UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

May 13, 2015

MEMORANDUM FOR: Donna Wieting
Director, Office of Protected Resources

FROM: for James W. Balsiger, Ph.D.
Administrator, Alaska Region

SUBJECT: Biological Opinion for Incidental Take Authorization; SAExploration, Inc., 2015, AKR-2015-9442

The National Marine Fisheries Service Alaska Region (NMFS AKR) has received your request for consultation under section 7 of the Endangered Species Act. SAExploration, Inc. (SAE) seeks incidental take authorization under the Marine Mammal Protection Act for seismic activities in Cook Inlet, Alaska, from May through November, 2015, as described in the attached biological opinion and associated biological assessment (SAE 2015). Briefly, SAE will survey a maximum of 777 square kilometers (300 square miles) using three-dimensional (3D) nodal or ocean-bottom node seismic surveys in state and federal waters within upper and lower Cook Inlet. It is estimated that it will take 160 days to complete both upper and lower Cook Inlet areas. The seismic operation will be active 24 hours per day, but in-water airgun activity will average 8-10 hours per day and will generally occur around the slack tide or low current periods. Within Cook Inlet, multiple watercrafts, pingers, nodal recorders and airguns arrays with up to 1,760 cubic inch displacements will be used to obtain the desired data. Mitigation measures to minimize the effects from these actions are described in the biological assessment for this project and in this biological opinion.

NMFS AKR determined that the proposed action, as described, is not likely to jeopardize the continued existence of any listed species, nor will it destroy or adversely modify any designated critical habitat. We concur with your determination that this action may affect, and is likely to adversely affect, Cook Inlet beluga whales (*Delphinapterus leucas*), humpback whales (*Megaptera novaeangliae*), and western distinct population segment (DPS) Steller sea lions (*Eumetopias jubatus)*. NMFS Permits and Conservation Division (PR1) determined this action would not affect Steller sea lion critical habitat since there is no such habitat within the action area. This biological opinion considers effects of the action on Cook Inlet beluga whale critical habitat. In formulating this opinion, NMFS AKR used the best available information, including: relevant published research, traditional knowledge of Alaska Natives, and information provided by NMFS and the applicant, as well as other sources.

In this biological opinion, NMFS AKR anticipates and authorizes the non-lethal incidental take from harassment of no more than 30 Cook Inlet beluga whales, no more than 5 humpback whales, and no more than 25 western DPS Steller sea lions during 2015 as a result of this proposed action.

Discretionary Conservation Recommendations and nondiscretionary Reasonable and Prudent Measures with implementing Terms and Conditions are provided with the biological opinion. Discretionary measures are intended to suggest ways in which NMFS PR1 can further minimize potential adverse effects under section 7(a)(1) of the ESA.

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Edits to This Document

THIS SHEET MUST ACCOMPANY THIS OPINION THROUGH FINAL SIGNATURE

NO.	DATE	FILE/IDENTIFIER/LOCATION	AUTHOR/EDITOR
1	4/3/2015	U:\0_PRD SHARED FILES\0- ESA\0-ESA SECTION 7 CONSULTATIONS\2015 ANNUAL - FORMALS & INFORMALS\FORMALS\SAExploration\140325 BiOp SAExploration ver I.docx	BAM
2	4/17/2015	U:\0_PRD SHARED FILES\0- ESA\0-ESA SECTION 7 CONSULTATIONS\2015 ANNUAL - FORMALS & INFORMALS\FORMALS\SAExploration\140325 BiOp SAExploration ver II.docx	BAM with GRB comments
3	4/24/2015	U:\0_PRD SHARED FILES\0- ESA\0-ESA SECTION 7 CONSULTATIONS\2015 ANNUAL - FORMALS & INFORMALS\FORMALS\SAExploration\140325 BiOp SAExploration ver III.docx	BAM with JMK edits
4	4/29/2015	U:\0_PRD SHARED FILES\0- ESA\0-ESA SECTION 7 CONSULTATIONS\2015 ANNUAL - FORMALS & INFORMALS\FORMALS\SAExploration\140325 BiOp SAExploration ver IIIgrb.docx	GRB edits to above
5	5/1/2015	U:\0_PRD SHARED FILES\0- ESA\0-ESA SECTION 7 CONSULTATIONS\2015 ANNUAL - FORMALS & INFORMALS\FORMALS\SAExploration\140325 BiOp SAExploration ver IV.docx	BAM
6	5/4/2015	U:\0_PRD SHARED FILES\0- ESA\0-ESA SECTION 7 CONSULTATIONS\2015 ANNUAL - FORMALS & INFORMALS\FORMALS\SAExploration\140325 BiOp SAExploration ver IV.docx	BAM with GRB edits and updates from SAE
7	5/6/2015	U:\0_PRD SHARED FILES\0-2015 Packages in Review\SAExploration CI Seismic IHA BiOp\150504 BiOp SAExploration ver V JMKedits	Received and accepted changes from Jon Kurland
8	5/11/2015	:\0_PRD SHARED FILES\0-2015 Packages in Review\SAExploration CI Seismic IHA BiOp\150504 BiOp SAExploration ver VI with CH highlighted	BAM with GRB CH additions

ENDANGERED SPECIES ACT: SECTION 7 CONSULTATION
BIOLOGICAL OPINION

Action Agency:	National Marine Fisheries Service and Department of Interior, Bureau of Ocean Energy Management
Activity:	Three Dimensional Seismic Surveys of Cook Inlet, Alaska by SAExploration, Inc.
Consulting Agency:	National Marine Fisheries Service, Alaska Region
Approved By:	for James W. Balsiger
Date Issued:	5/13/15

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA) (16 U.S.C. 1531 *et. seq.*) requires that each federal agency ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of any critical habitat of such species. The federal agency is required to consult with either National Marine Fisheries Service (NMFS) or U.S. Fish and Wildlife Service (USFWS), depending upon the protected species that may be affected. Formal consultations on most listed marine species are conducted between the action agency and NMFS. Consultation concludes when NMFS issues a biological opinion that identifies whether a proposed action is likely to jeopardize the continued existence of a listed species or destroy or adversely modify its critical habitat. If jeopardy or destruction or adverse modification is found to be likely, the biological opinion must identify reasonable and prudent alternatives to the action, if any, that would avoid jeopardizing any listed species and avoid destruction or adverse modification to designated critical habitat. If jeopardy is not likely, the biological opinion must include an incidental take statement (ITS), which specifies the amount or extent of incidental take that is anticipated from the proposed action. Non-discretionary reasonable and prudent measures to minimize the impact of the incidental take are included along with the implementing terms and conditions, and conservation recommendations.

NMFS Office of Protected Resources, Permits and Conservation Division (NMFS PR1) requested formal consultation on regulations and subsequent issuance of a Marine Mammal Protection Act (MMPA) incidental harassment authorization (IHA) to cover three dimensional (3D) seismic surveys of Cook Inlet, Alaska by SAExploration, Inc. (SAE or applicant). The U.S. Department of Interior, Bureau of Ocean Energy Management (BOEM) likewise requested formal consultation on the issuance of a permit for the SAE seismic surveys in federal waters.

This document constitutes NMFS Alaska Region's (AKR) opinion on the effects of these actions in accordance with section 7(a)(2) of the ESA. Specifically, this opinion considers the project as described in NMFS PR1's proposed rule for *Taking Marine Mammals Incidental to Seismic Surveys in Cook Inlet, Alaska* (80 FR 14913, March 20, 2015), and analyzes the effects of the

Cook Inlet 3D seismic surveys and related operations on the endangered Cook Inlet beluga whale (*Delphinapterus leucas*), humpback whale (*Megaptera novaeangliae*), and western distinct population segment (DPS) Steller sea lion (*Eumetopias jubatus*).

In formulating this biological opinion, NMFS AKR used information presented in the following documents or sources:

- Biological Assessment for SAExploration, Inc. Cook Inlet 3D seismic program Cook Inlet, Alaska (SAE 2015);
- Takes of marine mammals incidental to specified activities; taking marine mammals incidental to seismic surveys in Cook Inlet, Alaska (80 FR 14913, March 20, 2015);
- Biological Assessment for Apache Alaska Corp., Cook Inlet, Alaska (ASRC 2014);
- Conservation Plan for the Cook Inlet beluga whale (NMFS 2008a);
- 2008 Status Review and extinction risk assessment of Cook Inlet belugas (*Delphinapterus leucas*);
- 2008 Supplemental status review and extinction assessment of Cook Inlet belugas (*Delphinapterus leucas*);
- 2008 Final Supplemental Environmental Impact Statements for the Cook Inlet beluga whale subsistence harvest (NMFS 2008b);
- Recovery Plan for eastern and western distinct population segments of Steller sea lions (NMFS 2008c);
- Final Recovery Plan for the humpback whale, *Megaptera novaeangliae* (NMFS 1991);
- Published scientific studies;
- Proposed rule to designate 14 distinct population segments of the humpback whale and proposed revision of species-wide listing (80 FR 22304)
- Unpublished data and reports from the NMFS, NMML, the State of Alaska; and
- Local and traditional knowledge from Alaska Natives.

Consultation History

By memo dated February 26, 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 seismic surveys in Cook Inlet, Alaska. Along with the request for consultation, NMFS AKR received a biological assessment (SAE 2015), the application for an IHA, and the proposed rule to issue an IHA (80 FR 14913, March 20, 2015).

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Presentation of the Analysis in this Biological Opinion

Biological opinions are constructed around several basic sections that represent specific requirements placed on the analysis by the ESA and implementing regulations. These sections contain different portions of the overall analytical approach described here. This section is intended as a basic guide to the reader on the other sections in this biological opinion and the analyses that can be found in each section. Every step of the analytical approach described below will be presented in this biological opinion in either detail or summary form.

Description of the Proposed Action: This section contains a basic summary of the proposed federal action and any interrelated and interdependent actions. This description forms the basis of the first step in the analysis where we consider the various elements of the action and determine the stressors expected to result from those elements. The nature, timing, duration, and location of those stressors define the action area and provide the basis for our exposure analyses.

Status of the Species: This section provides the reference condition for the species and critical habitat at the listing and designation scale. These reference conditions form the basis for the determinations of whether the proposed action is likely to jeopardize the continued existence of species or result in the destruction or adverse modification of critical habitat. Other key analyses presented in this section include critical information on the biological and ecological requirements of the species and critical habitat and the impacts to species and critical habitat from existing stressors.

Environmental Baseline: This section provides the reference condition for the species and critical habitat within the action area. By regulation, the baseline includes the impacts on the species and critical habitat of all past and present actions and future federal actions for which consultation has been completed (except the effects of the proposed action). This section also contains summaries of the impacts from stressors that will be ongoing in the same areas and times as the effects of the proposed action (future baseline). This information forms part of the foundation of our exposure, response, and risk analyses.

Effects of the Proposed Action: This section details the results of the exposure, response, and risk analyses NMFS AKR conducted for listed species and elements, functions, and areas of critical habitat.

Cumulative Effects: This section summarizes the impacts of future non-federal actions reasonably certain to occur within the action area, as required by regulation. Similar to the rest of the analysis, if cumulative effects are expected, NMFS AKR determines the exposure, response, and risk posed to individuals of the species and features of critical habitat.

Synthesis and Integration: In this section of the biological opinion, NMFS AKR presents the summary from the effects identified in the preceding sections and then details the consequences of the risks posed to individuals and features of critical habitat to the species or DPS at issue. Finally, this section concludes whether the proposed action is likely to jeopardize the continued existence of a species or destroy or adversely modify designated critical habitat.

Legal and Policy Framework

The purposes of the ESA, "…*are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in subsection (a) of this section*." To help achieve these purposes, the ESA requires that, "*Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [designated critical] habitat*…"

Jeopardy Standard and Destruction or Adverse Modification Standard

The "jeopardy" standard has been further interpreted in regulation (50 CFR 402.02) as a requirement that federal agencies ensure that their actions are not reasonably expected to *reduce appreciably the likelihood of both the survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution*.[1] It is important to note that the purpose of the analysis is to determine whether or not appreciable reductions are reasonably expected, but not to precisely quantify the amount of those reductions. As a result, our assessment often focuses on whether a reduction is expected or not, but not on detailed analyses designed to quantify the absolute amount of reduction or the resulting population characteristics (abundance, for example) that could occur as a result of proposed action implementation.

