peak hearing range of Steller sea lions (1–16 kHz; Kastelein *et al*. 2005). The boomer emits acoustic energy at approximately 1.5 – 2.0 second intervals and is expected to be used on average 10 hours per day, for a total of 63 days. Of these operating days, 37 will be along the pipeline corridor and 26 will be in the marine terminal area.

2.4.1.6. Airgun

A 0.983 L (60 in^3) airgun will be used to gather high-resolution profiling at greater depths below the seafloor. The manufacturer's (Sercel) published source level for a 0.983 L (60 in^3) airgun is 216 dB re 1 µPa-m (peak) equating to about 206 dB re 1 µPa-m (rms). These airguns typically produce sound levels less than 1 kHz (Richardson *et al.* 1995), below the most sensitive hearing of beluga whales (45-80 kHz; Castellote *et al.* 2014) and Steller sea lions (1–16 kHz; Kastelein *et al.* 2005; 0.2-30 kHz; Muslow and Reichmuth 2011), but within the functional hearing of these animals. This low-frequency noise source is well within the hearing range of humpback whales. Airgun use will be short term and used only during geophysical surveys conducted in a subarea within the marine terminal survey area. The airgun fires at about 3.5 second intervals and is expected to be used on average 10 hours per day for about 7 days.

2.4.1.7. Downhole Geophysics

In this analysis, a suspension log transmitter (source) and receiver are both housed within a probe that is lowered into a bored hole in the seabed on a wireline. The transmitter is an electromechanical device that consists of a metallic barrel (the hammer) disposed horizontally in the tool and actuated by an electromagnet (solenoid) to hit a plate inside the tool body. The transmitter operates at two frequency modes; the fundamental H1 mode, at about 4.5 kHz, and the H2 mode, at 9 kHz. An extra (harmonic) resonance mode is also present at about 15 kHz.

Illingworth and Rodkin (2015) performed an analysis to estimate the expected sound level of the proposed borehole logging equipment. Because no source levels could be found on this apparatus, they concluded, based on the nature of the solenoid device, that sound produced by the system was analogous to sound produced by a 24 inch steel pile

driven by a 5,512 pound hammer. When comparing the efficiency of sound radiation and the radiated sound power of the ½ pound hammer of the solenoid, they estimated that the solonoid source would be at least 40 dB lower than the analogous pile driven system source of 182 dB at 25m (82 ft). They therefore derived that the sound level produced by the borehole logging equipment would be less than 142 dB at 25m (82 ft).

2.4.1.8. Operating Simultaneity
Additional information from the applicant indicates that the chirp and boomer sub-bottom profilers can be operated at the same time; the sub-bottom profiler-chirp and airgun can also be operated at the same time, and the echo-sounder may operate at the same time as the sub-bottom profilers. Due to the disparity in operating frequencies of these devices, we expect no additive effects on marine mammals from operations of these combinations of devices.

2.4.2. Geotechnical Surveys

Geotechnical borings provide geological information at greater sediment depths than vibracores. These data are required to help inform proper design and construction techniques for the pipeline crossing and terminal facilities. Geotechnical borings will be conducted within the marine terminal survey area and along the pipeline survey area near potential shoreline crossings. Borings will collect geotechnical samples from depths of 15.2 to 70.0 m (50–200 ft) using a rotary drilling unit mounted on a small jack-up platform.

2.4.2.1. 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; the entire 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 1). Because vibracoring is a continuous sound source, it would potentially result in the largest zone of influence (ZOI) of all equipment used in association with this project, where the ZOI is the area ensonified by sound energy greater than 120 dB for continuous sound sources and 160 dB for impulsive sound sources.

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. 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, 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 for the entire project. Some shallow geotechnical activity (sediment grab sampling) may be conducted from the geophysical source vessel.

2.4.2.2. Geotechnical Borings

Geotechnical borings provide geological information at greater sediment depths than vibracores. These data are required to help inform proper designs and construction techniques for the pipeline crossing and terminal facilities. Geotechnical borings will be conducted within the marine terminal survey area and within the pipeline survey area near potential shoreline crossings. Geotechnical borings will collect samples 15.2 to 70.0 m (50-230 ft) deep using a rotary drilling unit mounted on a small jack-up platform. Underwater sound generated from geotechnical borings is not expected to exceed 120 dB re 1 μPa-m (rms) at source and is therefore below the level that could constitute take for continuous sound sources. The effect of the borings on benthic habitat is described in Section 5.4.1 below.

2.4.2.3. Sediment Grab Samples

Direct sediment samples are used to aid interpretation of geophysical data. Grab samples will be obtained as warranted for environmental and geotechnical analysis, such as soil description and sieve analyses. Grab samples will be obtained at approximately 1.6 km (1 mi) intervals. In order to obtain samples, a 2 L Van Veen grab sampler will be lowered with its "jaws" open to the seafloor from the geophysical vessel. When on the sea floor, the mechanical closing mechanism is activated, thus "grabbing" a sample of bottom sediment. The sampler is retrieved to the vessel deck, and the sample of the sediments collected.

2.4.2.4. 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, as warranted by the geophysical survey results. 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.

2.4.3. 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. The jack-up platform from which geotechnical borings will be conducted 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 2.

Table 2. Vessels expected to be used in the Cook Inlet 2015 G&G program

Activity	Vessel Type	Example Vessel [2]	Length m (ft)	Width m (ft)	Horse-power
Geophysical surveys [1]	Source vessel	*Qualifier 105*	32.0 (105)	9.1 (30)	1,200
	Source vessel	*Westerly*	15.2 (50)	4.7 (15.5)	1,000
Vibracores	Source vessel	*Kittiwake*	30.5 (100)	7.9 (26)	650
Geotechnical studies	Jack-up platform	*Skate 3*	18.3 (60)	12.2 (40)	NA
	Tug	*Norman O*	22.9 (75)	7.3 (24)	1500
	Landing craft	*My Marie*	12.8 (42)	3.2 (10.5)	600

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

2.5. Mitigation Measures[1]

Cook Inlet beluga whales could potentially be harmed or disturbed by certain aspects of the proposed project. EMALL has prepared and will implement a Marine Mammal Monitoring and Mitigation Plan (4MP), which is incorporated as part of the proposed action. The 4MP (Attachment 1) specifies mitigation measures intended to eliminate Level A takes of any marine mammal and to minimize Level B takes of ESA-listed marine mammals during project activities. These measures are summarized below; greater detail is provided in Appendix A.

2.5.1. Seasonal Avoidance

The G&G activity will occur during the summer months when the majority of the Cook Inlet beluga whale population is concentrated in the Susitna Flats region north of the action area. No sub-bottom profiler or vibracorer activity is planned within 5 km (2.7 nm) of the Beluga River. The IHA proposal (NMFS 2015b) indicates that EMALL will not operate within 10 miles (16 km) of the mean higher high water line of the Susitna Delta (Beluga River to the Little Susitna River, defined as *Susitna Delta Exclusion Zone*) between April 15 and October 15[2]. The purpose of this mitigation measure is to provide

[1] See Appendix A for details of mitigation measures for this project.

[2] In previous biological opinions, we have defined the Susitna Delta Exclusion Zone in terms of mean lower low water (MLLW). See Terms and Conditions of this Biological Opinion.

seasonal protection to beluga whales using crucial feeding and calving habitat within their designated critical habitat.

2.5.2. Protected Species Observers (PSOs)

Qualified PSOs will be stationed aboard the survey source vessels during all sub-bottom profile, airgun, and vibracoring operations. For safety and practical reasons, and because boring is not expected to produce underwater noise exceeding 120 dB, monitoring will not occur from the jack-up platform during active boring operations.

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.
- Data for the analysis of marine mammal distribution, movement, and behavior relative to program activities.

Mitigation measures that will be initiated by the PSOs include:

1) slowing down of the towing operation at the approach of listed marine mammals, thereby reducing cavitation noise and the size of the harassment zone;
2) shutting down of sub-bottom profiling and airgun equipment at the approach of a listed species to the harassment (Level B) ZOI (see section 5.2); and
3) "clearing" the (MMPA Level B) harassment ZOI before commencing vibracoring. EMALL (2015a) indicates that vibracoring will also be shut down at the approach of a marine mammal, although this scenario is unlikely given vibracoring lasts only one or two minutes, and the site will already have been "cleared" of marine mammals by the PSOs. See terms and conditions in the Incidental Take Statement for clarification of what constitutes "clearing."

Further details of the 4MP, which are incorporated as part of this project, are presented in Attachment 1.

3.0. STATUS OF LISTED SPECIES

Of the species to be included in the proposed IHA for this project, the Cook Inlet beluga whale is the only ESA-listed species under NMFS's jurisdiction likely to occur in the action area. Information on humpback whales and Steller sea lions is included below to support our concurrence with NMFS PR1's determination that the action is not likely to adversely affect those species.

3.1. Cook Inlet Beluga Whale

The endangered Cook Inlet beluga whale is the protected species most likely to be affected by this project, primarily due to production of noise. In this opinion, we focus on aspects of beluga whale ecology that are relevant to the effects of this project.

3.1.1. Description and Status

The beluga whale is a small, toothed (Odontocete) whale in the family Monodontidae, a family shared with only the narwhal. Beluga whales are known as "white whales" because the adults are white. Beluga calves are born dark to brownish gray and lighten to white or yellow-white with age. Adult Cook Inlet beluga whales average between 3.6-4 m (12-14 ft.) in length, although Alaska Native hunters have reported some may grow to 6 m (20 ft.) (Huntington 2000).

A detailed description of the Cook Inlet beluga whales' biology, habitat and extinction risk factors may be found in the endangered listing rule for the species (73 FR 62919, October 22, 2008), the Conservation Plan for the Cook Inlet beluga whale (NMFS 2008) and the Draft Recovery Plan (NMFS 2015b). Additional information regarding Cook Inlet beluga whale can be found on the NMFS AKR web site at: http://alaskafisheries.noaa.gov/protectedresources/whales/beluga.htm.

The Cook Inlet beluga whale population was estimated at 1,300 whales in 1979 (Calkins 1989), but experienced a dramatic decline in the 1990s. This decline was attributed to over-harvesting by subsistence hunting, which was then estimated to have removed 10 to 15 percent of the population per year. During 1994-1998 the population was documented to decline about 47 percent, from an estimated 653 to 347 whales (Hobbs *et al.* 2000). After measures were established in 1999 to regulate subsistence harvests, NMFS expected the population to grow at an annual rate of 2 to 6 percent. However, abundance estimates from the 1999-2008 aerial surveys showed the expected population growth did not occur. This led to the ESA listing of Cook Inlet beluga in 2008 (73 FR 62919), and designation of critical habitat in 2011 (76 FR 20180 April 11, 2011). Although only five Cook Inlet beluga whales have been harvested since 1999, the population continues to decline. The 2014 population abundance estimate was 340 whales, indicating a 10 year decline of 0.4 percent per year (Shelden *et al.* 2015).

3.1.2. Range and Behavior

Beluga whales generally occur in shallow, coastal waters, often in water barely deep enough to cover their bodies (Ridgway and Harrison 1981). Although beluga whales remain year-round in Cook Inlet, they demonstrate seasonal movements within the inlet. 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). 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. 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 indicate that lower

densities of belugas are expected to occur in most of the pipeline survey area 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).

Beluga whales are extremely social and often interact in close, dense groups. Groups of 10 to more than 100 whales have been observed in Cook Inlet. Most calving in Cook Inlet is assumed to occur from mid-May to mid-July (Calkins 1984; NMFS unpublished data).Young beluga whales are nursed for two years and may continue to associate with their mothers for a considerable time thereafter (Reeves *et al.* 2002).

3.1.3. Hearing Ability

Like other odontocete cetaceans, beluga whales produce sounds for two overlapping functions: communication and echolocation. For their social interactions, belugas emit communication calls with an average frequency range of about 0.2 to 7.0 kHz (Garland *et al.* 2015), (well within the human hearing range), and the variety of audible whistles, squeals, clucks, mews, chirps, trills, and bell-like tones they produce have led to their nickname as sea canaries (ADFG 2015). At the other end of their hearing range, belugas use echolocation signals (biosonar) with peak frequencies at 40-120 kHz (Au, 2000) to navigate and hunt in dark or turbid waters, where vision is limited. Belugas and other odontocetes make sounds across some of the widest frequency bands that have been measured in any animal group.

Even among odontocetes, beluga whales are known to be among the most adept users of sound. It is possible that the beluga whale's unfused vertebrae, and thus the highly movable head, have allowed adaptations for their sophisticated directional hearing. Awbrey *et al.* (1988) examined their hearing in octave steps between 125 Hz and 8 kHz, and found average hearing thresholds of 121 dB re1 µPa at 125 Hz and 65 dB re 1 µPa at 8 kHz. Johnson and McManus (1989), further examining beluga hearing at frequencies between 40 Hz and 125 kHz, found a hearing threshold of 140 dB re 1 µPa at 40 Hz. The lowest measured threshold (81 dB re 1 µPa) was at 4 kHz. Ridgway *et al*. (2001) measured hearing thresholds at various depths down to 984 ft (298 m) at frequencies between 500 Hz and 100 kHz and found that beluga whales showed unchanged hearing sensitivity at any measured depth. Finneran *et al.* (2005) described the auditory ranges of two belugas as 2 kHz to 130 kHz. Most of these studies measured beluga hearing in very quiet conditions. However, in Cook Inlet tidal currents regularly produce ambient sound levels well above 100 dB (Lammers *et al.* 2013). Belugas' signal intensity can change with location and background noise levels (Au *et al.* 1985). In the first report of hearing ranges of belugas in the wild, results of Castellote *et al.* (2014) were similar to those reported for captive belugas, with most acute hearing at middle frequencies, about 10-75 kHz (Figure 2).