The parameters of productivity, abundance, and population spatial structure are important to consider because they are predictors of extinction risk and recovery potential, the parameters reflect general biological and ecological processes that are critical to the survival and recovery of the listed species, and these parameters are consistent with the "reproduction, numbers, or distribution" criteria found within the regulatory definition of jeopardy (50 CFR 402.02).

For critical habitat, NMFS does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the analysis with respect to critical habitat. NMFS will evaluate "destruction or adverse modification" of critical habitat by determining if the action appreciably diminishes the value of critical habitat for the conservation of the species.

Additional requirements on the analysis of the effects from an action are described in regulation (50 CFR 402) and our conclusions related to "jeopardy" and "destruction or adverse modification" generally require an expansive evaluation of the direct and indirect consequences of the proposed action, related actions, and the overall context of the impacts to the species and habitat from past, present, and future actions as well as the condition of the affected species. For example, see the definitions of "cumulative effects," "effects of the action," and the requirements of 50 CFR 402.14[g]). Recent court cases have reinforced the requirements provided in section 7

[1] For purposes of this opinion, NMFS interprets this definition consistent with the court's opinion in *National Wildlife Federation v. NMFS*, 524 F.3d 917 (9th Cir. 2008). NMFS's jeopardy analysis considers how the proposed action may affect the likelihood of survival of the species and how it may affect the likelihood of recovery of the species.

regulations that NMFS must evaluate the effects of a proposed action within the context of the current condition of the species and critical habitat, including other factors affecting the survival and recovery of the species and the functions and value of critical habitat.

Consultations conclude with the issuance of a biological opinion or a concurrence letter. Section 7 of the ESA, the implementing regulations (50 CFR 402), and associated guidance documents (e.g., USFWS and NMFS 1998) require biological opinions to present: 1) a description of the proposed federal action; 2) a summary of the status of the affected species and its critical habitat; 3) a summary of the environmental baseline within the action area; 4) a detailed analysis of the effects from the proposed action on the affected species and critical habitat; 5) a description of cumulative effects; and 6) a conclusion as to whether it is reasonable to expect the proposed action is not likely to appreciably reduce the species' likelihood of both surviving and recovering in the wild, by reducing its numbers, reproduction, or distribution or result in the destruction or adverse modification of the species' designated critical habitat.

1. THE PROPOSED ACTION

NMFS PR1 and BOEM jointly submitted a request for an ESA section 7 consultation to NMFS AKR to analyze the effects on Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions resulting from issuance of permits authorizing SAE's 3D seismic surveys in Cook Inlet from May through November, 2015 (SAE 2015).

The project is proposed to begin in May 2015, depending on weather conditions and permit stipulations, and conclude no later than November 30, 2015. The project duration would be approximately 160 days to survey both upper and lower Cook Inlet areas. SAE proposes to survey upper Cook Inlet in the spring and lower Cook Inlet in the fall to help reduce the probability of encountering endangered Cook Inlet beluga whales. Seismic data acquisition is expected to occur for only 2-3 hours at a time during each of the 3-4 daily slack tides. With up to four slack tide periods in a 24-hour day, airgun operations will average 8-10 hours per day.

1.1 Purpose of the Proposed Action

SAE plans to conduct 3D nodal or ocean-bottom node seismic surveys to map the subsurface and its geological structure for oil and gas pockets for future development.

1.2 Project and Action Areas

1.2.1 Project Area

SAE's seismic surveys would occur in the marine waters of upper and lower Cook Inlet. The total potential survey area is 3,934 square kilometers (km^2) (1,519 square miles [mi^2]); however, only a portion (currently unspecified) of this area will ultimately be surveyed and no more than 777 km^2 (300 mi^2) will be surveyed in 2015. Water depths within which the seismic surveys would occur are 4.6-128 meters (m) (15-420 feet [ft.]). Between April 15 and October 15, a 16 kilometer (km) (10 mile [mi]) buffer around the Susitna delta (defined as the nearshore area between the mouths of the Beluga and the Little Susitna rivers) will be completely avoided. Upper Cook Inlet would be surveyed in the spring and lower Cook Inlet would be surveyed in the fall.

1.2.2 Action Area

The action area is defined by the ESA as all areas to be affected directly or indirectly by the federal action [50 CFR 402.02]. The action area is typically larger than the project area and extends out to a point where no measurable effects from the project occur. The acoustic energy associated with project seismic operations will have the largest footprint of direct effects, and no indirect effects were identified that would extend beyond the geographic extent of the area affected by project seismic activities.

The action area for the full proposed Cook Inlet 3D seismic program encompasses approximately 5,013 km^2 (1,935 mi^2) and includes a 4.75 km (2.95 mi) buffer around the offshore areas in the project area. With the buffer area, the action area for the upper Cook Inlet consists of 2,515 km^2 (971 mi^2) (Figure 1). With the buffer area, lower Cook Inlet consists of 2,498 km^2 (964 mi^2), 727 km^2 (281 mi^2) of which is federal Outer Continental Shelf waters and 1,769 km^2 (683 mi^2) is Alaska state waters (Figure 2).

NMFS uses generic sound exposure thresholds to determine when an activity produces sound sufficient to affect marine mammals (70 FR 1871, January 11, 2005). These acoustic thresholds identify the levels at which different categories of noise (impulsive or continuous) may result in harm or harassment. For mid-frequency cetaceans (e.g., beluga whales), the harassment threshold for impulsive sounds, including those generated by airguns used during seismic surveys, is recognized at 160 decibels (dB) referenced to 1 microPascal (notated as 160 dB re 1 μPa_{rms} [hereafter noted as 160 dB]), and the harm/injury threshold is 180 dB re 1 μPa_{rms} hereafter noted as 180 dB). For pinnipeds (e.g., western DPS Steller sea lions) the harassment and harm thresholds are 160 dB and 190 dB re 1 μPa_{rms} (hereafter noted as 190 dB), respectively.

We recognize that these acoustic thresholds are inexact and responses to sounds vary among individual marine mammals and depend on a variety of factors, including previous experiences with noise, natural avoidance behaviors, activity (feeding, migrating, etc.) at the time of noise exposure, and characteristics of the noise. NMFS is in the process of reviewing and evaluating whether they fulfill their intended purposes (delimit when harassment occurs as defined by the MMPA). 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.

1.3 Description of the Proposed Action

Marine seismic operations will be based on a "recording patch" or similar approach. Patches are groups of six receiver lines and 32 source lines (Figure 3). Each receiver line has submersible marine sensor nodes tethered (with non-kinking, non-floating line) equidistant (50 m [165 ft.]) from each other along the length of the line. Each node is a multicomponent system containing three velocity sensors and a hydrophone. Each receiver line is approximately 8 km (5 mi) in length, and spaced approximately 402 m (1,320 ft.) apart. Each receiver patch is 19.4 km^2 (7.5 mi^2) in area. The receiver patch is oriented so the receiver lines run parallel to the shoreline.

The 32 source lines, 12 km (7.5 mi) long and spaced 502 m (1,650 ft.) apart, run perpendicular to the receiver lines (and perpendicular to the coast) and, where possible, will extend approximately 5 km (3 mi) beyond the outside receiver lines and approximately 4 km (2.5 mi) beyond each end of the receiver lines. The outside dimensions for the maximum shot area during a patch shoot

will be 12 km by 16 km (7.5 mi by 10 mi), with an area of 192 km^2 (75 mi^2). All shot areas will be wholly contained within the survey boxes (Figures 1 and 2). Shot intervals along each source line will be 50 m (165 ft.).

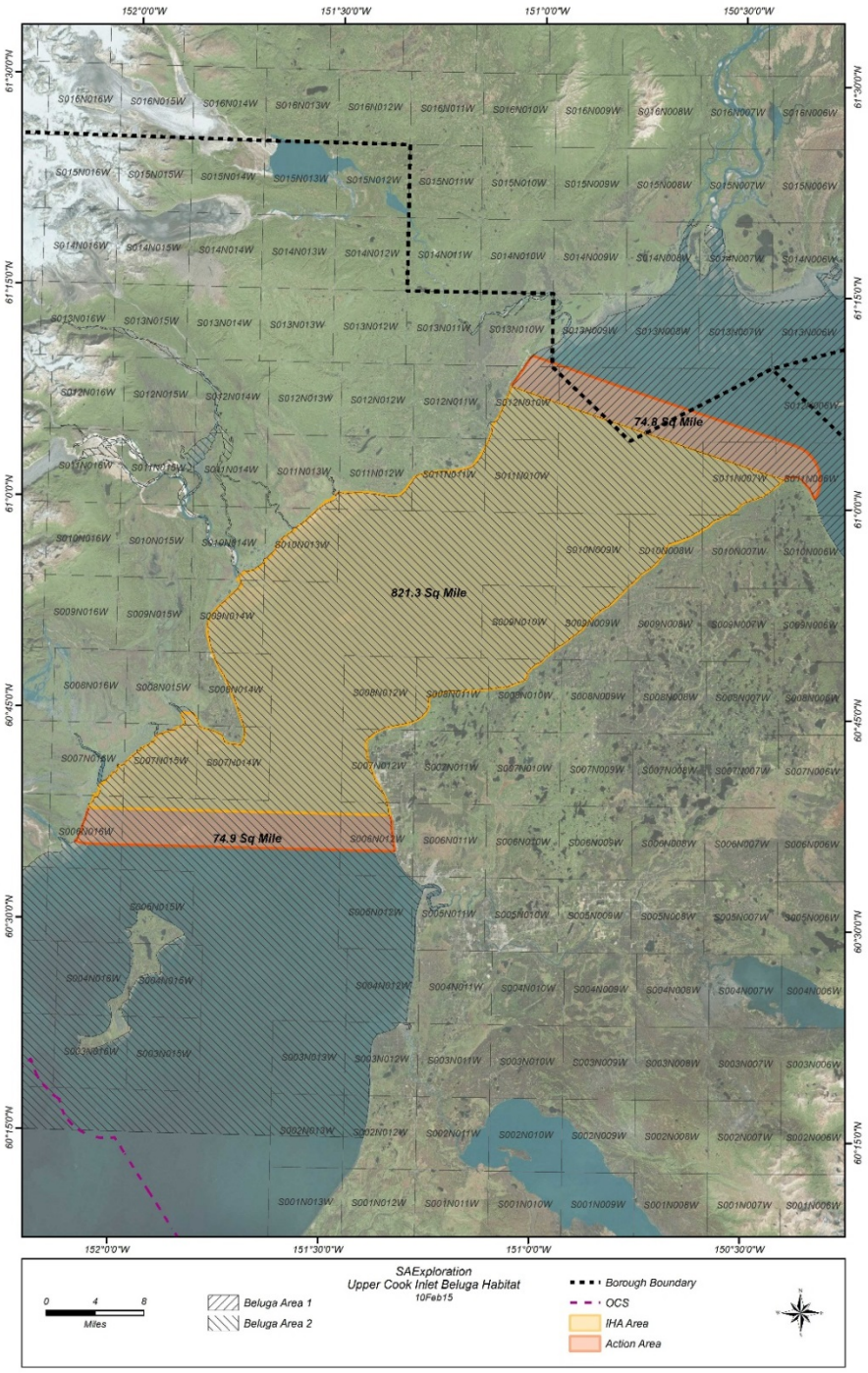

Figure 1. The survey area for upper Cook Inlet. Overlap of black cross-hatching and shaded project area shows the overlap between survey area and the Susitna Delta Exclusion Zone. Area around black cross-hatching will not be surveyed before October 15, 2015.