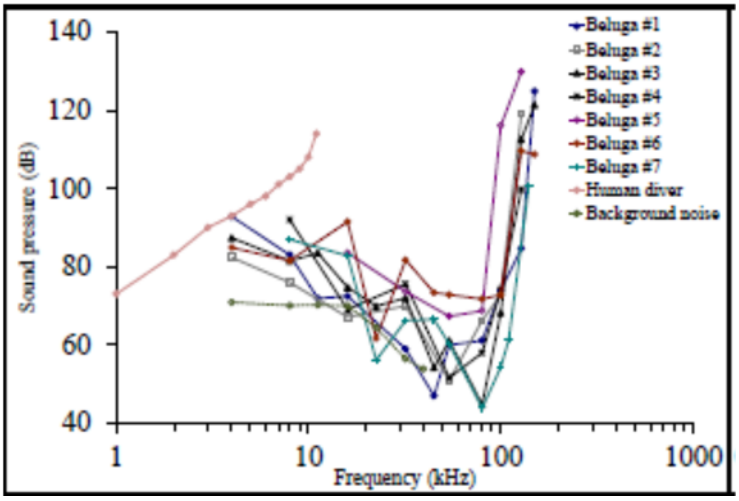


Figure 2. Audiograms of seven wild beluga whales; human diver audiogram and Bristol Bay background noise for comparison (from Castellote *et al.* 2014).

Figure 2 indicates that beluga whales conduct echolocation at relatively high frequencies, where their hearing is most sensitive, and communicate at frequencies where their hearing sensitivity overlaps that of humans.

3.1.4. Cook Inlet Beluga Whale Critical Habitat

Cook Inlet beluga whale critical habitat (Figure 3) includes two geographic areas in Cook Inlet comprising 7,809 km^2 (3,013 mi^2). The proposed G&G survey occurs almost entirely within Area 2 of designated critical habitat, with a small amount of overlap in Area 1 (Figure 1).

3.2. Western DPS Steller Sea Lions

Western DPS Steller sea lions occur in the project area, but in very low numbers (on the order of a few animals reported per year, and often no animals reported in a given year). As with Cook Inlet beluga whales, we focus in this opinion on aspects of western DPS Steller sea lion ecology that are relevant to the effects of this project.

3.2.1. Description and Status

Steller sea lions belong to the family Otariidae, which includes fur seals (*Callorhinus ursinus*). Steller sea lions are the largest otariid and show marked sexual dimorphism with males 2-3 times larger than females. On average, adult males weigh 566 kg (1,248 lbs.) and adult females are much smaller, weighing on average 263 kg (580 lbs.; Fiscus 1961; Calkins and Pitcher 1982; Winship *et al*. 2001).

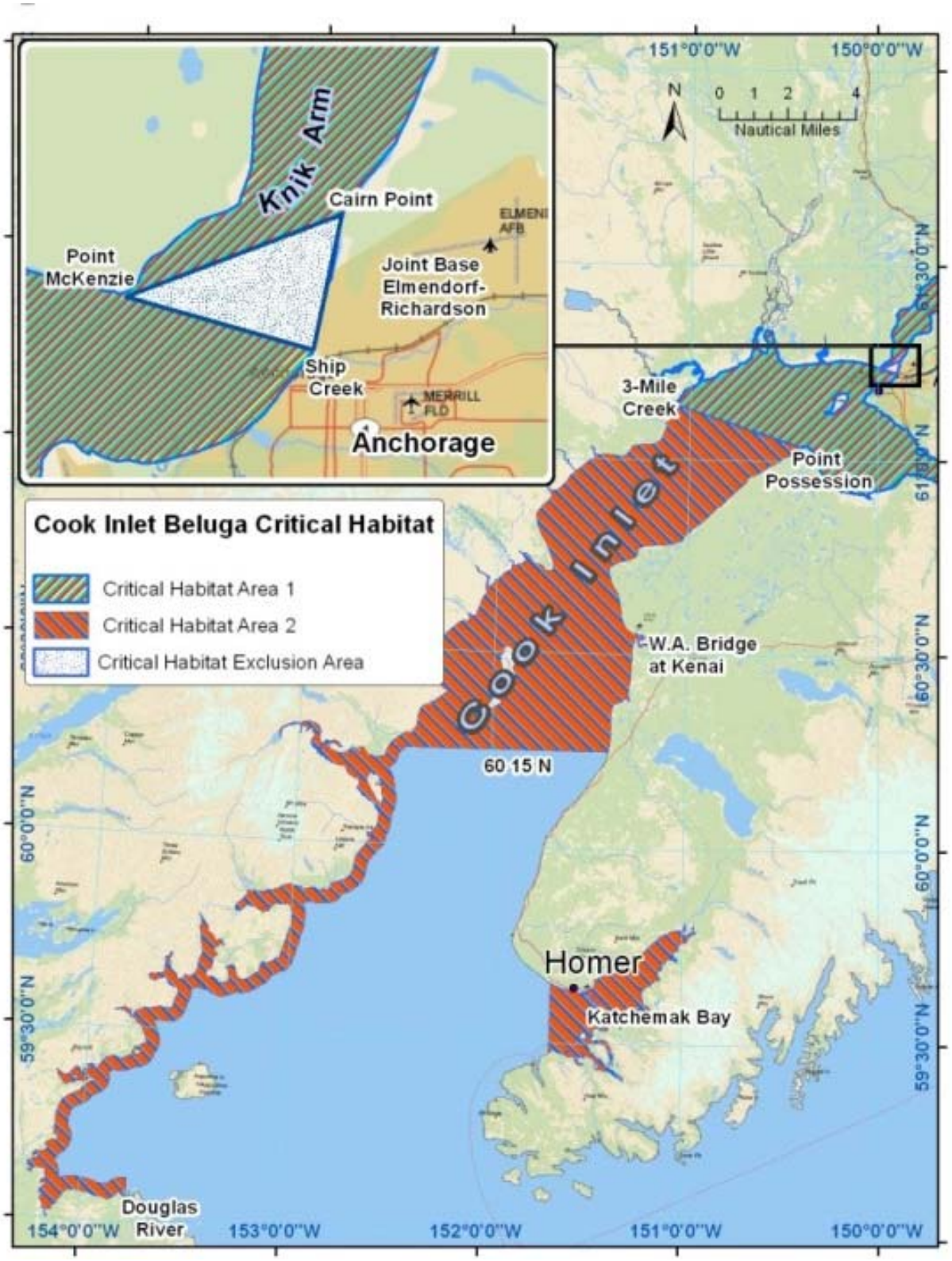


Figure 3. Critical habitat for the Cook Inlet beluga whale.

The Steller sea lion was listed as a threatened species under the ESA on November 26, 1990 (55 FR 49204). In 1997, NMFS reclassified Steller sea lions as two DPSs based on genetic studies and other information (62 FR 24345). At that time, the eastern DPS was listed as threatened, and the western DPS was listed as endangered. On November 4, 2013, the eastern DPS was removed from the endangered species list (78 FR 66139). Information on Steller sea lion biology, threats, and habitat (including critical habitat) is available online at: http://alaskafisheries.noaa.gov/protectedresources/stellers/default.htm and in the revised Steller Sea Lion Recovery Plan (NMFS 2008), which can be accessed at: http://alaskafisheries.noaa.gov/protectedresources/stellers/recovery/sslrpfinalrev030408.pdf .

The 2013 Stock Assessment Report for the western DPS of Steller sea lions indicates an abundance estimate of 79,300 individuals in this stock, a figure derived from surveys of Russia and the U.S. combined (Allen and Angliss 2014). The minimum population estimate for the U.S. portion of this stock (from the aggregate total of 2008-2012 counts) is 45,659 adults and pups (Allen and Angliss 2014). The population trend of western DPS Steller sea lions from 2000-2012 varies regionally, from -7.23 percent per year in the Western Aleutians to 4.51 percent per year in the eastern Gulf of Alaska. Overall, the western DPS Steller sea lion population was estimated to be increasing at about 1.67 percent per year from 2000-2012 (Allen and Angliss 2014).

3.2.2. Range

The range of the Steller sea lion extends across the rim of the North Pacific Ocean, from northern Japan, the Kuril Islands and the Okhotsk Sea, through the Aleutian Islands and Bering Sea, along Alaska's southern coast, and as far south as the California Channel Islands (NMFS 2008c). The eastern DPS includes sea lions born on rookeries from California north through Southeast Alaska; the western DPS includes those animals born on rookeries from Prince William Sound westward, with an eastern boundary set at 144°W (Figure 4).

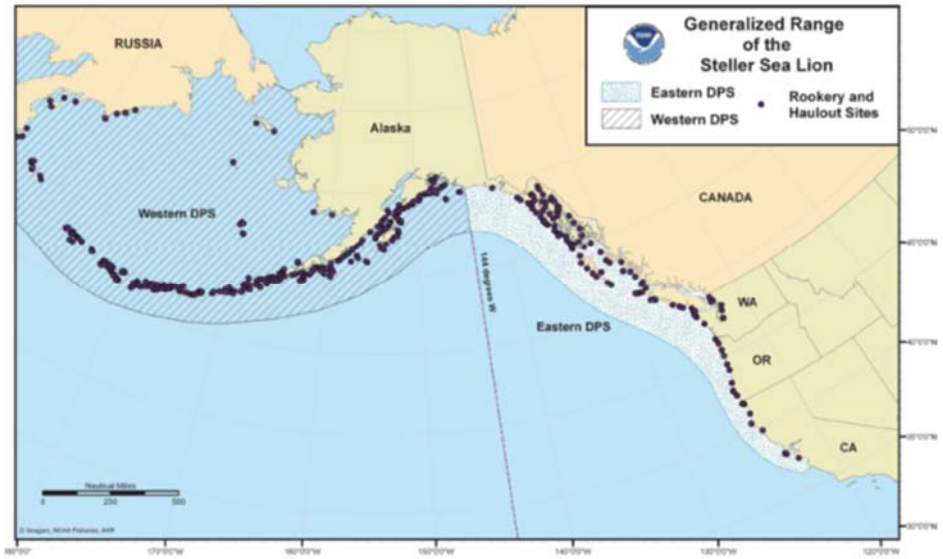
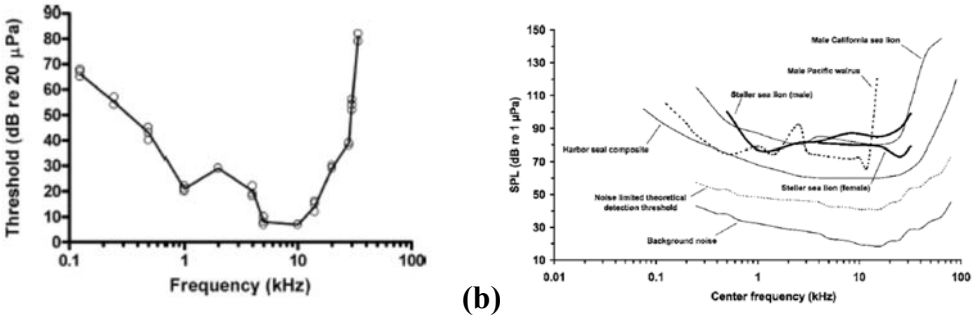


Figure 4. Range of the Steller sea lion.

In appendices to their surveys of Cook Inlet belugas, Rugh *et al.* (2005) and Shelden *et al.* (2013) noted counts of Steller sea lions in lower Cook Inlet, with concentrations on Elizabeth Island, Shaw Island, Akumwarvik Bay and Iniskin to Chinitna Bays. The closest of these locations to the project action area is over 110 miles to the south. Steller sea lion haulouts do not occur in upper Cook Inlet, and Steller sea lions are rarely observed in the action area vicinity. Although opportunistic sightings reported to NMFS have sporadically documented single Steller sea lions in Knik or Turnagain Arms, these are likely the occasional individual animal wandering into Cook Inlet river mouths during summer periods to seek seasonal runs of salmon or eulachon.

3.2.3. Hearing Ability

In-air and underwater hearing of Steller sea lions is similar to that of other otariids, ranging from hundreds of Hz to less than 100 kHz. (Muslow and Reichmuth 2010, Kastelein *et al.* 2005, Reichmuth and Southall 2011) (Figure 5).



(a) **(b)**

Figure 5. Underwater and aerial audiograms for Steller sea lions: (a) Muslow and Reichmuth (2010) for juvenile, aerial; (b) Kastelein *et al*. 2005 for adult male and female, underwater [audiograms of harbor seal, California sea lion and walrus for comparison].

3.2.4. Steller Sea Lion Critical Habitat

Steller sea lion critical habitat (Figure 6) includes a 20 nautical mile buffer around all major haulouts and rookeries, as well as associated terrestrial, air and aquatic zones, and three large offshore foraging areas. The proposed project is located well outside Steller sea lion critical habitat, and there are no recognized haul-outs or rookeries in the action area. Steller sea lions are rarely observed in the action area, with sightings reported to NMFS on the order of a few individuals per year.

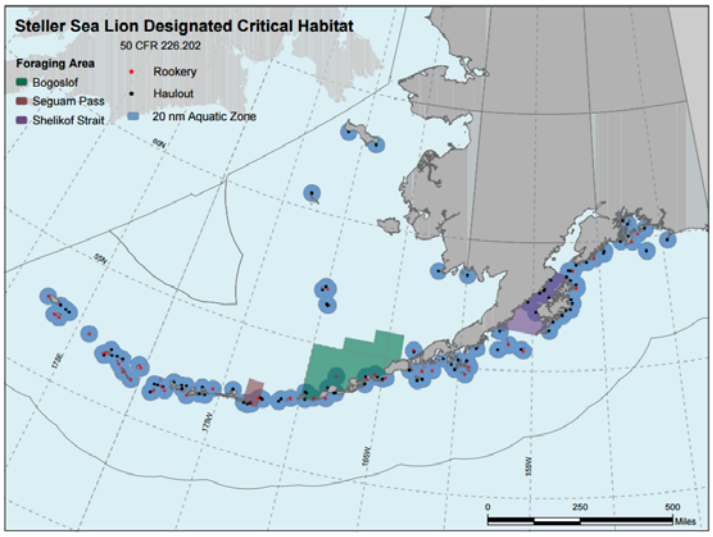


Figure 6. Designated critical habitat for Steller Sea Lions in southcentral and western Alaska.