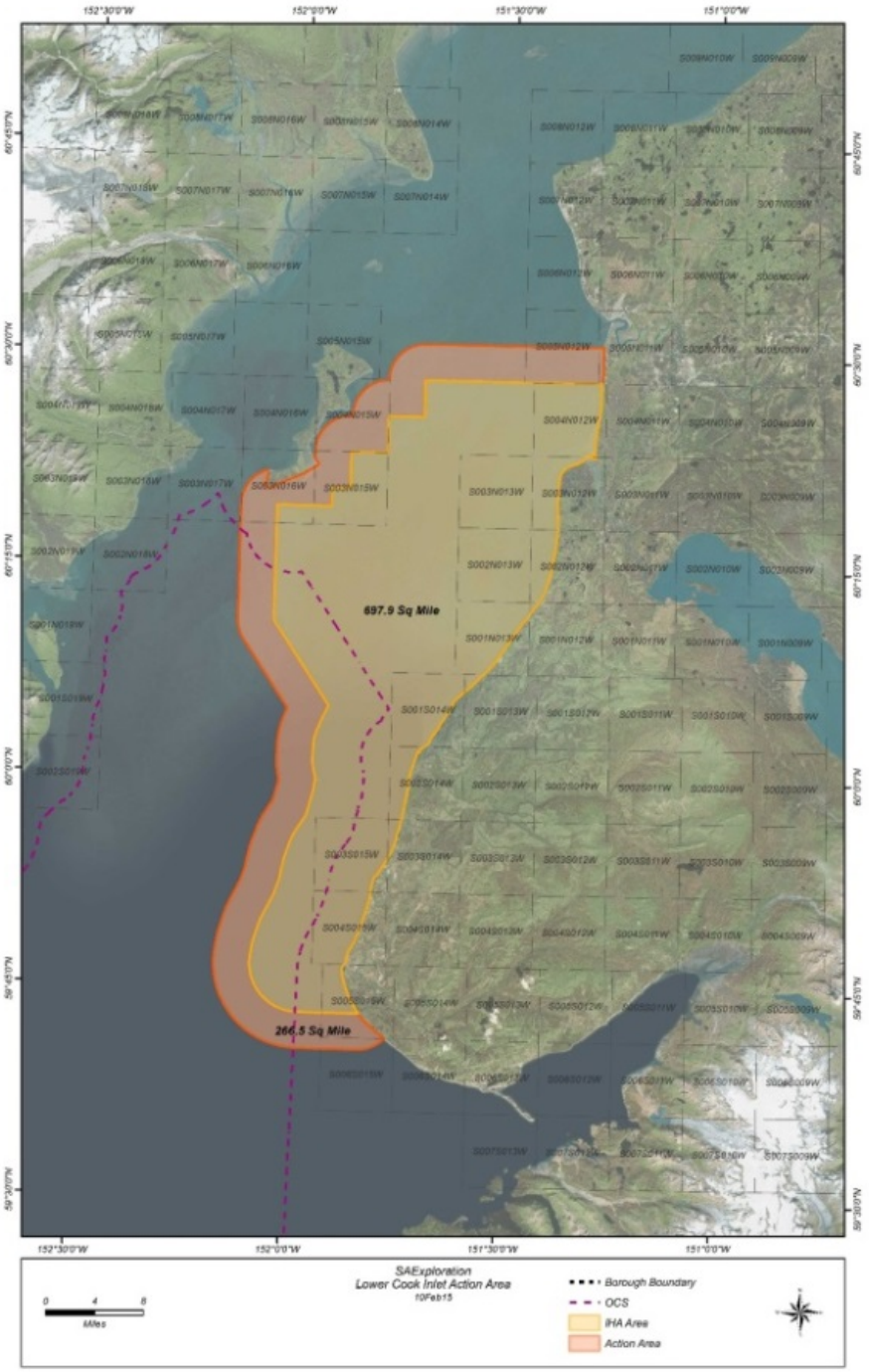

Figure 2. The action area for lower Cook Inlet.

It may take a period of 3-5 days to deploy, shoot, and record a single receiver patch. On average a single patch acquired is approximately 24.2 km^2 (9.35 mi^2) of receiver coverage and 194 km^2 (75 mi^2) of source coverage. On average, SAE may acquire 4.8-8.1 km^2 (1.87-3.1 mi^2) per day of acquired receiver coverage and 48.5 km^2 (18.75 mi^2) of source coverage. During the recording of one patch, nodes from the previously surveyed patch will be retrieved, recharged, and data downloaded prior to redeploying the nodes to the next patch. As patches are recorded, receiver lines are moved side to side or end to end to the next patch location so the receiver lines continuously cover the recording area.

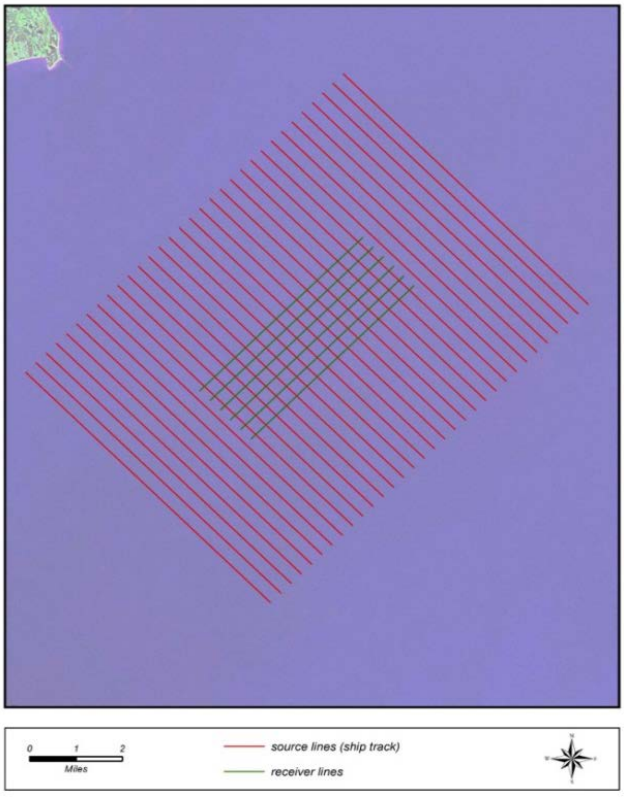

Figure 3. Typical patch layout, with patches are grouped in six receiver lines and 32 source lines.

Autonomous recording nodes lack cables, but will be tethered together using a thin rope for ease in retrieval. This non-floating, non-kinking rope will lay on the seabed surface, as will the nodes; and will have no effect on marine traffic. Primary vessel positioning will be achieved using GPS, with the antenna attached to the airgun array. Pingers deployed from the node vessels will be used to position the nodes. The geometry/patch could be modified as operations progress to improve sampling and operational efficiency.

1.3.1 Dates and Duration of the Action

The surveys and all associated activities, including mobilization and demobilization of survey and support crews, would occur from May through November, 2015. The plan is to conduct seismic surveys in the upper Cook Inlet area in the spring/summer. The northern border of the seismic survey area takes into account the restriction that no activity occur between April 15 to October 15 in waters within 16 km (10 mi) of the Susitna delta (Figure 1). A small wedge of the

upper Cook Inlet area falls within 16 km (10 mi) of the Beluga River mouth, but if SAE surveys this area, it would do so after October 15. The exact survey dates in a given area will depend on ice conditions, timing restrictions, and other factors. If the upper Cook Inlet seismic surveys are delayed by spring ice conditions, some surveys may occur in lower Cook Inlet during May, to maximize use of the seismic fleet. Data acquisition is expected to occur for only 2-3 hours at a time during each of the 3-4 daily slack tides. Thus, it is expected that airguns would operate an average of about 8-10 total hours per day. It is estimated that it will take 160 days to complete both the upper and lower Cook units, and that no more than 777 km^2 (300 mi^2) of survey area will be shot in 2015.

1.3.2 Equipment

The proposed action will make use of standard seismic surveying equipment. Such equipment includes vessels of several sizes and uses; airguns to produce the sound waves necessary to penetrate the seafloor; hydrophones ("nodal recorders") to record the echoes back from the seafloor; positioning sensors to accurately locate the recorders on the seafloor; and support aircraft.

Fuel Storage

Any fuel storage required within the program site will be positioned away from waterways and lakes, and located in modern containment enclosures. The containment's capacity will be 125 percent of the total volume of the fuel stored in the bermed enclosures. All storage fuel sites will be equipped with additional absorbent material and spill clean-up tools. Any fuel transfer or bunkering for offshore activities will occur at dock side or will comply with U.S. Coast Guard bunkering-at-sea regulations.

Seismic Source Array

The primary seismic source for offshore recording consists of a 2 x 880 cubic inch (cui) tri-cluster array for a total of 1,760 cui (although a 440 cui array may be used in very shallow water locations as necessary). Each array will be deployed in the following configuration:

- The arrays will be centered approximately 15 m (50 ft.) behind the source vessel stern, at a depth of 4 m (12 ft.), and towed along predetermined source lines at speeds between 4-5 knots per hour.
- Two vessels with full arrays will operate simultaneously in an alternating shot mode; one vessel shooting while the other is recharging. Shot intervals are expected to be about 16 seconds for each array resulting in an overall shot interval of 8 seconds considering the two alternating arrays.
- Operations are expected to occur 24 hours a day, with daily shooting to total up to 12 hours, because seismic acquisition only occurs during slack tides.

Based on the manufacturer's specifications, the 1,760 cui array has a peak-peak estimated sound source of 254.55 dB referenced to 1 microPascal at 1 m (3.3 ft.) (re 1 µPa @ 1 m), with a root mean square (RMS) sound pressure level (SPL) of 236.55 dB re 1 µPa @ 1 m. The manufacturer provided source directivity plots for the three possible airgun arrays that indicate the acoustical broadband energy is concentrated along the vertical axis (focused downward), while there is little energy focused horizontally. The spacing between airguns results in offset arrival timing of the

sound energy. These delays "smear" the sound signature as offset energy waves partially cancel each other, which reduces the amplitude in the horizontal direction. Thus, marine mammals near the surface and horizontal to the airgun arrays would receive sound levels considerably less than a marine mammal situated directly beneath the array, and at levels probably less than predicted by the acoustical spreading model. As a result, the estimates of the distances to NMFS Level A (injury) and B (harassment) take criteria determined for the IHA are likely conservative. Airguns typically produce most noise energy in the 10-120 Hertz (Hz) range, with some energy extending to 1 kilohertz (kHz) (Richardson et al. 1995). These sounds are within the hearing ranges for the endangered beluga whales, humpback whales, and western DPS Steller sea lions.

Transceivers and Transponders

An acoustical positioning (or pinger) system will be used to position and interpolate the location of the nodes. A vessel-mounted transceiver calculates the position of the nodes by measuring the range and bearing from the transceiver to a small acoustic transponder fitted to every third node. The transceiver uses sonar to interrogate the transponders, which respond with short pulses that are used in measuring the range and bearing. The system provides a precise location of every node as needed for accurate interpretation of the seismic data. The transceiver to be used is the Sonardyne Scout USBL, while transponders will be the Sonardyne TZ/OBC Type 7815-000-06. Because the transceiver and transponder communicate via sonar, they produce underwater sound levels. The Scout USBL transceiver has a transmission source level of 197 dB re 1 μPa_{rms} and operates at frequencies between 35-55 kHz. The transponder produces short pulses of 184-187 dB re 1 μPa_{rms} at frequencies also between 35-55 kHz.

Vessels

Several offshore vessels will be required to support recording, shooting, and housing in the marine and transition zone environments. Exact vessels to be used have not been determined, but similar vessel types typically used to fulfill these roles are found in Table 1.

Source Vessels

Source vessels will have the ability to deploy two arrays off the stern using large A-frames and winches and have a draft shallow enough to operate in waters less than 1.5 m (5 ft.) deep. On the source vessels, the airgun arrays are typically mounted on the stern deck with an umbilical that allows the arrays to be deployed and towed from the stern without having to re-rig or move arrays. The two marine vessels that have been used in the past are the *Peregrine Falcon* and *Arctic Wolf*. Each vessel's "acoustic signature" was measured by Aerts et al. (2008) and has source levels of 179 dB re 1 μPa_{rms} and 200 dB re 1 μPa_{rms}, respectively.

Recording Deployment and Retrieval

Jet-driven shallow draft vessels and bow-pickers will be used for the deployment and retrieval of the offshore recording equipment. These vessels will be rigged with hydraulically driven deployment and retrieval equipment allowing for automated deployment and retrieval from the vessel's bow or stern. Aerts et al. (2008) found the recording and deployment vessels to have source levels of approximately 165 dB re 1 μPa_{rms}, while the smaller bow pickers produce more cavitation resulting in higher source levels of 172 dB re 1 μPa_{rms}.

Table 1. Proposed vessels to be used during SAE's 2015 seismic survey program and maximum acoustic output attributed to that vessel.

Operation	Size (ft.)	Main Activity with Vessel Operations	Vessel Source Level (dB)1
Source vessel ***Arctic Wolf*** **or similar**	135 x 38	Seismic data acquisition 24 hour operation	200
Source vessel ***Peregrine Falcon*** **or similar**	99 x 24	Seismic data acquisition 24 hour operation	179
Node equipment deployment and retrieval ***Miss Diane I*** **or similar**	85 x 20	Deploying and retrieving nodes 24 hour operation	165
Node equipment deployment and retrieval ***Mark Stevens*** **or similar**	85 x 24	Deploying and retrieving nodes 24 hour operation	165
Node equipment deployment and retrieval ***Maxime*** **or similar**	70 x 16	Deploying and retrieving nodes 24 hour operation	165
Mitigation/Housing Vessel ***Dreamcatcher*** **or similar**	85 x 23	House crew 24 hour operation	200
Crew Transport Vessel ***TBD***	30 x 20	Transport crew Intermittent 8 hours	192
Bow picker ***Sleep Robber*** **or similar**	32 x 14	Deploying and retrieving nodes Intermittent operations	172
Bow picker ***BD***	32 x 14	Deploying and retrieving nodes Intermittent operations	172

[1]Sound source levels from Aerts et al. (2008) based on empirical measurements of the same vessels expected to be used during this survey.

Housing and Transfer Vessels

Housing vessel(s) will be larger with sufficient berthing to house crews and management personnel. The housing vessel will have ample office and bridge space to facilitate the role as the mother ship and central operations. Crew will be largely housed aboard the source vessel *Arctic Wolf* and the mitigation vessel *Dreamcatcher* (or similar vessels), both with large numbers of berths. The crew transfer vessels (*Gwyder Bay* or similar) will be sufficiently large to safely transfer crew between vessels as needed. The crew transfer vessel travels infrequently relative to other vessels and is operated at different speeds. During high-speed runs to shore, the *Gwyder Bay* was found to produce source noise levels of about 192 dB re 1 μPa_{rms}, while during slower on-site movements the vessel source levels were 166 dB re 1 μPa_{rms} (Aerts et al. 2008).

Mitigation Vessel

To facilitate marine mammal monitoring of the 160 dB disturbance zone (Level B), one dedicated vessel (a mitigation vessel) will be deployed a few kilometers from the active seismic source vessels to provide a survey platform for two or three Protected Species Observers (PSO). These PSOs will work in concert with PSOs stationed aboard the source vessels, and will provide an early warning about the approach of any marine mammals from their direction. The

Dreamcatcher, or a similar boat, will fulfill this role. There is no available acoustic signature for the *Dreamcatcher*, but it is similar in size to the *Peregrine Falcon* and therefore, is expected to have a similar source sound level (179 dB re 1 μPa_{rms}).

1.3.3 Mitigation Measures

Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions could be exposed to seismic sound during SAE's proposed Cook Inlet 3D seismic program. SAE will implement mitigation measures to:

1. Ensure that Level A takes of marine mammals will not occur.
2. Minimize Level B takes of marine mammals.

Mitigation measures include: marine mammal monitoring, course alteration, ramp-up, power-down and complete shutdown procedures. SAE designed its operations such that, prior to October 15, no work will be conducted north of a line connecting Point Possession and 3-Mile Creek, thereby avoiding the upper inlet area during the summer where most Cook Inlet beluga whales are concentrated (see 50 CFR 226.220).

Protected Species Observers (PSOs)

Seismic and mitigation vessels will provide suitable platforms for PSOs. PSOs stationed on the bridge will have an unobstructed view around the entire vessel. If surveying from the bridge, the PSO's eye level will be about 4.6 m (15 ft.) above sea level.

SAE will hire qualified PSOs. These PSOs will be stationed aboard all source and mitigation vessels to implement the marine mammal monitoring plan and ensure the appropriate mitigation measures are followed during all seismic operations. PSOs will ensure effective communication between and among all PSOs, vessel operators, and SAE personnel.

At least two PSOs will be stationed on each of the two source vessels and the mitigation vessel to fully cover the 160 dB disturbance zone. Seismic exploration operations will be separated into 3-4 daily sessions, up to three hours each. PSOs will rotate shifts after no more than four hours, with at least one hour rest between shifts. Overall PSO work days should not exceed 12 hours; and by NMFS calculations, six PSOs should be sufficient for this project.

Protected Species Observer Role and Responsibilities

Roles and responsibilities of all PSOs constitute three integral parts:

1. Accurately observe and record marine mammal species: Cook Inlet beluga whales, humpback whales, and Steller sea lions.
2. Follow monitoring and data collection procedures.
3. Ensure mitigation measures are followed.

PSOs will be stationed at the best available vantage point on the source and mitigation vessels (bridge), which allows an unobstructed 360 degree view. PSOs will scan systematically with the unaided eye and with 7x50 reticle binoculars, which are supplemented with 40x80 long-range binoculars. New PSOs will be paired with experienced PSOs to ensure the quality of marine mammal observations and data recording are consistent.

During periods when visual survey conditions are not conducive (due to environmental conditions such as: high sea state, fog, ice, low light, night time) to effectively monitor the designated applicable 160 dB disturbance zone, SAE will operate a 164 cm^3 (10 cui) mitigation gun when airgun arrays are not operating, with the intention of alerting marine mammals that seismic guns are in the area, thereby, allowing them to clear the area before SAE ramps the airguns up to noise levels that might be harmful when visual survey conditions permit effective monitoring of the disturbance zone.

All field data collected will be entered into a custom database. Weather data and viewing conditions will be collected hourly, on rotation, and when sightings occur, including:

- Beaufort scale
- Wind speed and direction
- Sun position
- Percent glare

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

- Bearing and distance to the initial 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, possibly 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.)
- Description of physical features that were observed, or determined not to be present with unknown or unidentified animals
- Time of sighting
- Location, speed, and activity of the source and mitigation vessels, and positions of the other vessel(s) in the project area
- Conditions: sea state, ice cover, visibility, and sun glare
- Mitigation measures taken

PSOs will monitor continuously:

1. For a minimum of 30 minutes prior to the planned start of airgun or pinger operations;
2. During daylight hours when seismic activities occur; and
3. After an extended shut down lasting more than 10 minutes.
    a. If marine mammals are sighted within the designated disturbance zone (waters within the 160-180 dB isopleth) (Table 2), airgun operators will not start seismic activities or will immediately shut down the activities.

To avoid injurious Level A take, SAE will power down or shut down operations in the event that a cetacean appears likely to enter, or enters, the 180 dB exclusion zone, or a pinniped appears likely to enter, or enters, the 190 dB exclusion zone (Table 2). NMFS AKR notes that any animal that enters its respective exclusion zone will be considered to have been subjected to Level A take under the MMPA, which is not authorized for this action.

Table 2. Maximum threshold distances for the mitigation airgun and two airgun arrays. 90th percentile distances (the distance within which 90 percent of observations occur) are maximized with direction and environment for airguns, and correspond to 180/190 dB exclusion and 160 dB disturbance zone radii for marine mammals, as indicated. Data for 440 cui airgun array (Austin and Warner 2012). Data for 1760 cui airgun array from Heath et al. 2014.

SPL_{rms90} Threshold ($dB\ re\ 1\ \mu Pa_{rms}$)	90th Percentile Distance (m)			
	Pinger[1]	10 cui	440 cui	1,760 cui
190, Level A pinniped exclusion zone[2]	1	10	50	880
180, Level A cetacean exclusion zone[3]	3	10	182	1,840
160, Level B marine mammal disturbance zone[4]	25	280	3,050	6,830

[1]Pinger exclusion zones assume a simple spreading loss of 20 log R (where R is radius) with a source level of 188 dB

[2]Each listed pinniped observed at less than the indicated distance during operational volumes of the indicated sound source must be considered to have been subjected to Level A take under the MMPA and must count as one take each time the individual enters the area so ensonified.

[3]Each listed cetacean observed at less than the indicated distance during operational volumes of the indicated sound source must be considered to have been subjected to Level A take under the MMPA and must count as one take each time the individual enters the area so ensonified.

[4]Each listed marine mammal observed at less than the indicated distance during operational volumes of the indicated sound source must be considered to have been subjected to level B take under the MMPA and must count as one take each time the individual enters the area so ensonified.

All observations and airgun shut-downs will be recorded in a standard form with data entered into a digital database. Quality control of all PSO data will be conducted daily by a designated PSO with experience in data quality control. These procedures will reduce errors; allow the preparation of short-term data summaries; and facilitate data transfer to statistical, graphical, or other programs for further processing and archiving.

Sound Source Verification

Sound source verification tests on the same airgun arrays proposed for 2015 surveys were conducted by Heath et al. (2014) during previous Cook Inlet operations. The sound source verification results were used to estimate distances to the NMFS Level A and Level B acoustic thresholds. Sound source verification for the vessels proposed to be used during the 2015 Cook Inlet operations were also conducted in 2008 (Aerts et al. 2008).

Marine Mammal Monitoring Radii

The seismic airguns that will be used during SAE's Cook Inlet operation have the potential to acoustically injure marine mammals at distances less than or equal to those indicated in Table 2. The IHA issued by NMFS PR1 will establish monitoring radii appropriate for cetaceans and pinnipeds for each airgun and airgun array as indicated in Table 2. Waters within these radii will be monitored according to PSO protocols described in this biological opinion.

While the pingers and transponders that will be used to determine precise positions of nodes generate sound source levels (185-193 dB) that exceed Level A criterion, the exclusion zones of ensonification are small (radii of 0-6 m [0-20 ft.]). These exclusion zones of harmful ensonification make marine mammal monitoring impractical (a 6 m [20 ft.] radius equates to only a 113 m^2 [1,216 $ft.^2$]) ensonification area), with more than half the area occupied by the deployment vessel. Further, marine mammals would likely avoid the vessel at that distance simply due to vessel disturbance. PSOs and operators will, however, ensure that no marine mammals are in the immediate vicinity of the vessel before deploying active pingers and transponders.

Housing and crew transfer vessels can produce noises exceeding 190 or 180 dB re 1 μPa_{rms} when traveling at higher speeds. However, these exclusion zones only extend 2-4 m (6.5-13.1 ft.) from the vessel and marine mammals are likely to avoid approaches of less than 4 m to these vessels.

Marine Mammal Monitoring

To minimize disturbance of, and effects of seismic and vessel activity upon, marine mammals, SAE will have a vessel-based PSO program. Monitoring will be conducted by qualified PSOs positioned and equipped so that they can effectively monitor the entire 160 dB disturbance zone as indicated in Table 2. PSOs will continuously monitor the appropriate exclusion and disturbance zones (as indicated in Table 2) for listed cetaceans and pinnipeds for 30 minutes prior to ramp-up and throughout seismic operations.

If one or more threatened or endangered marine mammals are detected adjacent to, but outside of the 160 dB disturbance zone, and it is determined by any PSO that the animal or animals are likely to enter the 160 dB disturbance zone, then the PSO will issue an order to power down seismic operations or, if warranted, switch to use of a mitigation gun.

If one or more threatened or endangered cetaceans are not detected until they are adjacent to, but outside of, the 180 dB cetacean exclusion zone, or if one or more threatened or endangered pinnipeds are detected adjacent to, but outside of, the 190 dB pinniped exclusion zone, and it is determined by any PSO that the animal or animals are likely to enter the exclusion zone, then the PSO will issue the order to shut down seismic operations. Otherwise, SAE will power down seismic operations since the animal will have entered the disturbance zone without detection prior to that point in time.

PSOs will also:

- Monitor: record the number of animals, by species, exposed to sound pulses and their reactions (where applicable); and document those incidents as required.
- Mitigate: Implement methods that reduce marine mammal harassment, which includes: start-up and ramp-up protocols; observe for and detect marine mammals within, or about to enter the 160 dB disturbance zone, 180 dB cetacean exclusion zone, or 190 dB pinniped exclusion zone; implement necessary shut-down, power-down and/or speed/ course alteration mitigation procedures as appropriate; and advise seismic vessel captain and crews of mitigation procedures that need to be taken immediately.

- Ensure compliance with all permit conditions, including those of the IHA, and the non-discretionary Incidental Take Statement (ITS) Reasonable and Prudent Measures (RPMs); and the associated implementing Terms and Conditions that result from this biological opinion.
- Document the effects of the proposed seismic activities on marine mammals.
- Collect data on the occurrence and distribution of marine mammals in the proposed project area (see Reporting).