3.3. Humpback Whales

This globally-distributed whale typically occurs only in the lower reaches of Cook Inlet, but NMFS is aware of one instance of occurrence in Cook Inlet as far north as Turnagain Arm. As with belugas, we focus in this opinion on aspects of humpback whale ecology that are relevant to the effects of this project.

3.3.1. Description and Status

Humpbacks are classified in the cetacean suborder Mysticeti, whales characterized by having baleen plates for filtering food from water, rather than teeth like the toothed whales (Odontoceti). The humpback whale is one of the larger baleen whales, weighing up to 25-40 tons (50,000-80,000 pounds; 22,000-36,000 kg) and up to 60 feet (18 m) in length, with females larger than males. Newborns are about 15 feet (4.5 m) long and weigh about 1 ton (2,000 pounds; 900 kg).

Humpback whales are sexually mature at 4-7 years, and their lifespan is probably around 50 years or more. Humpbacks are well known for their long pectoral fins, which can be up to 15 feet (4.6 m) long. The body coloration is primarily dark grey, but individuals have a variable amount of white on their pectoral fins and belly. This variation is so distinctive that the pigmentation pattern on the undersides of their flukes is used to identify individual whales, similar to a human fingerprint. Humpbacks filter feed on tiny crustaceans (mostly krill), plankton, and small fish; they can consume up to 3,000 pounds (1,360 kg) of food per day. Several hunting methods involve using air bubbles to herd, corral, or disorient fish. Information on humpback whale biology and habitat is available at:
http://www.fisheries.noaa.gov/pr/species/mammals/whales/humpback-whale.html and
http://www.nmfs.noaa.gov/pr/sars/2013/ak2013_humpback-wnp.pdf

The humpback whale is distributed worldwide in all ocean basins and is listed as endangered under the ESA. The worldwide population is at least 80,000 humpback whales; the best estimate for humpback whale abundance (excluding calves) for all feeding and wintering areas in the entire North Pacific is 21,808 animals (Barlow *et al.* 2011). In the North Pacific Ocean, there are at least three relatively separate populations: the eastern, central, and western North Pacific stocks (Allen and Angliss 2014). Although there is considerable distributional overlap in the humpback whale stocks that use Alaska, the whales seasonally found in lower Cook Inlet are most likely of the central North Pacific stock, the largest of the three stocks comprising the North Pacific population, and the one that winters in Hawaii. The abundance estimate for the central North Pacific stock is 7,469 individuals. Of these, 2,845 are included in the Gulf of Alaska feeding area which includes lower Cook Inlet (Allen and Angliss 2014). Surveys of North Pacific humpback whales from the 1980s to early 2000s estimated population growth rates of 6.8 to 10% per year (Mobley *et al.* 2001; Mizroch *et al.* 2004; Zerbini *et al.* 2010).

NMFS recently conducted a global status review and proposed changing the status of humpback whales under the ESA. We propose to divide the globally listed endangered species into 14 distinct population segments (DPSs), remove the current species-level listing, and in its place list 2 DPSs as endangered and 2 DPSs as threatened. The Hawaii DPS, which feeds in Alaskan waters, including Cook Inlet, is proposed for removal from listing (80 FR 22304; April 21, 2015). Final action on that proposal will not be taken until after the G&G surveys would occur.

3.3.2. Distribution in Project Vicinity

In recent years, humpback whales have been regularly observed in lower and mid Cook Inlet, especially in the vicinity of Elizabeth Island, Iniskin and Kachemak Bays and north of Anchor Point (Shelden *et al*. 2013**Error! Reference source not found.**). Of a total 83 humpback whales observed by NMFS during Cook Inlet beluga aerial surveys conducted from 1993-2012, only 5 were observed as far north as the Anchor Point area (Shelden *et al.*2013), which is over 100 miles south of the proposed G&G survey area.

Marine mammal observers during the 2013 marine mammal monitoring program at Cosmopolitan State well site #A-1, more than 60 miles south of the proposed project area, reported 29 sightings of 48 humpback whales, although most of these animals were observed at a distance well south of the well site and none was recorded inside an active harassment zone (Owl Ridge 2014). Similarly, Shelden *et al.* (2015) observed 4 humpbacks, all in lower Cook Inlet (well south of the project area) during 2014 beluga surveys. Although there were opportunistic sightings of a single humpback (or mother-calf pair) in the project vicinity in 2014, this observation is considered an anomaly.

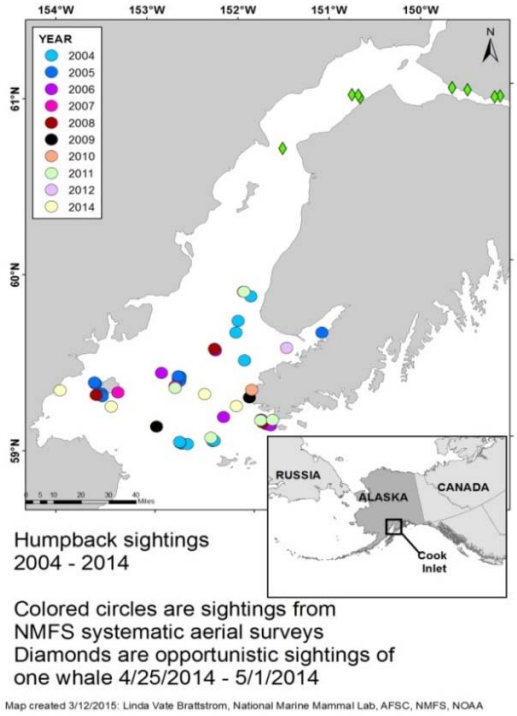


Figure 7. Humpback whale observations, as documented in Cook Inlet, 1994-2014. Green diamonds indicate opportunistic (and anomalous) sightings of a single whale, or possibly of an adult whale and calf, during April 25-May 1, 2014.

3.3.3. Hearing ability

Because of the lack of captive subjects and logistical challenges of bringing experimental subjects into the laboratory, no direct measurements of mysticete hearing are available. Consequently, hearing in mysticetes is estimated based on other means such as vocalizations (Wartzok and Ketten, 1999), anatomy (Houser *et al*., 2001; Ketten 1997), behavioral responses to sound (Edds-Walton 1997), and nominal natural background noise conditions in their likely frequency ranges of hearing (Clark and Ellison, 2004). The combined information from these and other sources strongly suggests that mysticetes are likely most sensitive to sound from perhaps tens of hertz to ~10 kHz. However, evidence suggests that humpbacks can hear sounds as low as 7 Hz (Southall *et al*. (2007) up to 24 kHz, and possibly as high as 30 kHz (Au *et al.*, 2006; Ketten 1997). Because of their size, no audiogram has been produced for humpback whales. However, Helweg *et al*. (2000) and Houser *et al*. (2001) modeled a predicted audiogram based on the relative length of the basilar membrane (within the inner ear) of a humpback whale, integrated with known data on cats and humans. The result (Figure 8) shows sensitivity to frequencies from about 700 Hz to 10 kHz, with maximum relative sensitivity between 2-7 kHz.

Because ambient noise levels are higher at low frequencies than at mid frequencies, the absolute sound levels that humpback whales can detect below 1 kHz are probably limited by increasing levels of natural ambient noise at decreasing frequencies (Clark and Ellison 2004).

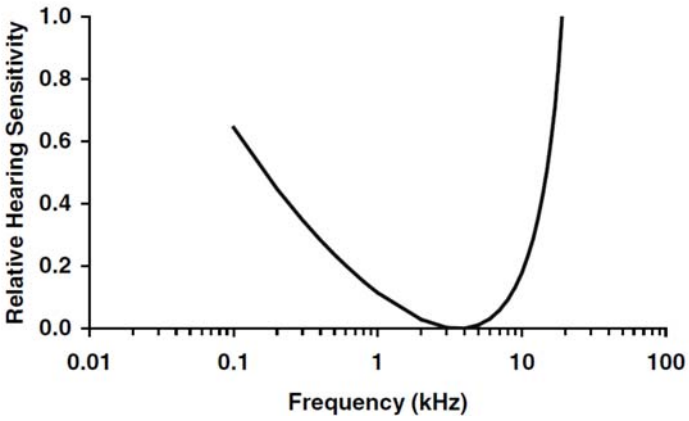


Figure 8. Predicted audiogram of humpback whale, derived by integrating the humpback frequency-position function with the sensitivity-position function derived from cat and human audiometric and anatomic data (see Houser *et al*. 2001).

4.0. ENVIRONMENTAL BASELINE

The environmental baseline for biological opinions includes the past and present impacts of all state, federal, or private actions and other human activities in the action area, the anticipated impacts from all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR §402.02). The environmental baseline for this opinion includes a review of activities that affect the survival and recovery of threatened and endangered species and designated critical habitat in the action area.

This section focuses primarily on existing ongoing activities that may affect Cook Inlet beluga whales or their critical habitat. Although some of the activities discussed below are outside the action area, they may still have an influence on the beluga whales or their habitat in the action area.

Cook Inlet beluga whales may be impacted by a number of anthropogenic activities present in upper and mid-Cook Inlet. Over 61 percent of Alaska's human population (735,601) resides within southcentral Alaska or the Cook Inlet region. The Alaska Department of Labor and Workforce Development 2014 population estimate for the Municipality of Anchorage was 300,9549, for the Matanuska-Susitna Borough was 98,063 and for Kenai Peninsula Borough, 57,212 (ADOLWD 2015). The high degree of human activity, especially within upper Cook Inlet, has produced a number of anthropogenic risk factors that marine mammals must contend with, including: coastal and marine development, ship strikes, noise pollution, water pollution, prey reduction, direct mortalities, and research, in addition to factors operating on a larger scale such as predation, disease, and environmental change. The species may be affected by multiple

threats at any given time, compounding the impacts of the individual threats (NMFS 1991; 2008b, 2015b). Anthropogenic risk factors are discussed individually below.

4.1. Coastal Development

Beluga whales and Steller sea lions in particular use nearshore environments to rest, feed, and breed and thus could be affected by any coastal development that impacts these activities. Coastline development can lead to both direct loss habitat loss from construction of roads, housing or other shoreline developments, or indirect loss associated with bridges, boat traffic, in-water noise, and discharges that affect water quality. For the most part, the Cook Inlet shoreline is undeveloped, but there are a number of port facilities, airports, housing developments, wastewater treatment plants, roads, and railroads that occur along or close to the shoreline. Knik Arm supports the largest port and military base in the state, and there are numerous offshore oil and gas platforms ranging between the Forelands to just north of Tyonek (Figure 9). Construction noise in Cook Inlet is associated with activities such as dredging and pile driving.

4.1.1. Port Facilities

Port facilities in Cook Inlet are found at Anchorage, Point Mackenzie, Nikiski, Kenai, Homer, Seldovia, and Port Graham; barge landings are present at Tyonek, Drift River, and Anchor Point.

The Port of Anchorage (POA) is Alaska's largest seaport and provides 90 percent of the consumer goods for about 85 percent of all of Alaska. It includes three cargo terminals, two petroleum terminals, one dry barge berth, two railway spurs, and a small craft floating dock, plus 220 acres of land facility. About 450 ships or tug/barges call at the POA each year. Operations began at the POA in 1961 with a single berth. Since then, the POA has expanded to a terminal with five berths that moves more than four million tons of material across its docks each year (POA 2009).

Port construction and maintenance activities are a source of noise that can harass and potentially harm marine mammals. For example, during the POA sheet pile driving activities between 2009 and 2011, 40 beluga whales were observed within the designated 160 dB disturbance zones, ranging from a high of 23 in 2009 to a low of 4 in 2011. A single Steller sea lion was sighted at the facility in 2009, and take of this animal was reportedly avoided by shutting down the pile driving activity. Maintenance dredging at the port began in 1965, and is an ongoing activity from May through November in most years, affecting about 100 acres of substrate per year. Dredging at the POA does not seem to be a source of re-suspended contaminants (USACE 2005, 2008).

Port MacKenzie is along western lower Knik Arm and development began in 2000 with the construction of a barge dock. Additional construction has occurred since then and Port MacKenzie currently consists of a 152 m (500 ft.) bulkhead barge dock, a 366 m (1,200 ft.) deep draft dock with a conveyor system, a landing ramp, and more than 8,000 acres of adjacent uplands. Current operations at Port MacKenzie include dry bulk cargo movement and storage.

The Drift River facility in Redoubt Bay is used primarily as a loading platform for shipments of crude oil. The docking facility there is connected to a shore-side tank farm and designed to accommodate tankers in the 150,000 deadweight-ton class. In 2009, a volcanic eruption forced the evacuation of the terminal and an eventual draw-down of oil storage. Hilcorp Alaska bought the facility in 2012 and after numerous improvements partially reopened the facility to oil storage and tanker loading operations.

Nikiski is home to several privately owned docks. Activity at Nikiski includes the shipping and receiving of anhydrous ammonia, dry bulk urea, liquefied natural gas, sulfuric acid, petroleum products, caustic soda, and crude oil. In 2014, the Arctic Slope Regional Corporation expanded and updated its dock in Nikiski, referred to as the Rig Tenders Dock, in anticipation of increased oil and gas activity in Cook Inlet and to serve activities in the Chukchi and Beaufort seas.

Ladd Landing beach, located on the Western Cook Inlet near Tyonek, serves as public access to the Three Mile Subdivision, and as a staging area for various commercial fishing sites in the area.

4.2. Oil and Gas Development

Oil and gas development in Cook Inlet provides natural gas to the State's largest population centers. Platforms, pipelines, and tankers represent potential sources of spills. Lease sales for oil and gas development in Cook Inlet began in 1959 (ADNR 2014). Prior to the lease sales, there were attempts at oil exploration along the west side of Cook Inlet. By the late 1960s, 14 offshore oil production facilities were installed in upper Cook Inlet; therefore most Cook Inlet platforms and much of the associated infrastructure is more than 40 years old.