Speed or Course Alteration

Whenever a listed marine mammal is detected outside the 160 dB disturbance zone, the vessel operators may adjust its ship speed and/or course to help avoid having the animal(s) enter the disturbance zone. However, vessel captains should note that multiple course alterations made in close proximity to marine mammals make it more difficult for the animals to predict the vessels track and hinders the animals own ability to avoid vessels. Therefore, as an additional mitigation measure, SAE proposes the following: vessel captains will avoid multiple changes in direction or speed when vessels are underway within 1 km (0.6 mi) of listed cetaceans. Vessels will always operate at less than 8 knots when within 1 km (0.6 mi) of Cook Inlet beluga whales. Vessels shall not be operated in a manner that would separate members in a whale group from other members in that group. Vessel captains should always avoid approaching within 1 km of any group of 5 or more Cook Inlet beluga whales.

Power-Down Procedures

A power-down procedure involves reducing the number or size of airguns in use. A power-down can result in the use of the mitigation gun alone. Power-down procedures will begin immediately upon observing one or more listed marine mammals within their respective 160 dB disturbance zone by any member of the vessel crew or upon orders by the PSO. If one or more threatened or endangered marine mammals are detected adjacent to, but outside of the 160 dB disturbance zone, and is determined by any PSO that the animal or animals are likely to enter the 160 dB disturbance zone, then power-down procedures will be implemented. Increase in acoustic output from airguns or airgun arrays will not occur until the 160 dB disturbance zone is void of listed marine mammals. The 160 dB disturbance zone will be considered void of listed marine mammals if:

- The animals that were observed within the 160 dB disturbance zone were all observed to have left the 160 dB disturbance zone; or
- No listed marine mammals have been seen within the 160 dB disturbance zone for:
    - 15 minutes, in the case of pinnipeds;
    - 30 minutes, in the case of cetaceans.

Note that if a power-down lasts for more than 10 minutes, ramp up procedures will be followed.

Shut-down Procedure

A shutdown occurs when all airgun activity (including mitigation guns) ceases. Shut-down procedures will begin immediately upon observing one or more listed marine mammals within their respective exclusion zone by any member of the vessel crew, or upon orders by any PSO. In addition, if one or more threatened or endangered cetaceans are detected adjacent to, but outside of, the 180 dB cetacean exclusion zone, or if one or more threatened or endangered pinnipeds are

detected adjacent to, but outside of, the 190 dB pinniped exclusion zone, and it is determined by any PSO that the animal or animals are likely to enter the exclusion zone, then the PSO will issue the order to shut down seismic operations.

Following a shutdown, airgun activity will not resume until the 160 dB disturbance zone is void of listed marine mammals. The 160 dB disturbance zone will be considered void of listed marine mammals if:

- The animals that were observed within the 160 dB disturbance zone were all observed to have left the area and no other animals have entered the disturbance zone since the shut down: or
- Listed marine mammals have not been seen within the 160 dB disturbance zone for:
    - 15 minutes, in the case of pinnipeds,
    - 30 minutes, in the case of cetaceans.

After a shutdown of seismic operations, ramp-up procedures will be followed. If there is a gap in airgun operations of more than 30 minutes between sunset and sunrise, seismic survey activities will be suspended until after sunrise and at such time that the entirety of the 160 dB disturbance zone is visible for at least 30 minutes prior to commencing ramp-up.

Ramp-up Procedures

A ramp-up procedure gradually increases airgun volume at a specified rate to encourage any marine mammals to leave the area prior to experiencing harm. SAE will use the ramp-up procedure prior to commencing airgun operations after shutdowns and prior to increasing acoustic output (e.g. switching from using a 440 cui airgun array to a 1760 cui airgun array.

The ramp-up rate shall be less than a 6 dB increase in volume per five minute period. Ramp-up will begin with the smallest gun in the array configurations.

During the pre-ramp-up observation period, the entire 160 dB disturbance zone must be visible at all times. Ramp-up will not be initiated if a listed marine mammal is observed within the 160 dB disturbance zone. Should marine mammals enter the 160 dB disturbance zone during ramp-up, ramp-up operations will cease until the disturbance zone is void of all listed marine mammals. At this time, ramp-up procedures will begin anew (i.e., the process will not resume at the level of acoustic output at which ramp-up was discontinued due to the presence of marine mammals). Pre-ramp-up observation periods are not necessary if a mitigation gun has been operating continuously during a daytime power-down or during a daytime shut-down lasting less than 10 minutes.

Ramping up following a power-down that concluded between sunset and sunrise will only occur if the source vessels' mitigation gun has been operating continuously since initiation of the power-down, noting that the mitigation gun may not be operated for more than three hours at a time.

Ramp-up procedures are not required if there has been an interruption of airgun operations for less than 10 minutes, and operations are returning to a state in which acoustic output is equal to or less than what was occurring prior to the <10-minute interruption of airgun acoustic output.

Reporting

Weekly Reports

Weekly reports will be submitted to NMFS PR1 and NMFS AKR no later than the close of business (Alaska Time) each Thursday during the weeks when in-water seismic activities take place. The weekly reports will summarize all marine mammal observations: species, number, estimated geographic coordinates of animals to the nearest second of latitude and longitude, animal behavior or activity, observed reactions to seismic activity, number of marine mammals taken, and whether they were subjected to level A or level B take.

Monthly Reports

Monthly reports will be submitted to NMFS PR1 and NMFS AKR for all months when in-water seismic activities occurred. The monthly report will contain and summarize the following information:

- Marine mammal species observed; date and time of observation; maximum estimated group size; time stamped geographic coordinates for animals and source vessel to the nearest second of latitude and longitude, each reported in five minute intervals; distance from the vessel; behavior or activity of all sighted marine mammals, as well as associated seismic activity; note date, time, and geographic coordinates where seismic activity changed (e.g., power-downs , shutdown or ramp-up initiated, full-volume operations initiated and completed).
- Species-specific estimate of the number of individual:
    - Cetaceans exposed to the seismic activity (based on visual observation) at received levels greater than or equal to 160 dB re 1 μPa_{rms} and 180 dB re 1 μP_{rms}, with a discussion about specific behaviors those individuals exhibited
    - Pinnipeds exposed to the seismic activity (based on visual observation) at received levels greater than or equal to 160 dB re 1 μPa_{rms} and 190 dB re 1 μPa_{rms}, with a discussion about specific behaviors those individuals exhibited
- A description of number and proportion of operational days in compliance with, and the effectiveness of the:
    - Biological Opinion's ITS Terms and Conditions
    - IHAs mitigation measures
    - ITS Conservation Recommendations (if implemented).

Final Technical Report

A final technical report will be submitted to NMFS PR1 and NMFS AKR within 90 days after the final seismic shot has been fired for the season, or at least 60 days before the request for another Incidental Take Authorization for the next open water season, which would enable NMFS PR1 to incorporate observation data into the next IHA and Biological Opinion. The report will summarize all seismic activities and marine mammal monitoring results (i.e., vessel and shore-based visual monitoring) conducted during in-water seismic surveys. The Final Technical Report will include the following:

- Summaries that include monitoring effort (e.g., total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors that affect visibility and detectability of marine mammals)
- Analyses on the effects of various factors that influence detectability of marine mammals (e.g., sea state, number of observers, fog, glare, etc.)

- 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
- Number of marine mammals observed (by species) during periods with and without seismic survey activities (and other variables that could affect detectability), such as:
    - Initial sighting distances versus survey activity state
    - Closest point of approach versus survey activity state
    - Observed behaviors and movement types versus survey activity state
    - Numbers of sightings/individuals seen versus survey activity state
    - Distribution around the source vessels versus survey activity state

All reporting units will be clearly defined. Derived values, including but not limited to rates and proportions, will reference the formulae used to obtain those values and the measured parameters used to calculate derived values.

Notification of Injured or Dead Marine Mammals
In the event that activity associated with this action is determined by the PSO or NMFS AKR to have taken a marine mammal in a manner not authorized by the IHA or not anticipated in this biological opinion, (e.g., gear interaction, gear entanglement, ship-strike, or other harmful interactions), SAE will immediately cease airgun operations and report the incident to NMFS PR1 and the Alaska Regional Stranding Coordinator. The report will include the following information:

- Time, date, and location (latitude/longitude) and nature of the incident
- Name and type of vessel involved
- Vessel's location, speed and heading prior to the incident and prior to any last minute evasive actions.
- Narrative of the incident
- Time, location, and acoustic output-specific reporting of all project vessels for the 24 hour period prior to the incident.
- Water depth at the location of the incident
- Environmental conditions (e.g., wind speed and direction, Beaufort scale, 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)
- Photographs and/or video footage of the animal(s) (if equipment is available).

Activities would not resume until formal consultation with NMFS PR1 on this activity has been reinitiated.

SAE will report sightings of all observed marine mammal carcasses as soon as possible to NMFS AKR, NMFS PR1, and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinator, noting carcass location, species, date and time observed, and subjective assessment on the degree of composition. Seismic activities will continue unaffected unless NMFS AKR determines that activities associated with this action played a role in causing the death of the animal(s).

2. STATUS of the SPECIES

The Cook Inlet beluga whale, western DPS Steller sea lion, and humpback whale are the only threatened or endangered species under NMFS's jurisdiction likely to occur in the action area.

2.1 Cook Inlet Beluga Whales

The Cook Inlet beluga whale was listed as endangered under the ESA on October 22, 2008 (73 FR 62919), and critical habitat was designated April 11, 2011 (76 FR 20180). A detailed description of the Cook Inlet beluga whales' biology, habitat and extinction risk factors may be found in the proposed listing rule (72 FR 19854, April 20, 2007), the 2008 Status Review and Status Review Supplement (Hobbs et al. 2008; Hobbs and Shelden 2008), and the Conservation Plan for the Cook Inlet beluga whale (NMFS 2008a). Additional information regarding Cook Inlet beluga whale can be found in the NMFS Stock Assessment Report at http://www.nmfs.noaa.gov/pr/sars/pdf/ak2013_final.pdf, as well as on the NMFS AKR web site at: http://alaskafisheries.noaa.gov/protectedresources/whales/beluga.htm.

2.1.1 Species Description and Taxonomy

The beluga whale is a small, toothed whale in the family Monodontidae, a family shared with only the narwhal. Beluga whales are also known as "white whales" because of the adults' white coloration. 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). Adult males may weigh up to 1,497 kilograms (kg) (3,300 pounds [lbs.]). Adult females are typically smaller, and weigh up to 1,361 kg (3,000 lbs.) (Nowak 2003). The cervical vertebrae in beluga whales are not fused, allowing them to turn and nod their heads. Instead of a dorsal fin, beluga whales have a tough dorsal ridge. They also have a relatively small head, fluke, and flippers.

2.1.2 Range

To identify Cook Inlet beluga habitat use, particularly in winter, NMFS researchers placed satellite positioning tags on 18 beluga whales during 1999-2002. Those tagged whales remained in Cook Inlet, indicating that beluga whales occupy Cook Inlet year-round and do not display the seasonal migrations of northern beluga populations (Hobbs et al. 2005). Given the best scientific information available, NMFS determined the Cook Inlet beluga whales comprise a DPS that is confined to Cook Inlet waters, and does not include beluga whales found in Yakutat or other Gulf of Alaska waters, beyond Cook Inlet. Thus, the range of Cook Inlet beluga whale DPS has been defined as the waters of Cook Inlet, north of a line from Cape Douglas to Cape Elizabeth (72 FR 19854, April 20, 2007).

During the 1970s, the summer distribution of Cook Inlet beluga whales included the upper, mid, and lower parts Cook Inlet, in both coastal and offshore waters (Harrison and Hall 1978; Murray and Fay 1979). An August 1979 survey observed beluga whales throughout Cook Inlet (Calkins 1989). Calkins (1983) indicated that beluga whales were "seen throughout the year in the central and lower inlet, with heaviest use occurring in the central area". Others reported seeing hundreds of beluga whales continuously throughout Cook Inlet in the 1970s and 1980s, including areas where few whales are now found.[2] Local knowledge and other historical evidence show that

[2] Foster, S. 1995. New York Life, Anchorage, Alaska. Personal communication via B. Mahoney (NMFS).

prior to the 1990s beluga whales were regularly observed in lower Cook Inlet waters, both nearshore and offshore (Huntington 2000; Rugh et al. 2000). Opportunistic sightings of beluga whales, as recently as 1996, in Kamishak Bay (i.e., lower Cook Inlet) were made during intermittent Pacific herring (*Clupea pallasii*) surveys flown during late April and early June, 1979-2002.[3] This information indicates that these areas were important habitats when the beluga whale population was larger. These reported observations provide evidence that beluga whales (1- 60 whales) formerly frequented Iniskin Bay,[4] Iliamna Bay, and Kamishak Bay in the lower inlet during spring and summer.