Today, there are 16 platforms in Cook Inlet (ADNR 2015), 12 of which are actively producing oil and gas; four are experiencing varying degrees of inactivity (Figure 9). ADNR (2015) reports 401 active oil and gas leases in Cook Inlet that total approximately 1,126,813 acres of State leased land, (419,454 acres onshore and 707,359 acres offshore). There are no platforms in the lower Inlet.

4.3. Ambient Noise and Noise Pollution

Underwater sound levels in Cook Inlet arise from many sources, including physical noise, biological noise, and human-caused noise. Physical noise includes wind, waves at the surface, currents, earthquakes, ice movement, and atmospheric noise (Richardson et al. 1995). Biological noise includes sounds produced by marine mammals, fish, and invertebrates. Human-caused noise consists of vessel motor sounds, oil and gas operations, maintenance dredging, aircraft overflights, and construction noise. Ambient sound varies within Cook Inlet. In general, ambient and background noise levels within the action area are assumed to be less than 120 dB whenever conditions are calm, and exceeding 120 dB during storm events and passage of large vessels (Blackwell and Greene 2003; Illingworth and Rodkin 2014).

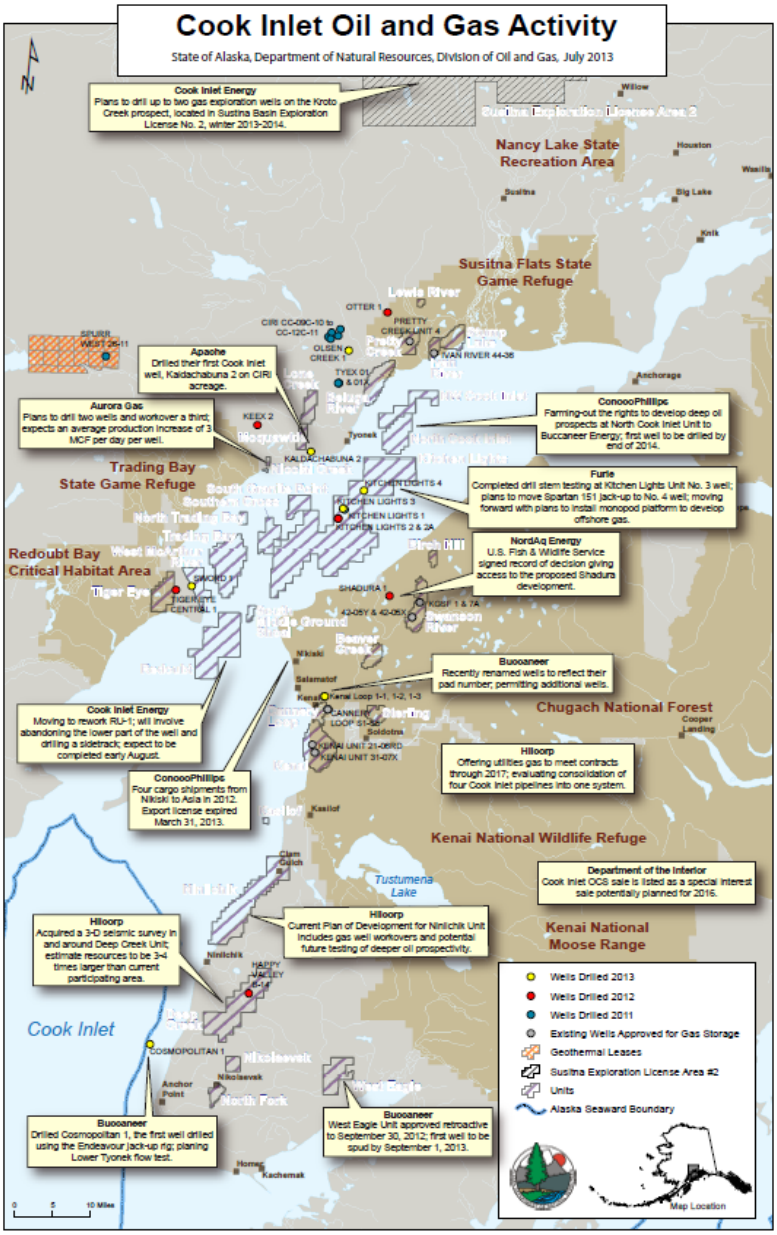


Figure 9. Oil and gas operations in the Cook Inlet Source: http://dog.dnr.alaska.gov/GIS/Data/ActivityMaps/CookInlet/CI_OilandGasActivity_20130724.pdf

4.3.1. Seismic Activity Noise in Cook Inlet

Seismic surveys use high energy, low frequency sound in short pulse durations to characterize subsurface geology (Richardson *et al*. 1995). Geophysical seismic activity has been described as one of the loudest human-made underwater noise sources, with the potential to harass or harm marine mammals, including beluga whales.

Cook Inlet has a long history of oil and gas activities including seismic exploration, G&G surveys, exploratory drilling, increased vessel and air traffic, and platform production

operation. A seismic program occurred near Anchor Point in the fall of 2005. Geophysical seismic operations were conducted in Cook Inlet during 2007, near Tyonek, East and West Forelands, Anchor Point, and Clam Gulch. Additional small seismic surveys were again conducted in Cook Inlet during 2012. ADNR (2015) notes that since December 31, 2013 approximately 3,367 km^2 (1,300 mi^2) of 3D and 40,000 km (25,000 mi) of 2D seismic line surveys have been conducted in Cook Inlet.

Airguns have been previously and are presently being used in Cook Inlet for seismic exploration. In the past, large airgun arrays of greater than 3,000 in^3 have been used, which produce source noise levels exceeding 240 dB re 1 µPa (rms). However, smaller arrays (440-2,400 in^3) are now being used in Cook Inlet both because of the generally shallow water environment and the increased use of ocean-bottom cable and ocean-bottom node technology.

Recent seismic surveys have used maximum airgun arrays of 1,760 and 2,400 in^3 with source levels of about 237 dB re 1 µPa (rms). Shallow water surveys have involved 440, 620, and 880 in^3 arrays with source sound pressure levels less than 230 dB re 1 µPa (rms). Measured radii to isopleths for MMPA Level A harm (190 dB for cetaceans and 180 dB for pinnipeds) from these guns have ranged from 50 m (164 ft) to nearly 2 km (1.2 mi), while Level B (160 dB) radii have ranged from 3 to 7 km (1.8-4.3 mi).

During over 1,800 hours of seismic activity in 2012, Apache Alaska Corporation (Apache) reported zero takes of either beluga whales or Steller sea lions; although some protected marine mammals were observed within zones ensonified to greater than 120 and 160 dB prior to powering down or shutting down of equipment. The company experienced five delays resulting from clearing the 160 dB disturbance zone, six shutdowns, one power-down, one shutdown followed by a power-down, and one speed and course alteration (Lomac-MacNair *et al.* 2013). In 2014 however, despite implementing a total of 13 shut-downs and 7 ramp up delays for marine mammals, observers recorded a total of 29 takes (12 beluga whales, 6 harbor porpoise, 9 harbor seals, and 2 humpback whales) from noise exposures (25 at ≥160 dB (rms) and 4 at ≥180 dB (rms) (Lomac-MacNair *et al.* 2013). SAE Exploration is conducting up to 777 km^2 (300 mi^2) of 3D seismic survey in Cook Inlet in 2015 for one or more clients.

4.3.2. Oil and Gas Exploration and Production Noise

Blackwell and Greene (2003) recorded underwater noise produced at Phillips A oil platform at distances ranging from 0.3-19 km (0.2-12 mi) from the source. The highest recorded sound level was 119 dB at a distance of 1.2 km (0.75 mi). These were operating noises from the oil platform, not drilling noise, with frequencies generally below 10 kHz. While much sound energy in this noise fell below the hearing thresholds for beluga whales, some noises between 2-10 kHz were measured as high as 85 dB as far away as 19 km (12 mi) from the source. These frequencies are audible to beluga whales, but do not fall within the whale's most sensitive hearing range. Jack-up drilling rigs with the drilling platform and generators located above the sea surface and with lattice legs with very little surface contact with the water are relatively quiet as compared to drill ships or semi-submersible drill rigs (Richardson *et al.* 1995).

4.3.3. Vessel Traffic Noise

Vessel traffic includes large shipping, commercial and support vessels, commercial fishing vessels, and personal water craft. Vessel and air traffic are required for support during oil and gas development. Oil produced on the western side of Cook Inlet is transported by tankers to the refineries on the east side. Refined petroleum products are then shipped elsewhere. Liquid natural gas is also transported via tankers once it is processed (ADNR 2015). Blackwell and Greene (2003) recorded underwater noise produced by both large and small vessels near the POA. The tugboat *Leo* produced the highest broadband levels of 149 dB re: 1 µPa at a distance of approximately 100 m (328 ft), while the docked *Northern Lights* (cargo freight ship) produced the lowest broadband levels of 126 dB re: 1 µPa at 100 to 400 m (328-1,312 ft). Continuous noise from ships generally exceeds 120 dB re 1 µPa (rms) to distances between 500 and 2,000 m (1,640 and 6,562 ft), although noise effects are short term as the vessels are continuously moving.

Blackwell and Greene (2003) observed that beluga whales "did not seem bothered" when travelling slowly within a few meters of the hull and stern of the moored cargo-freight ship *Northern Lights* in the Anchorage harbor area. They speculated that in areas where belugas are subjected to a lot of boat traffic, they may habituate and become tolerant of the vessels. Ship noise is generally below 2 kHz (Blackwell and Greene (2003), below the most sensitive hearing range of beluga whales.

4.3.4. Aircraft Noise

Cook Inlet experiences significant levels of aircraft traffic. The Anchorage International Airport is directly adjacent to lower Knik Arm and has high volumes of commercial and cargo air traffic. Joint Base Elmendorf Richardson also has a runway near and airspace directly over Knik Arm. Lake Hood and Spenard Lake in Anchorage are heavily used by seaplanes. Other small public runways are found at Birchwood, Goose Bay, Merrill Field, Girdwood, the Kenai Municipal Airport, Ninilchik, Homer, and Seldovia. Drilling projects often involve helicopters and fixed-winged aircraft, and aircraft are used for surveys of natural resources including Cook Inlet beluga whales. Airborne sounds do not transfer well to water because much of the sound is attenuated at the surface or is reflected where angles of incidence are greater than 13°; however, loud aircraft noise can be heard underwater when aircraft are directly overhead and surface conditions are calm (Richardson *et al*. 1995).

Richardson (1995) observed that beluga whales in the Beaufort Sea will dive or swim away when low-flying (500 m (1640 ft)) aircraft passed directly above them. However, during the Cook Inlet beluga whale surveys, aircraft flying at approximately 244 m (800 ft.) observed little or no change in swimming direction (Rugh *et al.* 2000). This is probably because beluga whales in Cook Inlet have habituated to routine small aircraft overflights. Beluga whales may be less sensitive to aircraft noise than vessel noise, but individual responses may be variable, and depend on previous experiences, beluga activity at the time of the noise, and noise characteristics.

4.3.5. Construction and Dredging Noise

Construction noise in Cook Inlet is associated with activities such as dredging and pile driving. Like large port facilities, small and/or private docks may also use pile driving as a part of their expansions or repairs, but no planned activities have been identified for 2015. Dredging is conducted on an annual basis at POA, but occurs near Anchorage, outside of the action area. Impacts to listed marine mammals can occur from underwater noise associated with underwater pipeline construction, including noise from the use of pipe laying barges, tugs, and support vessels.

4.4. Underwater Installations

Currently in Cook Inlet there are approximately 365 km (227 mi) of undersea pipelines, including 125 km (78 mi) of oil pipelines and 240 km (149 mi) of gas pipelines (ADNR 2015). In 2014, the Trans-Foreland Pipeline Co. LLC (owned by Tesoro Alaska) received approval from state, federal, and regional agencies to build the Trans-Foreland Pipeline, a 46.7-km (29-mi) long, 20.3-cm (8-in) diameter oil pipeline from the west side of Cook Inlet to the Tesoro refinery at Nikiski and the Nikiski-Kenai Pipeline company tank farm on the east side of Cook Inlet. The pipeline will be used by multiple oil producers in western Cook Inlet, to replace oil transport by tanker from the Drift River Tank farm. Horizontal directional drilling (HDD) will be used at nearshore locations at the East and West Forelands to install the pipeline.

4.5. Water Quality and Water Pollution

The draft Recovery Plan for the Beluga Whale (NMFS 2015b) states that exposure to industrial chemicals as well as to natural substances released into the marine environment is a potential health threat for CI belugas and their prey. An in-depth review of available information on pollution and contaminants in Cook Inlet is presented in the supplement section IX.F of the draft recovery plan (NMFS 2015b).

Main sources of pollutants found in Cook Inlet likely include the 10 wastewater treatment facilities, stormwater runoff, airport de-icing, and discharge from oil and gas development (Moore *et al*. 2000). Ballast water discharge from ships is another source of potential pollution as well as potential release of non-indigenous organisms into Cook Inlet. Information and statistics ballast water management in Cook Inlet can be found at: http://reports.nukaresearch.com/Reports/Cook-Inlet-ballast-water/Draft%201/regulations/ Given the amount of oil and gas production and vessel traffic, spills of petroleum products are a source of concern for marine mammals inhabiting Cook Inlet. Research has shown that while cetaceans are capable of detecting oil, they do not seem to avoid it (Geraci 1990). Oil has been implicated in the deaths of pinnipeds (St. Aubin 1990).

According to the ADEC oil spills database, oil spills to marine waters consist mostly of harbor and vessel spills, and spills from platform and processing facilities. A reported 477,942 L (126,259 gal) (from 79 spills) of oil was discharged in the Cook Inlet area since July 1, 2013, primarily from vessels and harbor activities and from exploration and production facilities. Three of the ten largest spills in Alaska during state fiscal year 2014 occurred in Cook Inlet; these included 84,000 gallons of produced water by Hillcorp, Kenai gas field, 9100 gallons of process water released by the Tesoro API Tank Bypass

Spill, and a Flint Hills, Anchorage spill of 4,273 gallons of gasoline (ADEC 2014).

Related effects to the marine mammals associated with these events could include death or injury from swimming through oil (skin contact, ingestion of oil, respiratory distress from hydrocarbon vapors), contamination of food sources, or displacement from foraging areas.

4.6. Fisheries

Fishing is a major industry in Alaska. Several fisheries occur in Cook Inlet waters and have varying likelihoods of competing with beluga whales for fish due to gear type, species fished, timing, and fisheries location. Commercial, personal use and subsistence fisheries all occur within Cook Inlet.

Potential impacts to the beluga whale from personal use, recreational, and subsistence fishing include operating small watercrafts in the river mouths and shallow waters; these could lead to displacement from important habitat, harassment, prey competition, and ship strikes. In the spring of 2012, a young beluga whale was found dead in an educational subsistence fishing net. While histopathology analysis determined the animal likely drowned, other health issues were documented that may have been a contributing factor (NMFS unpublished data). Other than this recent interaction, NMFS is unaware of any beluga whale mortalities in Cook Inlet due to personal use, recreational, or subsistence fisheries. In general, the overall impacts from personal use, recreational and subsistence fishing on the Cook Inlet beluga population is considered low (NMFS 2015b).

Potential impacts from commercial fishing on Cook Inlet beluga whales include harassment, gear entanglement, ship strikes, reduction in prey, and displacement from important habitat. The likelihood of a lethal incidental take of a beluga whale from commercial fishing is low; however, the likelihood of prey reduction from fisheries and/or other sources substantially impacting the recovery of the Cook Inlet beluga whale population is high (NMFS 2015b). There is strong indication that these whales are dependent on access to relatively dense concentrations of high value prey species throughout the summer months. A significant reduction in the amount of available prey may impact the energetics for Cook Inlet beluga whales and delay recovery.

4.7. Direct Mortality

Within the proposed action area there are several potential sources of direct mortality, including shooting, strandings, fishery/gear/debris interactions, vessel collisions, predation, and research activities.

4.7.1. Subsistence Harvest

The effect from past subsistence harvests on the Cook Inlet beluga whale population was significant. While a harvest occurred at unknown levels for decades or longer, the subsistence harvest levels increased substantially in the 1980s and 1990s. Reported subsistence harvests during 1994-1998 probably account for the stock's decline during that interval. In 1999, beluga whale subsistence harvest did not occur as a result of a

voluntary moratorium by the hunters that spring; and Public Law 106-553, which required hunting of Cook Inlet beluga whale for subsistence uses by Alaska Natives be conducted pursuant to a cooperative agreement between NMFS and affected Alaska Native organizations. During 2000-2005, only five Cook Inlet beluga whales were harvested for subsistence purposes.

4.7.2. Poaching and Illegal Harassment

Due to their distribution within the most densely populated region in Alaska and their approachable nature, the potential for poaching beluga whales in Cook Inlet exists. Although NMFS maintains an enforcement presence in upper Cook Inlet, effective enforcement across such a large area is difficult. No poaching incidents have been confirmed to date, although NMFS Enforcement has investigated several reported incidences of Cook Inlet beluga whale harassment.

4.7.3. Stranding

Live stranding occurs when a marine mammal is found in waters too shallow to swim. Cook Inlet beluga whales are probably predisposed to stranding because they breed, feed, and molt in the shallow waters of upper Cook Inlet where extreme tidal fluctuations occur, especially in Turnagain Arm. Strandings can be intentional (e.g., to avoid killer whale predation), accidental (e.g., chasing prey into shallows then trapped by receding tide), or a result of illness or injury (NMFS 2015b). More than 800 whales stranded (alive and dead) in Cook Inlet since 1988 (NMFS unpublished data). During the past 15 years (1999-2014), 319-331 beluga whales were reported to have stranded alive in upper Cook Inlet. Stranding events that last more than a few hours may result in significant mortalities. During the past 10 years (2004-2014), reports of dead stranded beluga whales averaged 10 whales per year. Beluga whale stranding events may represent a significant threat to the conservation and recovery of this stock.

4.7.4. Predation

Killer whales are the only natural predators for beluga whales in Cook Inlet (Allen and Angliss 2014). Beluga whale stranding events have also been correlated with killer whale presence, and Native hunters report that beluga whales intentionally strand themselves in order to escape killer whale predation (Huntington 2000). Prior to 2000, an average of one Cook Inlet beluga whale was killed annually by killer whales, with 18 reported killer whale sightings in upper Cook Inlet during 1985-2002 (Shelden *et al*. 2003). During 2001-2012 only three Cook Inlet beluga whales were reported as preyed upon by killer whales (NMFS unpublished data). This is likely an underestimate, however, as preyed-upon belugas may well sink and go undetected. Killer whale predation has been reported to have a potentially significant impact on the Cook Inlet beluga whale population (Shelden *et al*. 2003).

4.7.5. Ship Strikes

Cook Inlet beluga whales may be susceptible to ship strike mortality. To date, however, only one whale death, in October 2007, has been attributed to a potential ship strike based on blunt force injuries (NMFS unpublished data). Beluga whales may also be more susceptible to strikes from commercial and recreational fishing vessels since both belugas

and fishing activities occur where salmon congregate. A number of beluga whales have been photographed with propeller scars (Maguire and Stephens 2014), suggesting that small vessel ship strike is not rare, but such strikes are often survivable. Small boats and jet skis, which are becoming more abundant in Cook Inlet, are able to quickly approach and disturb these whales in their preferred shallow coastal habitat.

4.7.6. Research

Research is a necessary endeavor to assist in the recovery of the Cook Inlet beluga population; however, research activities can also disturb these whales, especially when these activities include animal capture, drawing blood and tissue samples, or attaching tracking devices such as satellite tags. In the worst case, research can result in deaths of the animals. Shortly after a tagging event in 2002, a beluga whale was found dead; its tag had transmitted for only 32 hours. Another two beluga whales transmitted data for less than 48 hours, with similar dive patterns; it was assumed they too had died (NMFS, unpublished data). In 2015, an additional animal previously tagged by researchers washed up dead, with infection at the site of instrument attachment implicated as the cause of death.

Beluga surveys require boats and/or planes, adding to the vessel traffic, noise, and pollution near the action area. Aerial surveys could also potentially disturb Cook Inlet beluga whales, especially where circling low-altitude flights are conducted to obtain accurate group counts. Boat based surveys, such as the photo-identification study, often require the boat to come within close proximity to a whale or whale group, likely increasing noise in the immediate area. Deployment and retrieval of passive acoustic monitoring devices requires a boat, which temporarily increases noise in the immediate area. However, once the instruments are deployed, this type of monitoring is noninvasive.

Although research may have an effect on beluga whales, it is anticipated that research will continue to increase because there are many remaining data gaps on Cook Inlet beluga whale biology and ecology (NMFS 2008a). However, managers are increasingly cautious in permitting only minimally invasive techniques.

4.8. Environmental Change

Overwhelming data indicate the planet is warming (IPCC 2014), which poses a threat to most Arctic and Subarctic marine mammals. Cook Inlet is a very dynamic environment which experiences continual change in its physical and structural composition; there are extreme tides, strong currents, and a tremendous volume of silt input from glacial scouring.

Beluga whales seasonally breed and feed in nearshore waters during the summer, but are ice-associated during the remaining part of the year. Ice floes can offer protection from predators and, in some regions, support prey, such as ice-associated cod. Moore and Huntington (2008) suggested that belugas and other ice-associated marine mammals might benefit from warmer climates as areas formerly covered ice would be available to forage. However, given the limited winter prey available in upper Cook Inlet (where ice predominates during winter), less winter ice might not benefit Cook Inlet beluga whales.

The bigger threat of climate change to belugas may not be the direct change in climate, but rather the affect regional warming would have on increased human activity. Less ice would mean increased vessel activity with an associated increase in noise, pollution, and risk of ship strike. Other factors include changing prey composition, increased killer whale predation due to lack of ice refuge, increased susceptibility to ice entrapment due to less predictable ice conditions, and increased competition with co-predators. Specific to Cook Inlet beluga whales, the greatest climate change risks would be where it might change salmon and eulachon abundance, and any increase in winter susceptibility to killer whale predation. Also, more rapid melting of glaciers might significantly alter the silt deposition in the Susitna Delta, potentially altering habitat for prey (NMFS 2008b). However, the magnitude of these potential effects is unpredictable, and the isolation of beluga whales within Cook Inlet since the last ice age suggests a strong resilience to environmental changes.

5.0. EFFECTS OF THE ACTION

Effects of a proposed action are defined in the ESA at 50 CFR 402.02 as: "…the direct and indirect effects of an action on the species or habitat together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline." The types of effects to be analyzed include:

- Direct Effects – Those immediate effects caused by the proposed action and occurring concurrently with the proposed action;
- Indirect Effects – Those effects that are caused by the proposed action and are later in time but still are reasonably certain to occur;
- Cumulative Effects – As defined in the ESA, cumulative effects are future state, tribal, local, or private activities, not involving federal activities, which are reasonably certain to occur within the action area of the proposed action;
- Interrelated Actions – Those actions that are a part of a larger action and depend on the larger action for justification; and
- Interdependent Actions – Those actions that have no independent utility apart from the action under consideration.

The proposed 2015 G&G activities are interrelated with future development of the proposed LNG plant, marine terminal and pipeline; however, any such future developments will be evaluated individually under the ESA and MMPA and therefore are not a part of this action. No interdependent actions have been identified.

The applicable standard to find that a proposed action is "not likely to adversely affect" listed species or critical habitat is that all of the effects of the action are expected to be insignificant, discountable, or completely beneficial. Insignificant effects relate to the size of the impact and are those that one would not be able to meaningfully measure, detect, or evaluate, and should never reach the scale where take occurs. Discountable effects are those that are extremely unlikely to occur. Beneficial effects are contemporaneous positive effects without any adverse effects to the species.

5.1. Direct Acoustic Effects of G&G Equipment

As mentioned in Section 4.3, background noise levels in much of the action area can remain below 120 dB during calm conditions and rise above 120 dB during storm events or passage of large vessels. Almost all the geophysical equipment and some of the geotechnical equipment produce underwater sound. However, the echo sounders and side scan sonar produce sound at frequencies well above the hearing range of listed marine mammals in the project vicinity, and the drill rig for the geotechnical borings and solenoid system for downhole geophysics analyses are not expected to produce sound above background levels. G&G equipment that is expected to produce underwater sound levels exceeding NMFS Level B harassment criteria and that operate within the hearing range of listed marine mammals in Cook Inlet, as shown in Table 1, include the chirp and boomer sub-bottom profilers, airgun, and vibracore. Potential effects of these instruments could include masking, behavioral responses, and hearing impairment. These potential effects are considered below.

5.1.1. Masking

The concept of acoustic interference is familiar to anyone who has tried to have a conversation in a noisy restaurant. In such situations, the collective noise from many sources can interfere with one's ability to understand, recognize, or even detect sounds of interest. Masking from chronic anthropogenic noise sources may disrupt marine mammal communication when industrial sound frequencies overlap communication frequencies used by marine mammals.

Beluga whales communicate with a variety of sounds, including 807 tonal calls (whistles) and 436 pulsed calls (click series). Their auditory bandwidth spans from about 0.04-150 kHz (Au 2000). For their social interactions, belugas emit communication calls with an average frequency range of about 0.2 to 7.0 kHz (Garland *et al.* 2015), and use echolocation signals (biosonar) with peak frequencies at 40-120 kHz (Au, 1993). Small airguns typically produce sound at frequencies less than 1 kHz (Richardson *et al.* 1995, Zykov and Carr 2012), while the sub-bottom profilers operate at frequencies of 2 to 16 kHz (chirp) and 0.5 to 6 kHz (boomer). The broadband noise of the vibracorer has been measured at between 0.01 and 20 kHz (Chorney *et al.* 2011). All of these devices overlap almost entirely with the communication frequency band of belugas and are almost entirely within their auditory range.

Both the chirper and boomer sub-bottom profilers are characterized as producing impulsive sounds[3] exceeding 160 dB re 1 µPa-m (rms). The louder boomer operates at a source level of 205 dB re 1 µPa-m (rms), with a frequency between 0.5 and 6 kHz. While

[3] At a repetition rate of 6 chirps per second, the chirp sub-bottom profiler could approach the acoustic characteristics of a continuous sound source. See further discussion in Sections 8 and 12. [It sounds like you struggled here to accept PR1's view. That's fine, but since in the end you accepted it, I've suggest language for you to consider as another way to express the issue.]

the chirper is not as loud (202 dB re 1 μPa-m [rms]), it operates at a higher frequency range (2-16 kHz). When these two devices are operating simultaneously, they would mask a significant portion of the frequency window used by belugas to communicate (0.5 -16 kHz output from the instruments vs. 0.2-7.0 kHz used by belugas to communicate). However, at the 160 dB threshold, their ZOIs are not large (

Table 3). The airgun's impulsive sounds at frequencies less than 1 kHz leave considerable bandwidth for communicating. The continuous noise associated with the vibracoring has the potential to mask beluga communication because it overlaps the majority of the communication band for belugas; however, the total operating period of the vibracorer is very short (2 hours total within the 12-week project timeframe), so while masking could occur, it would not be of sufficient duration to significantly prevent belugas from effectively engaging in their essential biological functions (e.g. eating, resting, mating).

In summary, beluga whales communicate at frequencies that range well above those produced by airguns, allowing them to compensate by communicating and echo-locating outside of the airgun frequency range. The masking effect of small airgun operation is very slight because of its operating frequency and short operating timeframe. The vibracorer will operate for such a short period (1-2 minutes duration per location) that its masking effect is very limited. However, the sub-bottom profilers may adversely affect beluga communication within their zones of influence, especially when both sub-bottom profilers are operating simultaneously.

The risk of masking of communication or echolocation signals for Steller sea lions or humpback whales is considered discountable due to the rarity of these species in the action area and the limited spatial extent at which masking would occur.