Dedicated surveys in the lower inlet (south of Kalgin Island) during late July through August 1995-1999, did not document beluga whales (Speckman and Piatt 2000). Annual aerial abundance surveys by NMFS during June 1994-2012 and 2014, show that beluga whales are no longer regularly observed in the lower inlet, with the last observation in 2001 (Rugh et al. 2005, 2010). Alaska Native traditional knowledge and systematic aerial surveys have documented a contraction in the summer range of Cook Inlet beluga whales (Huntington 2000; Rugh et al. 2010). While beluga whales were once abundant and frequently sighted in the mid and lower inlet during summer, they are now primarily concentrated in the upper inlet during summers,

It is unknown if the current contracted distribution is a result of changing habitat (Moore et al. 2000), predator avoidance (Shelden et al. 2003), or a shift of a reduced population into preferred habitat areas that offer the most abundant prey, most favorable feeding topography, and the best calving areas (Rugh et al. 2010; Goetz et al. 2007). Regardless, the result is a smaller distribution range in greater proximity to Anchorage, Alaska. While the population's overall range contracted within Cook Inlet as the population declined, whales continue to inhabit predictable locations and in patterns clearly related to time of year and the appearance of seasonally important prey resources. The range contraction of this population northward into the upper inlet makes it far more vulnerable to catastrophic events, with the potential to kill a significant fraction of the population. If and when the Cook Inlet beluga population begins to increase, a reoccupation of mid and lower inlet habitats during the summer months may be the first indication of recovery.

In 2012, NMFS aerial surveys to estimate the Cook Inlet beluga whale population abundance consistently documented beluga whales in Trading Bay, near West Forelands and MacArthur River. This was the first sighting of beluga whales in this region since the 2001 aerial surveys, and the first time consistent sightings in the area were made since 1995 (Shelden et al. 2013).

2.1.3 Distribution and Movements

Beluga whales generally occur in shallow, coastal waters, often in water barely deep enough to cover their bodies (Ridgway and Harrison 1981). Little information is available on the beluga whale distribution in Cook Inlet prior to 1970; however, in the 1970s and 1980s, beluga sightings occurred throughout upper and lower Cook Inlet (Calkins 1984).

Beluga whales remain in Cook Inlet year-round, as evidenced by satellite tagging studies (Goetz et al. 2012), monthly aerial surveys conducted between June 2001 and June 2002 (Rugh et al.

[3] Otis, T. 2008. Alaska Department of Fish and Game, Homer Alaska. Personal communication via J. Wilder (NMFS)

[4] Magowan, J. 2008. Turnagain Times, Girdwood, Alaska. Personal communication via B. Mahoney (NMFS).

2004), systematic aerial surveys (Rugh et al. 2000, 2005, Shelden et al. 2013), boat and land based observations (Speckman and Piatt 2000; McGuire et al. 2008, 2009, 2011a, 2011b), Alaska Native traditional ecological knowledge (Huntington 2000, Braund and Huntington 2011), and opportunistic reports (Rugh et al. 2000; Vate-Brattstrom et al. 2010; NMFS unpublished data). Although beluga whales remain year-round in Cook Inlet, they demonstrate seasonal movements within the inlet. During summer and fall, beluga whales concentrate in rivers and bays in upper Cook Inlet; while in winter and early spring, they tend to disperse offshore and in mid Inlet (Goetz et al. 2012). There is obvious and repeated use of certain habitats by these whales. Beluga whales were consistently documented in Knik Arm; Turnagain Arm; and the Susitna delta, (Rugh et al. 2010; Goetz et al. 2012; McGuire et al. 2008, 2009, 2011; NMFS unpublished data).

The timing and location of eulachon (*Thaleichthys pacificus*) (i.e., hooligan or smelt) and salmon (*Oncorhynchus sp*.) runs have a strong influence on the beluga whales' spring and summer movements. In late April and early May, beluga whales are regularly sighted feeding on the eulachon and Chinook salmon (*O. tshawytscha*) in the Susitna River and eulachon in the Twenty Mile River, Turnagain Arm. During the various salmon runs, whales are documented near the Susitna delta, and regularly visit Knik Arm and Turnagain Arm in August feeding on coho salmon (*O. kisutch*). During May 2011 and 2012, beluga whales were documented in the Kenai River (McGuire et al. 2014; NMFS unpublished data).

Satellite telemetry data and traditional knowledge supports beluga whale use along the west side, during late summer and fall, from Susitna delta, south to Chinitna Bay (Huntington 2000; Goetz et al. 2012). As recently as September 2007, 25-30 beluga whales were sighted in Chinitna Bay, suggesting that some beluga whales still visit the lower inlet in the fall.[5]

Prior to satellite tagging data during 2000-2003, the winter distribution of this stock was poorly understood; in part, because winter aerial surveys were limited (Rugh et al. 2004). Eight dedicated aerial surveys in Cook Inlet during February 12-March 14, 1997 resulted in a few beluga whale sightings (Hansen and Hubbard 1999). Conversely, satellite data showed tagged whales used Knik and Turnagain Arms for much of the tracked time (August-March), venturing as far south as Redoubt Bay (October), East Foreland (December-January), and Kalgin Island (January) (Goetz et al.2012).

The available information indicates that Cook Inlet beluga whales move throughout mid to upper Cook Inlet in the winter months. They concentrate in deeper waters in mid Inlet near Kalgin Island, with occasional forays into the lower inlet and upper inlet, including the upper ends of Knik and Turnagain Arms. Although the beluga whales move into the mid to lower inlet during the winter, ice cover does not appear to limit their movements. Winter distribution does not appear to be associated with river mouths, as it is during the warmer months. Spatial dispersal and diversity of winter prey likely influences the wider beluga whale winter range, throughout the mid Inlet.

A marine mammal monitoring program sighted Cook Inlet beluga whales during May-September 2012 operations. Cook Inlet beluga whales were most often sighted in coastal waters, less than 1 km (0.6 mi) from shore, from Susitna River to Trading Bay, Cook Inlet (Figure 4). About 57

[5] Baird, S. 2008. Kachemak Bay Research Reserve, Homer, Alaska. Personal communication, via M. Migura, NMFS

percent of the whales were in river mouths associated with the Susitna delta, which includes: Beluga, Theodore, Lewis, Ivan, and Susitna rivers. These observations support other data that emphasize the importance of the Susitna delta to Cook Inlet beluga whales during May-September.

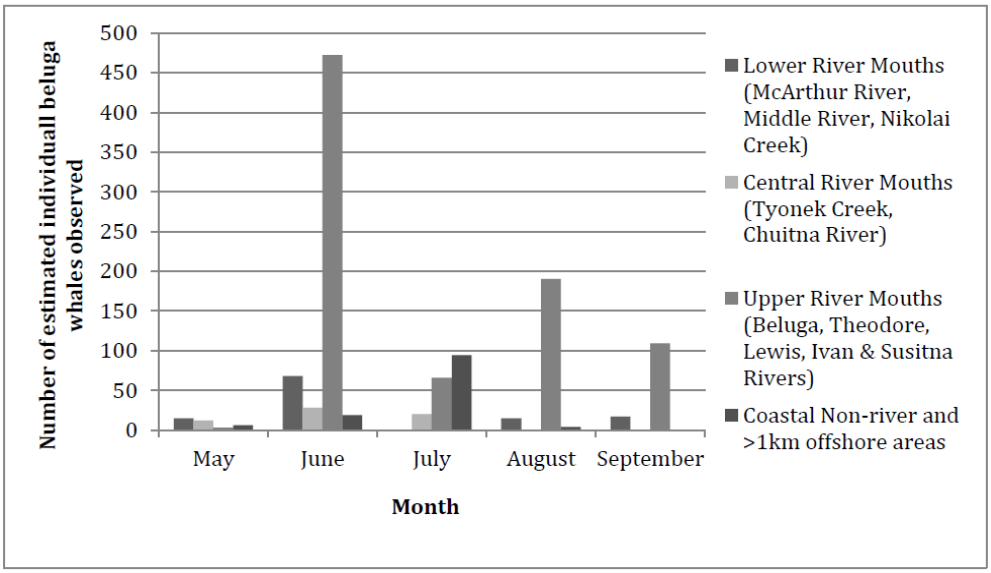

Figure 4. Beluga whales and their seasonal habitat use in mid to upper Cook Inlet during 2012 (Lomac-MacNair et al. 2013).

2.1.4 Biology and Behavior

Beluga whales are extremely social animals that typically interact together in close, dense groups. Groups with 10 to more than 100 whales have been observed in Cook Inlet. It is unknown if these whale groups represent distinct social divisions; however, Reeves et al. (2002) found that beluga groups are often of the same gender and age class. Traditional knowledge suggests that Cook Inlet beluga whales maintain family groups (Huntington 2000).

Beluga whales may live 35-50 years. Sexual maturity can vary from 4-10 years for females and 8-15 years for males. While mating is assumed to occur sometime between late winter and early spring, there is little information available on beluga whale mating behavior. Beluga whales typically give birth to a single calf every 2-3 years, after a gestation period of about 14 months. 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). Most calving in Cook Inlet is assumed to occur from mid-May to mid-July (Calkins 1984; NMFS unpublished data), although Native hunters have observed calving during April-August (Huntington 2000).

Beluga whales normally swim about 2-6 miles per hour, but when pursued, can attain a speed of 14 miles per hour. While they usually surface to breathe every 30-40 seconds, tagging studies show they also routinely dive for longer periods (9.3-13.7 minutes) and to depths of 20-347 m (66-1,140 ft.), presumably for feeding (Nowak 2003). Data from satellite tagged Cook Inlet beluga whales indicated that more than 50 percent of the dives were no more than 2 m (6.6 ft.) in depth and lasted no more than two minutes, although, there were deeper (5-50 m [16-164 ft.]) dives and longer (more than 21 minutes) dives recorded (Goetz et al. 2012).

Beluga whale vision is reported to be well developed. They appear to have acute vision both in and out of water and, as their retinas contain both rod and cone cells, are believed to see in color (Herman 1980). Beluga whales are also known to be among the most adept users of sound of all marine mammals, and they use sound rather than sight for many important functions. Most sound reception takes place through the lower jaw, which is hollow at its base and filled with fatty oil. Sounds are conducted through the lower jaw to the middle and inner ears, then to the brain. A study conducted with a captive beluga showed that beluga whales' most efficient hearing pathway is from the rostrum tip, which may indicate there are acoustic fat channels that begin at the rostrum tip to effectively guide sound to the inner ear (Mooney et al. 2008). This feature may provide beluga whales with higher directional hearing characteristics than other odontocetes. It is possible that the beluga whale's unfused vertebrae, and thus the highly movable head, have allowed adaptations for this sophisticated directional hearing.

These whales hear over a large range of frequencies, from about 40 Hz to approximately 150 kHz (Au 1993); although their hearing is most acute at middle frequencies, about 10-75 kHz (Fay 1988). At lower frequencies, around 40 Hz, the whale's hearing threshold is about 140 dB re 1 µPa (Figure 5). At about 40 kHz, their best hearing range, the threshold is 40 dB re 1 µPa. Beluga whales conduct communication and echolocation at relatively high frequencies, where they have a lower hearing threshold and greater hearing sensitivity. Studies show beluga whales emit communication calls with an average frequency range from about 2.0-5.9 kHz. Echolocation is generally conducted at frequencies more than 40 kHz. Studies have shown that beluga whales generally produce signals with peak frequencies at 40-120 kHz during echolocation, and the signal's intensity can change with location and background noise levels (Au et al. 1985). Complementing their excellent hearing, beluga whales have one of the most diverse vocal repertoires of all marine mammals. They are to make a variety of vocalizations: (e.g., whistles, buzzes, groans, roars, trills, peep, etc.), which lead to their nickname as sea canaries.