5.1.2. Disturbance

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). During field observations in the Beaufort Sea, Miller *et al.* (2005) reported evidence of belugas avoiding large array seismic operations. Further, Romano *et al.* (2004) found that a captive beluga whale exposed to airgun sounds produced stress 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 0.983 L (60 in^3) airgun arrays proposed for the current project, they demonstrate that belugas are susceptible to sound-induced stress and may be behaviorally and physiologically disturbed by loud noises, potentially leading to restricted use of available habitat when such sounds are produced. Therefore, Cook Inlet belugas may experience negative effects resulting from the operation of airguns and sub-bottom profilers in zones exceeding 160 dB re1 μPa and from vibracore operations exceeding 120 dB re1 μPa.

The risk of acoustic disturbance occurring in Steller sea lions or humpback whales is considered discountable due to the rarity of these species in the action area and the limited spatial extent at which such disturbance would occur.

5.1.3. Threshold Shift (Hearing Loss)

Noise has the potential to induce temporary threshold shift (TTS) or permanent threshold shift (PTS) in cetaceans (Weilgart 2007). Such impacts are of great concern to marine mammals. TTS can last from minutes to days (Weilgart 2007), and even this temporary loss in hearing can lead to injuries or fatalities in the wild if TTS prevents detection of a predator or other significant hazard.

PTS is defined as "irreversible elevation of the hearing threshold at a specific frequency" (Yost 2007). PTS has never been induced in marine mammals despite some hearing threshold studies exposing beluga whales to pulses up to 208 dB (Finneran *et al.* 2002), 28 dB louder than NMFS's current Level A (injury potential) harassment threshold, and louder than the source levels of any equipment to be used in the G&G surveys.

Finneran *et al.* (2005) noted that 18 percent of exposures to an SEL of 195 dB re 1μPa^{2}s resulted in measurable TTS in beluga whales. During the proposed G&G surveys, only belugas located within 4 m (13 ft) of the airgun (the loudest source) could potentially experience TTS. It is unlikely that belugas will occur within 4 m of the airgun during its use.

Likewise, the likelihood of Steller sea lions or humpback whales occurring within a few meters of the sound source is considered discountable due to the species rarity in the action area.

5.1.4. Injury and Mortality

There is a very low probability of Level A harassment, serious injury, or mortality to humpback whales, beluga whales, and Steller sea lions from noise associated with the G&G project. The noise sources involved emit sound pressures that are too low to permanently injure listed marine mammals, and operational vessels travel at speeds too low (<18.5 km/hr {10 kt}) to pose a notable risk of ship strike to these species.

5.1.5. Noise Effects on Prey

Acoustic effects to prey resources are 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 acoustic impact studies have been conducted to date on the fish species most likely present during the summer months in Cook Inlet, but studies have been conducted on Atlantic cod (*Gadus morhua*) and sardine (*Clupea* sp.). Davis *et al.* (1998) cited various studies and found no effects to Atlantic cod eggs, larvae, and fry when received levels were 222 dB. What effects were 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 two-day larvae, but these effects were greatest at 0.5 ft (1.6 ft), and again confined to 5.0 m (16 ft). 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 in Cook Inlet. Therefore we have determined that this action poses an insignificant risk to the prey items of Cook Inlet beluga whales, Steller sea lions, and humpback whales.

5.2. Quantifying Potential for Noise-induced Take of Marine Mammals

EMALL (2015a) estimated potential disturbance take of belugas from this project by multiplying the total area to be ensonified by the airgun (loudest sound within their hearing range) by the density of beluga whales within that area. This assumes that there is no overlap of ensonified areas on successive days, for the 12 week project duration. In this biological opinion we do not assume a lack of overlap, because the applicant could not substantiate this assumption (EMALL pers. comm. July 23, 2015). Because we could not assume no overlap of ensonification between survey days, we estimated potential disturbance take of belugas differently for different equipment types, as follows:

1. The sub-bottom profilers will move through the pipeline area in upper Cook Inlet and the marine terminal area in lower Cook Inlet. Because the two profilers will operate simultaneously and the ZOI for the boomer is larger, our estimation of take includes only the larger area ensonified by the boomer. We calculate a daily ensonification rate by calculating the daily ZOI along a transect of 80.5km, the distance the ship is expected to travel in one day while operating this equipment. Expected take is the product of area-specific beluga density, area ensonified per day, and the number of days of operation in that area.

2. Airgun operations are restricted to the terminal area. Otherwise, expected take is derived in the same manner as for the boomer sub-bottom profiler.

3. Vibracore operations are point sources of acoustic energy that will occur for 1-2 minute durations in both the pipeline and marine terminal areas. Expected take is the product of area ensonified per event, the number of ensonification events, and area-specific beluga density.

5.2.1. Beluga Densities

Goetz *et al*. (2012) modeled aerial survey data collected by the NMFS June - July surveys between 1993 and 2008, and developed specific beluga summer densities for each 1-km^2 cell of Cook Inlet. To develop a density estimate associated with the planned action area, EMALL, in the draft BA submitted to NMFS, overlaid the potential ensonified area associated with each activity on a map of the 1-km^2 density cells. The cells falling within each ensonified area were then quantified, and an average cell density calculated. The associated ensonified areas and beluga density contours relative to the survey areas within the action area are shown in **Figure 10**.

A B

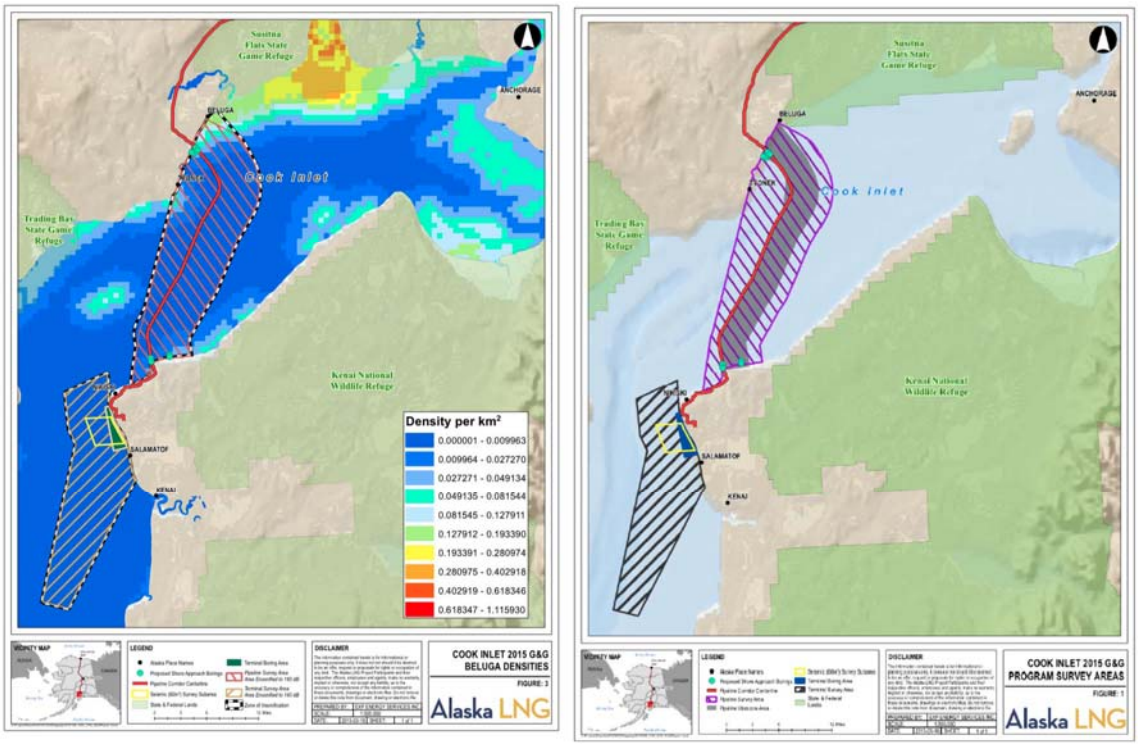


Figure 10. Maximum ensonified areas. A - ZOIs associated with the pipeline and marine terminal survey areas relative to beluga density contours from Goetz *et al.* (2012). B - Maximum ensonified area of vibracore along pipeline route, shown in gray.

Based on Goetz *et al.* (2012), the mean raw densities of beluga whales within the action area are 0.000166 whale/km^2 (0.000064 whale/mi^2) for the terminal area and 0.011552 whale/km^2 (0.00446 whale/mi^2) for the pipeline area (EMALL 2015a). We note that these summer density estimates for upper Cook Inlet include the Beluga River/Susitna Delta area, where belugas are known to concentrate during the summer months. G&G operations are excluded from this area from mid-April through mid-October. Therefore, using the summer density of belugas for upper Cook Inlet is likely an over-estimate of beluga density in the pipeline area when G&G activities will occur there. In other words, by including the high density Beluga River/Susitna Delta area in the density estimate for this action, which does not include that high-density area, NMFS adopted a conservative estimate for the total number of animals likely to be exposed to certain sound sources and thus taken.

5.2.2. Equipment Zones of Influence

The ZOI is the area around a sound source to which a certain sound energy or pressure threshold extends. NMFS considers the ZOI as the area ensonified to greater than 120 dB for continuous sounds and to 160 dB for impulsive sounds. EMALL (2015a) calculates the radius of the ZOI for each equipment type by applying the source sound pressure

levels described in Table 1 to a general formula of:

$$RL = SL - T\text{Log}_{10}\,(\text{radius}) - A(\text{radius})$$

where RL is received level of sound, SL is source level, T is the transmission loss coefficient and A is the coefficient for absorptive sound loss. These coefficients are site specific. Collins *et al.* (2007) measured these coefficients in Cook Inlet and derived: T=18.4 and A = .00188. The resulting attenuation model derived from Cook Inlet is therefore:

$$RL = SL\text{-}18.4\ \text{Log}_{10}(r) - 0.00188(r).$$

Because we know the source levels emitted and the received levels we wish to achieve, we can calculate the distance to any received sound level. Distances to 160 dB and 120 dB isopleths (as applicable) are shown in Table 3. Using ZOI, area-specific beluga densities, and estimated days of operation, or number of point-source acoustic events in each area, we can calculate exposures and thus Level B takes of Cook Inlet beluga whales as described in section 5.2. Table 4 shows the values used in these calculations to arrive at total expected take.

Table 3. Distances to the required thresholds and associated ZOIs

Survey Equipment	Sound Source Level (dB re 1 µPa-m [rms])	Distance to 160 dB Isopleth in m	Distance to 120 dB Isopleth in km
Sub-bottom Profiler (Chirp)[1]	202	184	6.4
Sub-bottom Profiler (Boomer)	205	263	N/A
Airgun	206	300	N/A
Vibracore	187	N/A	2.54

[1]Considered by NMFS PR1 to be an impulsive sound source, but treated as a continuous sound source in our conservation recommendations.

Table 4. Expected take calculations

Sound Source	Area	ZOI Radius (km)[1]	Area Ensonified per Day[2]	Operational Days per Area	Area-Specific Density[3]	Expected take
Boomer	pipeline	0.263	42.55	37	0.011552	18.18
Boomer	terminal	0.263	42.55	26	0.000166	0.18
Airgun	terminal	0.300	48.56	7	0.000166	0.06
			Area Ensonified per Event	Number of Ensonification Events		
Vibracore	pipeline	2.54	20.27	22	0.011552	5.15
Vibracore	terminal	2.54	20.27	33	0.000166	0.11
Total Expected Take (rounded up to next highest integer)						**24**

[1] ZOI is the zone of influence, with a radius defined as the distance to the 160 dB isopleth for impulsive sound (chirper, boomer and airgun) and 120 dB isopleth for continuous sound (vibracore).

[2] Calculated as 2(r)(zoi)(daily transect length) + πr_{zoi}^2. For point source vibracore sampling, area ensonified = π(r)zoi^2. Expressed as km^2. [3]Expressed as whales per km^2, from Goetz *et al*. (2012).

Although we recognize that belugas often travel in groups, the mitigation measures in place (e.g., PSO shifts lasting a maximum of 6 hours, project activities occurring only during daylight hours) should increase the likelihood that any group of belugas in the project vicinity will be spotted in time for mitigation actions (e.g. shut-downs, see Appendix A) to be implemented before any groups of belugas enter the ZOI.

5.3. Potential Non-Acoustic Direct Effects from G&G Operations

5.3.1. Behavioral Responses to Vessel Movement

Beluga whales' reactions have been shown to vary when exposed to vessel traffic. In the Canadian high Arctic where vessel traffic is rare, beluga whales exhibited rapid swimming from ice-breaking vessels up to 80 km (49.7 mi) away, and showed changes in surfacing, breathing, diving, and group composition (Finley 1990). In other cases, beluga whales were more tolerant of vessels, but responded differentially to certain vessels and operating characteristics by reducing their calling rates (especially older animals) in the St. Lawrence River where vessel traffic is common (Blane and Jaakson 1994). Although belugas' response to vessels can result in temporary displacement (NMFS unpublished data), there is no evidence that they have abandoned significant parts of their range in Cook Inlet because of vessel noise or traffic. Therefore, we conclude that any response exhibited by belugas to vessel movement will not affect the species' survival or recovery, especially given the small number of vessels involved in the proposed G&G survey. We conclude that the effects of vessels on Steller sea lions and humpback whales will be discountable due primarily to the rarity of the species in the action area.

5.3.2. Vessel Strike

Ship strikes of cetaceans can cause major wounds, which may lead to the death of the animal. An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or a vessel's propeller could injure an animal just below the surface. The severity of injury typically depends on the size and speed of the vessel and species. An examination of all known ship strikes for large (baleen and sperm) whales from all shipping sources indicates vessel speed is a principal factor in whether a vessel strike results in death (Laist *et al.* 2001; Vanderlaan and Taggart 2007). In assessing records with known vessel speeds, Laist *et al.* (2001) found a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision. The authors concluded that most deaths occurred when a vessel was traveling in excess of 24.1 km/h (14.9 mph; 13 kts). Vessel speeds associated with the proposed project are not expected to exceed 4 knots, thus minimizing the probability of beluga whale injury from vessel strike.

While humpback whales are among the marine mammal species most prone to ship strikes in Alaska, they are very uncommon in the action area, and the operational speeds of project vessels will help minimize the risk of collision for any humpback whales that may be present. The agility of Steller sea lions is likely to preclude collision with vessels travelling as described in this action. Therefore, we have determined that the risk of

injury or death posed by vessel strikes is extremely unlikely to occur and thus discountable for all listed marine mammals in the action area under NMFS jurisdiction.

5.3.3. Entanglement

Entanglement can occur if wildlife becomes immobilized in survey lines, cables, nets, or other equipment that is moving through the water column. The proposed G&G survey would require towing approximately 8.0 km (4.9 mi) of equipment and cables. Most documented cases of marine mammal entanglement involve abandoned or lost fishing lines, nets, pots, or other gear (see https://alaskafisheries.noaa.gov/protectedresources/entanglement/ for more information).

There are no reported cases of entanglement from geophysical equipment in the Cook Inlet area (NMFS unpublished data). Maximum lengths of cables to be used to tow G&G equipment include approximately 50 m (165 ft) for boomers and 30 m (100 ft) for airguns. All equipment is towed at approximate depths of 1-2 m (3-7 ft). Further, the applicant will be constantly monitoring the towed equipment and does not anticipate losing any of it. The operators would make every effort to retrieve any of the costly gear that might accidentally disconnect from the vessel. Accordingly, the entanglement of any listed marine mammal species with any G&G survey gear is extremely unlikely to occur and thus discountable.

5.3.4. Effects to Substrate

The shallow geotechnical investigations and geotechnical boring aspects of the proposed project will result in some disturbances of the substrate. The temporary and very limited nature of substrate disturbance within the range of the Cook Inlet beluga would not be measurable in any meaningful way and is considered insignificant.

5.4. Effects to Critical Habitat

50 CFR 424.12 (b) 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 that are essential to the conservation of a given species and that may require special management considerations or protection.’’ These essential features are sometimes referred to as “primary constituent elements” or PCEs.

The proposed G&G surveys will not affect Steller sea lion habitat; the proposed project is located outside Steller sea lion critical habitat, and there are no haul-outs or rookeries in the vicinity of the action area. Critical habitat has not been designated for humpback whales.

The primary constituent elements for Cook Inlet beluga whale critical habitat (76 FR 20180) are:

> **(1)** Intertidal and subtidal waters of Cook Inlet with depths <30 feet (MLLW) and within 5 miles of high and medium flow anadromous fish streams;

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

(3) Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales;

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

(5) Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.

The G&G program survey areas are located in both upper (pipeline corridor) and lower (marine terminal survey area) Cook Inlet. As shown in Figure 1, the action area is almost entirely within Cook Inlet beluga Critical Habitat Area 2, although a small portion at the north end overlaps Critical Habitat Area 1.

5.4.1. Project Effects to PCE 1 (shallow waters and areas near anadromous streams)

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 (Threemile Creek, Indian Creek, and two unnamed streams) enter 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. Grab samples, PCPTs, vibracores, and geotechnical borings may result in minor impacts to the seafloor, but these effects will be transitory. Therefore, we conclude that this action will have insignificant impacts on Cook Inlet beluga whale critical habitat PCE1.

5.4.2. Project Effects to PCE 2 (prey resources)

Pacific salmon, Pacific eulachon, Pacific cod and other beluga prey species could potentially be affected by the sound generated by G&G equipment, physical disturbance of the fish habitat, or discharges associated with vessels or geotechnical borings. As discussed in Section 5.1.5, the sound generated by G&G equipment is not expected to injure fish. Direct impact to benthic habitat will be limited to the surface area of the four spud cans that form the "foot" of each 0.762-m (30-in) diameter leg of the drilling platform, the (42) 25.4-cm (10-in) diameter borings, and the (55) 10.4-cm (4.0-in) diameter vibracore samplings (plus sediment from 44 grab and 11 PCPT samples). Collectively, these samples would temporarily disturb about 100 m^2 (1,076 ft^2) of benthic habitat, an extremely small area relative to the size (nearly 21,000 km2/8,108 mi^2) of Cook Inlet. These effects will be transitory and insignificant.

5.4.3. Project Effects to PCE 3 (water quality)

No toxins will be discharged or otherwise introduced into waters of Cook Inlet by the G&G program. Small discharges associated with the geotechnical borings include: 1) the

discharge of deck drainage (runoff of precipitation and deck wash water) from the drilling platform, 2) the discharge of drill cuttings and drilling mud, and 3) vessel discharges. Deck drainage discharges will include normal stormwater-type non-point source discharges from precipitation and deck wash-down water consisting of seawater withdrawn at the work site. The drilling mud consists of ambient seawater and guar gum, which is commonly used as a food additive. Vessel discharges will be authorized under the EPA's National Pollutant Discharge Elimination System (NPDES) Vessel General Permit (VGP) for Discharges Incidental to the Normal Operation of Vessels. 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. Further details of typical BMPs that will be used to minimize and eliminate pollutant discharges are detailed in EMALL 2015a and 2015b. Therefore, we have determined that the G&G program is likely to have no significant effect on this PCE.

5.4.4. Project Effects to PCE 4 (sufficient passage)

Belugas may avoid areas ensonified by the G&G activities that generate sound within the beluga hearing range and at levels above threshold values. This includes the chirp sub-bottom profiler with a radius of 184 m (604 ft), the boomer sub-bottom 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 sub-bottom 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 one to two minutes; vibracoring is conducted only once at a given location. Most of the areas where these activities will occur fall within Critical Habitat Area 2 during the summer, when beluga density is relatively low (NMFS 2008a). Although 28.5 km^2 (11 mi^2) of the pipeline survey area occurs within Critical Habitat Area 1, the survey program is not expected to result in any restriction of passage by belugas within or between critical habitat areas because:

- The area to be surveyed is small relative to the size of Cook Inlet, and the airgun and sub-bottom profilers will produce temporary and moving zones of ensonification.
- No sub-bottom profiler or vibracorer activity is planned within 5 km (2.7 nm) of the Beluga River;
- No survey activity will occur within the Susitna Delta Exclusion Zone between April 15 and October 15; and
- Although the jack-up platform from which the geotechnical borings will be conducted will be at a stationary location for up to four to five days, its small size would not result in any obstruction of passage by belugas.

Therefore, we have determined that the G&G survey program is likely to have insignificant effects on this PCE.

5.4.5. Project Effects to PCE 5 (acceptable marine soundscape)

Operation of the G&G devices that generate sounds within the beluga hearing range at levels above threshold values may result in temporary displacement of belugas. The sub-bottom 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 one to two minutes; vibracoring is conducted only once at a given location. Thus, any displacement of belugas would be momentary as the sound sources are either mobile or very brief in duration. Additionally, the 4MP, included as part of the project description, specifies that PSOs will be monitoring ZOIs for the presence of marine mammals, and operations will be shut down should a beluga approach any ZOI during equipment operation. Given these precautionary measures, we conclude that the probability of belugas abandoning their habitat as a result of degradation of the acoustic landscape resulting from this project is discountable.

6.0. INDIRECT EFFECTS

Indirect effects defined under the ESA are effects from the proposed action that occur later in time, but are still reasonably certain to occur. In the future, it is likely that EMALL will propose construction activities, based in part on the results of this year's G&G operations. However, such later work would require additional federal authorization and permitting, which would trigger further ESA section 7 review. Therefore, future development of the AK LNG project is not considered an indirect effect of the current G&G work. Additional indirect effects that may result from this work, and from subsequent development of a natural gas pipeline, would be an increase in tanker traffic in Cook Inlet, with all the consequences that may accrue (e.g. increased risk of introduction of invasive species, increased risk of spill of harmful substances). However, these effects are more appropriately considered in any future consultations on development of the pipeline and marine terminal.

7.0. CUMULATIVE EFFECTS

Cumulative effects associated with the ESA are defined in 50 CFR 402.02 as: "those effects of future State or private activities not involving Federal activities that are reasonably certain to occur within the action area of the federal action subject to consultation." Many cumulative effects will result (or continue) from activities and sources discussed above under Environmental Baseline (Section 4), summarized below.

7.1 Fisheries

Fishing, a major industry in Alaska, is expected to continue in Cook Inlet. As a result, there will be continued prey competition, risk of ship strikes, potential harassment, potential for entanglement in fishing gear, and potential displacement from important foraging habitat for the Cook Inlet beluga whales. NMFS and the ADF&G will continue to manage fish stocks and monitor and regulate fishing in Cook Inlet to maintain sustainable stocks.

7.2 Oil and Gas Development

It is likely that oil and gas development will continue in Cook Inlet with associated risks to belugas from seismic activity, vessel and air traffic, well drilling operations, wastewater discharge; habitat loss, and potential for oil spills and natural gas well blowouts. Any such proposed development would undergo ESA section 7 consultation and therefore the associated effects are not cumulative effects pursuant to the ESA.

7.3 Coastal Development

Coastal development may result in the loss of habitat, increased vessel traffic, increased pollutants, and increased noise associated both with construction and with the activities associated with the projects after construction. Any projects with a federal nexus (e.g. Chuitna Coal Mine, ORPC Tidal Energy Projects, Port of Anchorage expansions) will require section 7 consultation. However as population in the area increases, coastal development with unspecified impacts to Cook Inlet could occur, and vessel traffic in the area could increase.

7.4. Pollution

As the population in urban areas continue to grow, an increase in pollutants entering Cook Inlet is likely to occur. Hazardous materials may be released into Cook Inlet from vessels, aircraft, and municipal runoff. There is a possibility an oil spill could occur from vessels traveling within the action area, or that oil could migrate into the action area from a nearby spill. There are many nonpoint sources of pollution within the action area; such pollution is not federally-regulated. Pollutants can pass from streets, construction and industrial areas, and airports into Cook Inlet and beluga habitat. However, the EPA and the ADEC will continue to regulate the amount of pollutants that enter Cook Inlet from point and nonpoint sources through NPDES/APDES permits. As a result, permittees will be required to renew their permits, verify they meet permit standards, and potentially upgrade facilities.

7.5. Tourism

There currently are no commercial whale-watching companies in upper Cook Inlet. The popularity of whale watching and the close proximity of beluga whales to Anchorage make it possible that such operations may exist in the near future. However, it is unlikely this industry will reach the levels of intensity seen elsewhere because of upper Cook Inlet's climate and navigation hazards (e.g., shallow waters, extreme tides, and currents).

Vessel-based whale-watching, should it occur, may cause additional stress to the beluga population through increased noise and intrusion into beluga habitat not ordinarily accessed by boats. Avoidance reactions have often been observed in beluga whales when approached by watercraft, particularly small, fast-moving craft that are able to maneuver quickly and unpredictably; larger vessels that do not alter course or motor speed around these whales seem to cause little, if any, reaction (NMFS 2008a). The small size and low profile of beluga whales, and the poor visibility within the Cook Inlet waters, may increase the temptation for whale watchers to approach the beluga whales more closely than usually recommended for marine mammals.

7.6. Subsistence Hunting

Alaska Natives, while not currently hunting belugas, may continue to hunt harbor seals in Cook Inlet for subsistence purposes, as allowed by the MMPA. These are typically boat-based hunts that could temporarily increase noise in the environment and increase the potential for accidental ship strikes of Cook Inlet belugas. Any future hunts of Cook Inlet belugas will likely require a federal authorization and are not considered under the ESA definition of cumulative impacts.

8.0. SUMMARY OF EFFECTS TO COOK INLET BELUGA WHALES

Belugas may experience disturbance in areas ensonified by the G&G activities that generate sound with frequencies within their hearing range and at levels above disturbance threshold values. This includes the chirp sub-bottom profiler, considered an impulsive sound source[4], with a radius of 184 m (604 ft) to the 160 dB Level B harassment threshold; the boomer sub-bottom profiler, an impulsive sound source, with a radius of 263 m (863 ft) to the 160 dB Level B harassment threshold (which we consider to subsume the radius of the chirp profiler); the airgun, an impulsive sound source with a radius of 300 m (984 ft) to the 160 dB Level B harassment threshold; and the vibracorer, a continuous sound source with a radius of 2.54 km (1.58 mi) to the 120 dB Level B harassment threshold. All of these activities will be conducted in relatively open areas of Cook Inlet. All of the marine terminal survey area and most of the pipeline survey area is located in Critical Habitat Area 2. A small (28.5 km^2/11 mi^2) portion of the pipeline survey area occurs within Critical Habitat Area 1.

The maximum cumulative ZOIs of the G&G impulsive sound activities over the entire 12-week operating period encompass 347 km^2 (149 mi^2) for the marine terminal area (lower Cook Inlet) and 572 km^2 (221 mi^2) for the pipeline survey area (upper Cook Inlet). Accounting for daily ensonification, the boomer sub-bottom profiler will cumulatively impact 1574 km^2 (608 mi^2) of habitat along the pipeline corridor, and 1106 km^2 (427 mi^2) of habitat in the terminal area. The airgun will cumulatively impact 340 km^2 (131 mi^2) of habitat in the terminal area. Continuous sound (vibracore) ZOIs comprise 22 instances of a 20.26 km^2 (7.82 mi^2) ZOI in upper Cook Inlet and 33 instances of this ZOI in lower Cook Inlet. We anticipate that 24 Cook Inlet beluga whales will be exposed to sound sources that constitute Level B harassment as a result of sound-producing activities associated with the G&G project.

Mitigation measures described in Section 2.5 and Appendix A will be implemented throughout the duration of the project to reduce beluga whales' exposure to noise associated with the G&G activity. Mitigation measures include vessel-based monitoring, safety radii, power-down procedures, shutdown procedures, clearing and ramp-up procedures, and speed or course alteration.