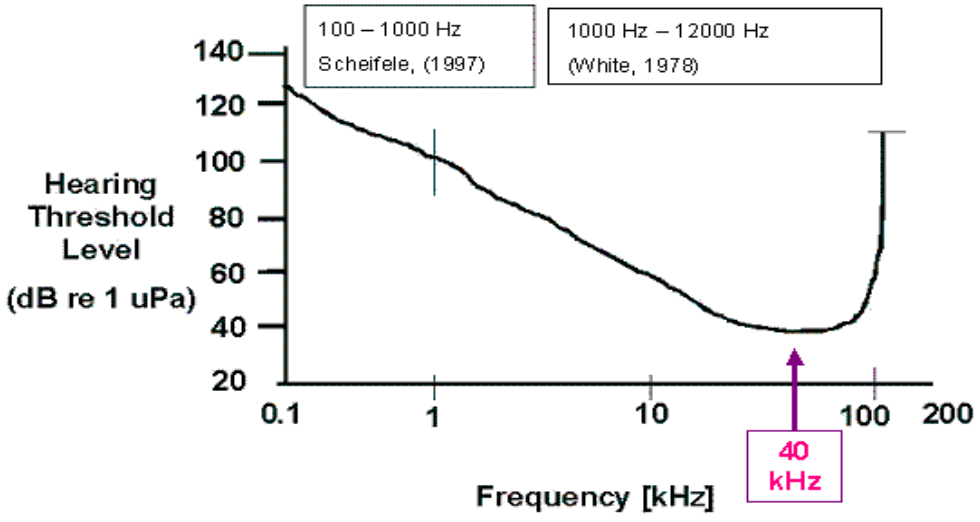

Figure 5. The hearing range and threshold for the beluga whale (Anderson et al. 2007).

2.1.5 Feeding Behavior and Habitat

Cook Inlet beluga whales are opportunistic feeders and feed on a wide variety of prey species, focusing on specific species when they are seasonally abundant. Spring prey for these whales includes eulachon and gadids (e.g., saffron cod [*Eleginus gracilis*], Pacific cod [*Gadus macrocephalus*], and walleye pollock [*Theragra chalcogramma*]). Eulachon first enter the upper inlet in April, with two major spawning migrations in the Susitna River in May and July. The early run is estimated at several hundred thousand fish and the later run at several million fish (Calkins 1989). Cod prefer shallow coastal waters, and are found near and in rivers, within the tidal influence area (Morrow 1980; Cohen et al. 1990).

During summer, as eulachon runs begin to diminish, beluga whales rely heavily on salmon as a primary prey resource. Beluga whale hunters in Cook Inlet reported one whale having 19 adult Chinook salmon in its stomach (Huntington 2000). In July 2005, NMFS observed a 4.3 m (14 ft.) male with 12 coho salmon, totaling 27.9 kg (61.5 lbs.), in its stomach (NMFS unpublished data).

In the fall, as anadromous fish runs decline, beluga whales again return to consume the gadid fish species found in nearshore bays and estuaries. This includes cod species observed in the spring diet as well as other bottom-dwellers, such as Pacific staghorn sculpin (*Leptocottus armatus*); and flatfishes, such as starry flounder (*Platichthys stellatus*) and yellowfin sole (*Limanda aspera*). This change in diet during the fall is consistent with other beluga whale populations, also known to feed on a wide variety of food.

During winter, Cook Inlet beluga whales concentrate in deeper waters in mid Inlet, past Kalgin Island. They make deep feeding dives, likely to find prey species, such as: flatfish, cod, sculpin (Cottoidea), and pollock. The narrowing of the inlet in this area and the presence of Kalgin Island just south of the Forelands may create eddies and an upwelling that concentrate nutrients, which may provide a still-water refuge area for several migrating anadromous fishes (Calkins 1984, 1989). The Kalgin Island area may also be rich in biological productivity; for instance, crustaceans are known to occur south of the island (Calkins 1984). This area may serve as a late winter staging area for eulachon prior to migrating to their natal streams in upper Cook Inlet. If these fish and crustaceans are generally present in this area during the winter months, they may be an important food source for beluga whales, and the Kalgin Island area may be an important winter feeding habitat for beluga whales.

Based on beluga whales' movements and feeding distribution, it is apparent that these movements are not simply explained by fish abundance and location. Beluga whales do not always feed at rivers and streams with the largest fish runs; for example, beluga whales today are infrequently observed at the Kenai River mouth, despite large salmon returns to this river. Dense prey concentrations appear essential to beluga whale feeding success, but the relationship between beluga whale concentrations and salmon concentrations is not fully known. In upper Cook Inlet, beluga whales concentrate offshore from several important salmon streams and appear to use a feeding strategy which takes advantage of the local bathymetry. The channels formed by the river mouths and the shallow waters may funnel the salmon as they swim past waiting beluga whales. Therefore, bathymetry and fish density may be more important than fish numbers to their feeding success. If true, this would imply Cook Inlet beluga whales do not

simply go where the fish are located, but are partially dependent on particular feeding habitats with appropriate topography.

Beluga whales exhibit high site fidelity and may persist in an area with fluctuating fish runs or may tolerate certain levels of disturbance, from boats or other anthropogenic activities, in order to feed. Beluga whales repeatedly use several areas in the upper inlet for summer and fall feeding. The primary "hotspots" for beluga feeding areas by season include: Susitna and Little Susitna rivers, Eagle Bay to Eklutna River, Twentymile River, and Chickaloon Bay. Access to these feeding areas and to corridors connecting these areas is important.

2.1.6 Breeding and Calving Habitat

Very little is known about beluga whale breeding behavior, and it is difficult to identify beluga breeding habitat with any certainty. Gestation is about 14 months, with a single calf born in the late spring or early summer. Pregnant females that were necropsied in April, June, and early July (Mahoney and Shelden 2000; Vos and Shelden 2005; NMFS unpublished data) suggests breeding may occur during the spring months.

The shallow and fresh waters in upper Cook Inlet may play an important role in reproduction. Because newborn beluga whales do not have thick blubber layers like adult whales, they benefit from the warmer water temperatures found in the tidal flat areas, where fresh water empties into the inlet, and therefore, these areas are most likely used as nurseries (Katona et al. 1983; Calkins 1989). Alaska Natives described calving areas as: 1) north side of Kachemak Bay during April-May, 2) Beluga and Susitna river mouths in May, and 3) Chickaloon Bay and Turnagain Arm in summer (Huntington 2000). The warmer waters from these freshwater sources may be important to newborn calves (Katona et al. 1983; Calkins 1989). Boat surveys conducted during 2005-2007 in the upper inlet documented neither localized calving areas nor a definitive calving season, since calves were encountered in all surveyed locations and months (April-October) (McGuire et al. 2008).

Knik Arm is used extensively in the summer and fall by cow and calf pairs. Boat surveys noted a relatively high representation of calves in the upper part of Knik Arm (Funk et al. 2005; McGuire et al. 2011a). Lower Knik Arm was reported as a summer and fall transit area for cow and calf pairs (Cornick and Kendall 2008), presumably, moving into upper Knik Arm. During 2005-2007, 37 distinct beluga whales with calves were photographically identified in the upper inlet (McGuire et al. 2008). Because calves were seen in all areas of upper Cook Inlet: Susitna delta, Knik Arm, Chickaloon Bay and Southeast Fire Island, and Turnagain Arm), distinct calving areas were not determined (McGuire et al. 2008, 2011). However, when corrected for effort, Knik Arm had the largest number of calf sightings within the observed areas.

2.1.7 Population Abundance and Trends

The Cook Inlet beluga whale population probably always numbered fewer than several thousand animals but, since the 1990s, the population significantly declined from its historical abundance (NMFS 2008a). It is difficult to accurately determine the decline's magnitude because little information is available on the beluga whale population that existed in Cook Inlet prior to the region's development; and prior to recent subsistence whaling by Alaska Natives. Without a reliable abundance survey prior to the 1990s, an estimated historical abundance of 1,293 beluga

whales was determined from an aerial survey conducted in portions of Cook Inlet during 1979 (Calkins 1989). This overall abundance estimate represents the best available information on historical abundance. For management purposes, NMFS currently considers 1,300 beluga whales as a reasonable historical abundance estimate.

During 1994-2014, comprehensive and systematic aerial surveys of Cook Inlet determined the beluga whale abundance and population trend (Figure 6). A decline in abundance of about 47 percent, from an estimate of 653 whales to 347 whales, was documented during 1994-1998 (Hobbs et al. 2000). After measures were established in 1999 to regulate subsistence harvests, NMFS expected the population to grow at an annual rate between 2-6 percent. Abundance estimates from the 1999-2008 aerial surveys showed the expected growth did not occur. The lack of growth led to the ESA listing in 2008. Since hunting was regulated in 1999, the population continues to declines at 1.3 percent per year. The 2014 population abundance estimate was 340 whales, indicating a 10 year decline of 0.4 percent per year (Shelden et al. 2015).

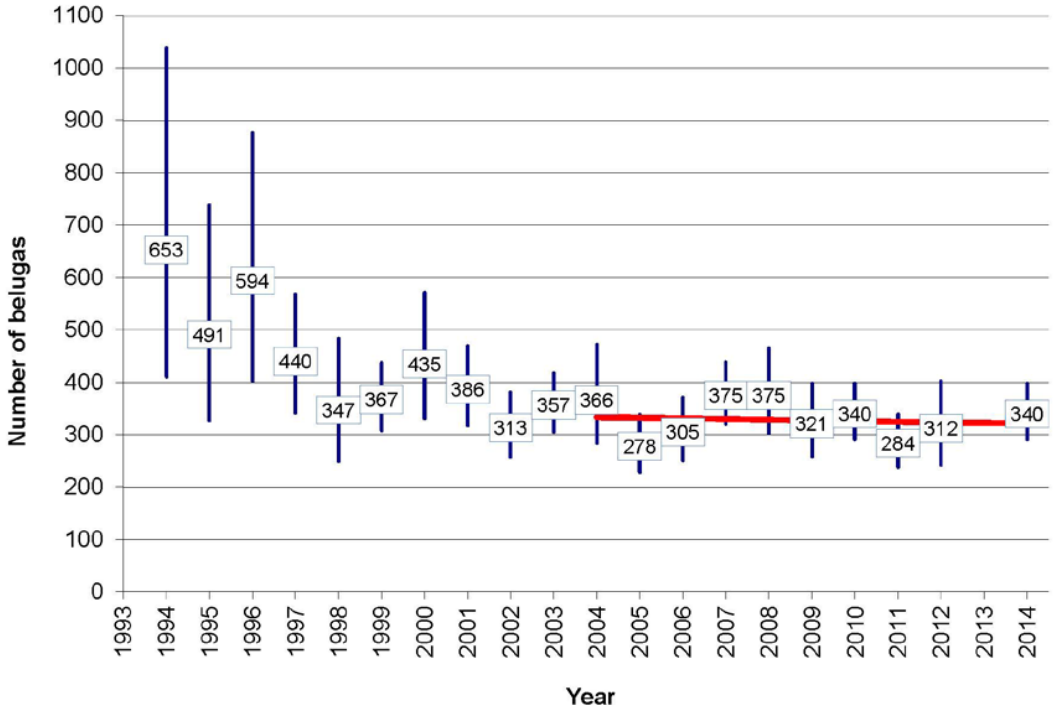

Figure 6. Abundance estimates for Cook Inlet beluga whales (1994-2014) with 95 percent confidence intervals (vertical bars). During 2004-2014 the decline rate was 0.4 percent annually. Because the harvest regulations in 1999 (69 FR 17973, April 6, 2004), the rate of decline (red trend line) was 1.3 percent annually. The 2014 population estimate was 340 beluga whales.

While a precise comprehensive statistical assessment of the population trend since 1979 is not possible, given differences in survey methods and analytical techniques prior to 1994, a straight comparison of the 1979 estimate (1,293 whales) with the 2014 estimate (340 whales) would indicate a roughly 74 percent decline during the 35 years, but with unspecified confidence. NMFS committed to systematic abundance surveys, which monitor population status and growth over time, such that a significant change in abundance and trend would be detected after a 10 year time period.