The proposed G&G program is not likely to adversely affect Cook Inlet beluga whale critical habitat. No permanent modifications are anticipated from the seismic program on Cook Inlet beluga whale critical habitat because the activities will be short-term and localized and include mitigation measures (4MP – see Appendix A). Potential damage to the Cook Inlet benthic community will be limited to about 100 m^2 (1,076 ft^2) of habitat, an insignificantly small area relative to the size (3,016 mi^2 [7,809 km^2]) of Cook Inlet beluga whale critical habitat. Any impacts to prey species are expected to be short-term,

[4] As previously mentioned, the chirp repetition rate of 6 times/second could approach the acoustic characteristics of a continuous sound source.

and fish would likely return to their pre-disturbance behavior once the G&G activity ceases. Passage of beluga whales between areas within their critical habitat is not likely to be affected by this action.

9.0. SYNTHESIS AND INTEGRATION

In this section, we synthesize the effects of EMALL's proposed G&G surveys on Cook Inlet beluga whales and integrate those effects with the environmental baseline and cumulative effects. We then consider the implication of those effects on the continued existence of Cook Inlet beluga whales. In particular, we examine the scientific data available to determine whether there may be responses to the effects of the project that are likely to have consequences for the individual's growth, survival, annual reproductive success, or lifetime reproductive success. Any reduction in these parameters for an individual whale could incrementally affect the viability of the entire listed entity.
As we have detailed in previous biological opinions (e.g., NMFS 2015b) and conservation documents (NMFS 2008a,b, 2015a) the baseline condition for Cook Inlet beluga whales is characterized by: (1) very low abundance; (2) lack of recovery; and (3) a high (26 percent) probability of extinction within the next 100 years (Hobbs and Shelden 2008). The additional annual mortality of even a single animal above those predicted in the population viability model would accelerate this predicted extinction timeframe. At the same time, this population faces continuing, but unquantified, natural and anthropogenic threats.

Our review of the ***cumulative effects*** to Cook Inlet beluga whales found some unquantified level of threats from activities without a federal nexus, for which no consultation would occur under the ESA. Unregulated harassment is likely occurring as a result of small vessels operations, aircraft overflights, and other actions by humans, but there are no data available as to the extent of this harassment. Of these stressors, vessel traffic may be of most concern, with the potential to harass beluga whales, displace them from important feeding habitat near the mouths of certain salmon streams, and injure them by strikes with boat hulls or propellers. However, it appears that at least some of the time, beluga whales continue to occupy feeding areas despite small boat traffic (including feeding habitat in the Susitna Delta where they were actively hunted during past subsistence harvests). It is unknown whether the whales fail to flee from this boat traffic because they have habituated to it, or because the food resources there are so vital to their survival that they have no choice but to tolerate the boat traffic. Ship strikes have not been implicated as the cause of death for any stranded Cook Inlet beluga whales, although many stranding investigations are inconclusive, and at least one stranded beluga showed trauma consistent with what one would expect from a collision with a boat hull.

While beluga whales are likely being subjected to take under the environmental baseline and through cumulative effects, such takes are mostly due to harassment and disturbance by noise. We are currently unable to quantify the effects of this harassment upon the extinction risk probabilities for this DPS.

We have considered the ***project's effects*** on Cook Inlet beluga whales and their critical habitat. The proposed EMALL G&G project activities may result in the harassment of

beluga whales from sound-producing equipment, including airguns, sub-bottom profilers, and vibracores. Overall, the issuance of an IHA for EMALL 2015 G&G survey project in Cook Inlet is expected to result in disturbance take of an estimated 24 Cook Inlet beluga whales (about seven percent of the population). The most likely manifestations of this take would be temporary changes in behavior that would return to normal shortly after cessation of exposure to noise levels exceeding 120 dB for continuous or 160 dB for impulsive sounds. The potential effects of this project on Cook Inlet beluga whales will be further diminished due to: 1) the avoidance in space and time of the belugas using the Susitna Delta area; 2) the visual and acoustic monitoring program in place; and 3) clearing, ramp-up and power/shut-down procedures to reduce harassment to belugas.

We anticipate individual Cook Inlet beluga whales could be exposed to MMPA level B harassment take as a result of the G&G project. However, there is no available evidence to indicate that a single exposure to sound sources constituting Level B harassment would have a negative consequence to an individual beluga whale's fitness (i.e., growth, survival, or reproductive success), or would result in population-level consequences to survival or recovery of the Cook Inlet beluga whales.

As set forth above, the factors that may affect recovery include prey availability, access to foraging areas, contaminants, direct mortality events (e.g., ship strikes, researcher induced take), stranding events, and killer whale predation. It is unlikely that the proposed surveys will affect these factors in any way that would measurably decrease the probability of recovery. 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 expected to be of little consequence to any individual beluga whale's fitness. Accordingly, the proposed action does not involve circumstances that would negatively affect survival or recovery such that the continued existence of the Cook Inlet beluga whale will be jeopardized.

On integrating the effects from the proposed EMALL G&G surveys on beluga whales and their critical habitat with the environmental baseline and cumulative effects, we expect that individual or small groups of whales may be harassed by impulsive and continuous noise from project activities, but we conclude take associated with this project will be limited to temporary behavioral changes. This project is not likely to have meaningful adverse consequences to the Cook Inlet beluga whale population. Beluga whales are unlikely to be killed or injured by this project, and harassment would be expected to be localized and temporary.

10.0 CONCLUSION

After reviewing the project description, mitigation measures, status of these species, effects from the action, environmental baseline, and cumulative effects, it is NMFS's biological opinion that the proposed authorization by NMFS PR1 and the Corps of Engineers for the EMALL G&G operations in Cook Inlet for 2015 is not likely to jeopardize the continued existence of Cook Inlet beluga whales.

We also conclude that the effects of this action on western DPS Steller sea lions and humpback whales would be insignificant, discountable, or both. Given the rarity of these species in the action area and the mitigation measures that will be in effect to further reduce risk of take, we concur that the proposed action is not likely to adversely affect Steller sea lions or humpback whales. Finally, we conclude that this action is not likely to affect Cook Inlet beluga critical habitat because effects to the PCEs would be insignificant and/or discountable.

This concludes consultation on this action. As provided in 50 CFR §402.16, reinitiation of consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded in any operational year; 2) new information reveals effects from this action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this biological opinion; 3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this biological opinion; or 4) a new species is listed or critical habitat designated that may be affected by the identified action.

11.0. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of ESA section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking, provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Section 7(b)(4)(C) of the ESA specifies that the operator needs to obtain authorization under section 101(a)(5) of the MMPA before this incidental take statement can become effective. Accordingly, the terms of this statement and the exemption from Section 9 of the ESA that the statement affords are conditional upon the issuance of MMPA authorization to take the marine mammals identified here.

11.1. Amount or Extent of the Take

Available information indicates that incidental take of small numbers of Cook Inlet beluga whales by acoustic harassment may occur during EMALL G&G survey activities. NMFS does not expect beluga whales to be injured or killed by these surveys. Although this project may result in behavioral disturbance in a small number of Cook Inlet beluga whales, planned monitoring and mitigation measures are designed to avoid exposing listed marine mammals to sound pulses that may cause disturbance.

NMFS AKR anticipates and authorizes the non-lethal incidental take of no more than 24 Cook Inlet beluga whales as a result of exposure to impulsive sounds with received levels

≥ 160 dB re:1 μPa$_{RMS}$, and continuous sounds ≥ 120 dB re:1 μPa$_{RMS}$, in association with the proposed G&G surveys.

The taking of Cook Inlet beluga whales shall be by incidental harassment only. The taking by serious injury or death, or the taking by harassment of a greater number of animals than authorized by this Incidental Take Statement (ITS), is prohibited and may result in the modification, suspension, or revocation of this ITS.

11.2. Reasonable and Prudent Measures (RPMs):
NMFS AKR concludes the following Reasonable and Prudent Measures are necessary and appropriate to minimize the impact of incidental take of the endangered Cook Inlet beluga whale.

1) Conduct operations in a manner that will minimize impacts to any Cook Inlet beluga whale that may occur within or in the vicinity of the project action area.

2) Exercise special caution in the vicinity of the Susitna Delta to minimize the impacts of G&G operations within this seasonally vital Cook Inlet beluga whale habitat.

3) Implement a comprehensive monitoring and reporting program to ensure that Cook Inlet beluga whales are not taken in numbers or in a manner not anticipated by the biological opinion.

11.3. Terms and Conditions
For any incidental takes that result from the actions of NMFS PR1, the Corps, or their applicant or permittees to be exempt from the prohibitions of section 9 of the ESA, the action that causes the take must comply with the following terms and conditions. These non-discretionary terms and conditions implement the reasonable and prudent measures described above.

To implement RPM #1:
1.1. All project activity must comply with all terms, conditions, and requirements listed in the Incidental Harassment Authorization (IHA) issued pursuant to MMPA section 101(a)(5), and this incidental take statement (ITS). The operator/s must possess current and valid IHA and ITS documentation at all times during project operations.

1.2. To ensure that the harassment ZOI is clear of marine mammals, NMFS PR1 must require the following:

The entire 160 dB disturbance zone must be visible for 30 minutes prior to initiating acoustic operations for the day or reinitiating acoustic operations following a 15 minute interruption of acoustic output. During this 30-minute observation period, PSOs must constantly scan the entire 160 dB disturbance zone to ensure that it remains void of listed marine mammals. If the disturbance zone remains void of listed marine mammals for the entire 30-minute observation period, acoustic operations may be implemented. If a listed

marine mammal is observed within the 160 dB disturbance zone during the 30-minute observation period, then the 30 minute observation period must start over.

1.3. In the event that EMALL or its agents observe the take of a marine mammal in a manner other than that authorized by this ITS, such as serious injury or mortality (e.g., Level A harassment; ship-strike; gear interaction; and/or entanglement), EMALL shall immediately cease the specified activities and immediately report the incident to NMFS AKR Protected Resources Division at 907-271-3023, and/or by email to greg.balogh@noaa.gov.

To implement RPM #2:
NMFS PR1 and the Corps must prohibit EMALL from operating within 10 miles (16 km) of Susitna Delta Exclusion Zone from April 15 to October 15. The Susitna Delta Exclusion Zone is defined as the union of the areas defined by a 10 mi (16 km) buffer of the Beluga River thalweg [i.e. line of lowest elevation] seaward of the MLLW line, a 10 mi (16 km) buffer of the Little Susitna River thalweg seaward of the MLLW line, and a 10 mi (16 km) seaward buffer of the MLLW line between the Beluga River and Little Susitna River. The 10 mi (16 km) radius extends in all directions from both the Beluga River and the Little Susitna River thalwegs, and the MLLW line in between.

To implement RPM #3:
3.1. NMFS PR1 and the Corps must require EMALL to implement all mitigation measures and reporting requirements outlined in the 4MP prepared for this project (Appendix A). The draft 90-day report, as described in Appendix A, will include all data and associated metadata and will be submitted to NMFS AKR in a form that can be directly imported into an Excel spreadsheet template, for incorporation into NMFS **Cook Inlet Beluga Scientific Sightings Mapper.** The draft report will be subject to review and comments by NMFS AKR. Any recommendations made by NMFS AKR must be addressed in the final report prior to acceptance by NMFS AKR. The draft report will be considered final for the activities described in this opinion if NMFS AKR has not provided comments and recommendations within 90 days of receipt of the draft report.

3.2. Copies of all reports (including Weekly and Monthly Field Reports and 90-day Technical Reports) shall be submitted within the specified timeframes to:

NMFS AKR
ATTN: Greg Balogh
222 W. 7th Ave.
Rm 552, Box 43
Anchorage, AK 99513
Email: greg.balogh@noaa.gov

Effective Date:
This ITS will be in effect only upon the issuance of MMPA authorization to take the marine mammals identified herein, and will remain in effect throughout the period specified in the IHA (approximately 12 weeks after IHA issuance), provided the operator possesses a current and valid IHA and ITS at all times during project operations. Should the operator fail to possess such an authorization, this ITS shall become ineffective

immediately and shall remain ineffective until such time as the operator again possesses a current and valid IHA and ITS.

12.0. CONSERVATON RECOMMENDATIONS

ESA Section 7(a)(1) directs federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help carry out recovery plans, or to develop information. In anticipation of future development of the Alaska LNG project, conservation recommendations are as follows:

1. EMALL should consider implementing a passive acoustic monitoring program in the action area adjacent to the proposed Marine Terminal and Liquifaction Plant to verify seasonal use of the area by Cook Inlet beluga whales, in order to inform and plan future proposed work schedules.
2. Although the chirper is considered by the applicant and NMFS PR1 to be an impulsive sound source, this device, which "chirps" 6 times per second, approaches the acoustic characteristics of a continuous sound source operating at 202 dB within the hearing range of beluga whales. Therefore, the applicant should consider monitoring for the presence of beluga whales out to the 120 dB isopleth from this source, which we have calculated as an area of radius 6.4 km from the source. Mitigation measures described elsewhere in this document and in the attached 4MP should be applied to this area to minimize the likelihood of level B harassment takes of Cook Inlet beluga whales due to exposure to loud continuous sound from the chirping sub-bottom profiler.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, NMFS requests notification if either of these conservation recommendations are carried out.

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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 safety zone radii for those activities producing noise exceeding Level A (180 and 190 dB re 1 µPa (rms)) and Level B (160 and 120 dB re 1 µPa (rms)) are provided in Table A1. 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 A1. Safety Zone Radii for each G&G Equipment Type Generating Sound at Frequencies <200 kHz.

Survey Equipment	Safety Zone Radii		Harassment Zone Radii	
	190-dB radius m (ft)	180-dB radius m (ft)	160-dB radius m (ft)	120-dB radius km (mi)
Sub-bottom Profiler - Chirp	5 (16)	6 (20)	184 (604)	N/A
Sub-bottom Profiler - Boomer	7 (23)	23 (75)	263 (863)	N/A
0.983 L (60 in^{3}) Airgun	8 (26)	26 (85)	300 (984)	NA
Vibracore	0	3 (10)	N/A	2.54 (1.58)

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.