2.1.8 Threats

It is likely that cumulative effect from multiple factors influence the Cook Inlet beluga whale population trends. Such factors may include prey availability, stranding, predation (i.e., killer whale [*Orcinus orca*] and shark), disease, parasitism, winter survival, nutritional stress due to competition for prey related to commercial fisheries and regime change, anthropogenic disturbance (e.g., aircraft, vessels, habitat alteration).

2.1.9 Population Viability Analysis and Extinction Risk Assessment

The 2008 Supplemental Status Review and Extinction Risk Assessment of Cook Inlet Beluga Whales (*Delphinapterus leucas*) included an update of the November 2006 (Hobbs et al. 2006) and April 2008 (Hobbs et al. 2009) Status Reviews; and responded to issues raised by a panel of independent experts regarding these earlier Status Reviews (Supplemental Review) (Hobbs and Shelden 2008). The conclusions of this review were:

- The contraction of the population's range northward and westward into the upper inlet makes the population more vulnerable to catastrophic events, which have the potential to kill a significant fraction of the population.
- The population is not growing at 2-6 percent annually as was anticipated, since the subsistence hunting was regulated.
- The population is discrete and unique with respect to the species, and should it fail to survive, it is highly unlikely that Cook Inlet would be repopulated with beluga whales. This would result in the permanent loss of a significant portion of their range.
- The importance of seasonal anadromous fish runs in Cook Inlet to beluga whales is evident and the bulk of their annual nutrition is acquired during the summer months.
- Beluga whales in Cook Inlet are unique in Alaska given that their summer habitat is close to the largest urban area in the state.
- While the impacts from disease and parasitism on this population have not been quantified, this population is at great risk because its small size and limited range would allow a novel disease to spread easily through this population.
- The population viability analysis (PVA) shows a 26 percent probability of extinction in 100 years and a 70 percent probability of extinction in 300 years (the model assumes one predation mortality per year; and a 5 percent annual probability that an unusual mortality event would kill 20 percent of the population).
- It is likely that the Cook Inlet beluga population will continue to decline or go extinct during the next 300 years unless factors that determine its growth and survival are altered in its favor.

The Supplemental Review also reaffirmed NMFS's earlier position that the Cook Inlet beluga whale stock is discrete and significant in terms of the ESA, and constitutes a species under the definitions of the ESA. The Supplemental Review included a PVA model that was the most detailed of any such models for Cook Inlet beluga whales, being age and gender based; and focused on whale behavior in a declining population at sizes less than 500 whales. Small population effects, demographic stochasticity, Allee effects, predation mortality, and unusual mortality events were modeled explicitly. The PVA employed 20 sub-models with 11 various assumptions, which included: different predation levels, unusual mortality events, Allee effects, habitat loss, counting/survey errors, and other factors. For each sub-model, 100,000 trials were run to provide a statistical distribution of the stochastic and deterministic variables of the model in order to allow for analysis. The PVA results were then used in the Extinction Risk Analysis

(ERA) to estimate the probabilities for the stock to become extirpated within certain time frames. The ERA found that, for the sub-model judged to be the best approximation for the current population, the extinction probability was 26 percent within 100 years.

An important outcome of the ERA was that the extinction probabilities increased dramatically when predation was set for more than one beluga whale mortality per year. Adequate data does not exist that would accurately evaluate the removal levels from this stock due to killer whale predation or other factors, but annual mortalities could exceed this threshold. This finding has particular significance in assessing the cumulative risks to the Cook Inlet beluga whales. The Environmental Baseline section of this biological opinion discusses factors (stressors) known to be, or thought to be, impacting this population within the action area.

In 2008, NMFS published a Conservation Plan for the Cook Inlet Beluga Whale that delineates reasonable actions required to recover and/or protect marine mammals species designated as depleted under the MMPA (NMFS 2008a). Prior to publishing the Conservation Plan, NMFS implemented several management measures in an effort to curb the decline of the Cook Inlet beluga whale stock. However, there were still gaps in knowing and understanding the factors that limit their recovery. The Conservation Plan's goal is to restore the Cook Inlet beluga whales to a healthy, viable population that is no longer designated as depleted under the MMPA. The Conservation Plan outlines criteria for when that goal would be met, and recommended specific actions that to help achieve that goal. Subsequent to publishing the Conservation Plan, the Cook Inlet beluga whale was listed as an endangered species under the ESA. NMFS is developing a recovery plan that, when completed, is intended to outline a path to recovery. This Conservation Plan is the guiding document until the recovery plan is final.

2.2 Cook Inlet Beluga Whale Critical Habitat

Subsequent to the ESA listing and pursuant to ESA section 4(b)(2), NMFS designated critical habitat for the Cook Inlet beluga whales in April 2011 (76 FR 20180).

2.2.1 Critical Habitat Boundaries

Cook Inlet beluga whale critical habitat (Figure 7) includes two geographic areas of marine habitat in Cook Inlet comprising 7,809 km^2 (3,013 mi^2). These areas are bounded on the upland by Mean High Water (MHW) datum. Critical habitat does not extend into the tidally-influenced channels of tributary waters of Cook Inlet, with the exceptions noted in the descriptions of each critical habitat area.

Area 1 comprises 1,918 km^2 of marine habitat in Cook Inlet and encompasses all marine waters of Cook Inlet north of a line from the mouth of Threemile Creek (61°08.5′ N., 151°04.4′ W.) connecting to Point Possession (61°02.1′ N., 150°24.3′ W.), including waters of the Susitna River south of 61°20.0′ N., the Little Susitna River south of 61°18.0′ N., and the Chickaloon River north of 60°53.0′ N.

Area 2 comprises 5,891 km^2 of Cook Inlet and encompasses all marine waters of Cook Inlet south of a line from the mouth of Threemile Creek (61°08.5′ N., 151°04.4′ W.) to Point Possession (61°02.1′ N., 150°24.3′ W.) and north of 60°15.0′N., including waters within two

nautical miles seaward of MHW along the western shoreline of Cook Inlet between 60°15.0′ N. and the mouth of the Douglas River (59°04.0′ N., 153°46.0′ W.). Area 2 also includes all waters of Kachemak Bay east of 151°40.0′ W. and waters of the Kenai River below the Warren Ames Bridge at Kenai, Alaska.

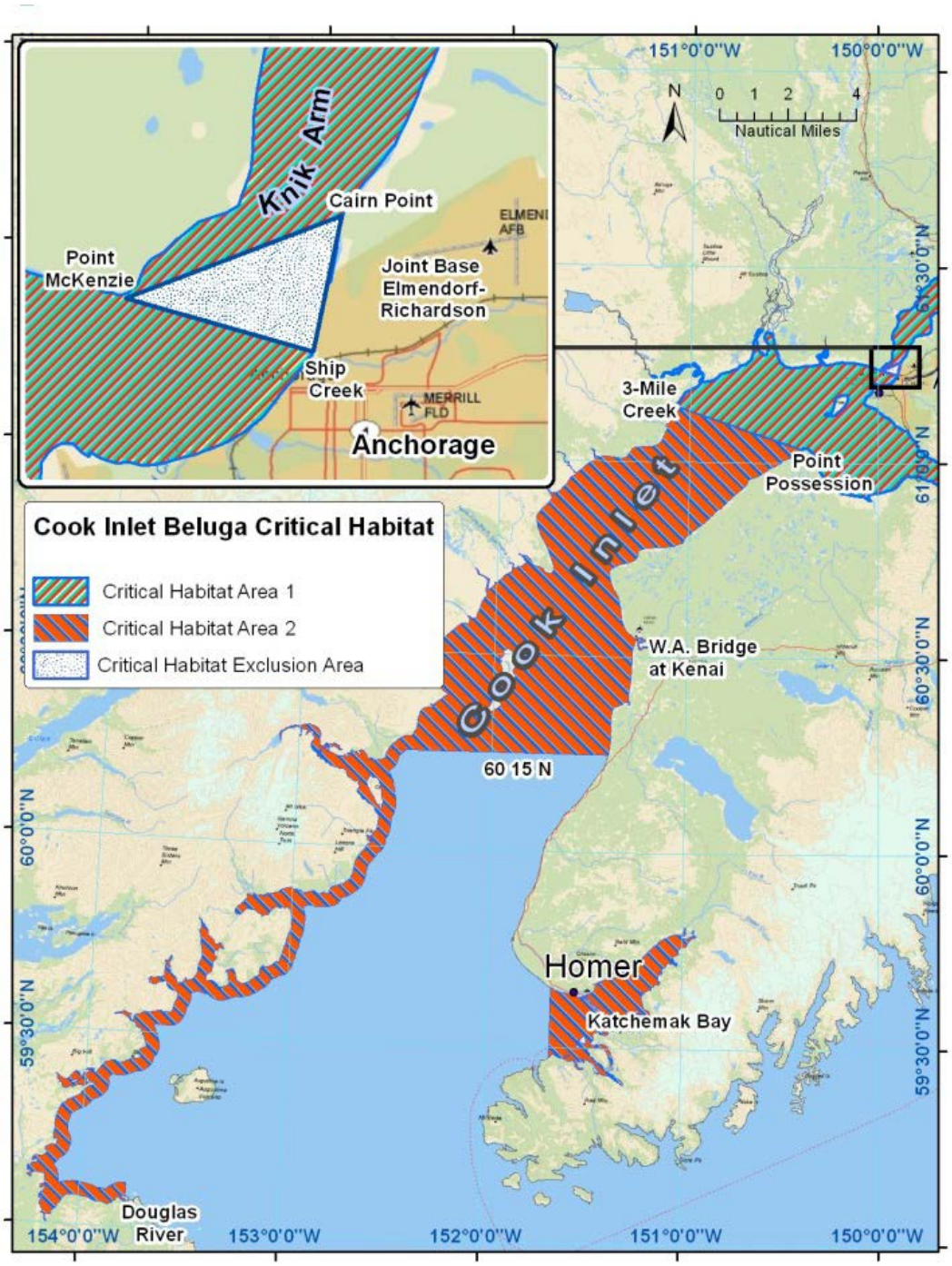

Figure 7. Critical habitat for the Cook Inlet beluga whale.

Section 4(a)(3)(B)(i) of the ESA allows for an exemption from critical habitat of military lands if the Integrated Natural Resources Management Plan (INRMP) provides benefit for the listed species. NMFS concluded that the Army's INRMP provides benefit for the Cook Inlet beluga whale and exempted the Eagle River Flats area from the critical habitat designation. This also included the lower reaches of Eagle River. NMFS also exempted the Port of Anchorage from the final rule in consideration of national security interests (76 FR 20180; April 11, 2011).

2.2.2 Primary Constituent Elements

Cook Inlet beluga whale critical habitat includes five Primary Constituent Elements (PCEs) deemed essential to the conservation of the CI beluga whale (50 CFR 226.220). These attributes are:

- Intertidal and subtidal waters of Cook Inlet with depths <30 feet (MLLW) and within five miles of high and medium flow anadromous fish streams.
- 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.
- Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.
- Unrestricted passage within or between the critical habitat areas.
- Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.

<u>PCE 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.</u>

Intertidal and subtidal waters of Cook Inlet with depths less than 9 m (30 ft.) MLLW and within 8 km (5 mi) of high and medium flow anadromous fish streams support important beluga feeding habitat. Their shallow depths and bottom bathymetry act to concentrate prey and aid beluga whales in feeding efficiency. The physical attributes of this PCE could be modified or lost with projects that propose: filling, dredging, channel re-alignment, dikes, and other structures.

Approximately 1,171 km^2 (455 mi^2) of intertidal and subtidal habitats within 8 km (5 mi) of high and medium flow anadromous fish streams exist in the action area. This includes 736 km^2 (284 mi^2) in upper Cook Inlet (Figure 8a) and 435 km^2 (168 mi^2) in lower Cook Inlet (Figures 8b). There are 20 anadromous fish streams in the action area (Table 3). Currently, the majority of coastal development in Cook Inlet exists near Anchorage. As a result, the intertidal and subtidal habitats within 8 km (5 mi) of anadromous fish streams within the action area are generally intact and undisturbed.

<u>PCE 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.</u>

Four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole constitute the most important food sources for Cook Inlet beluga whales as identified through research and by the traditional knowledge of

Alaska Natives who hunted these whales. Cook Inlet beluga whale stomachs were analyzed and these species constitute the majority of consumed prey by weight during the summer and ice free periods. These species are targeted by commercial fisheries, and some are prized by sport fishermen. All prey species listed under PCE 2 exist in the proposed action area.

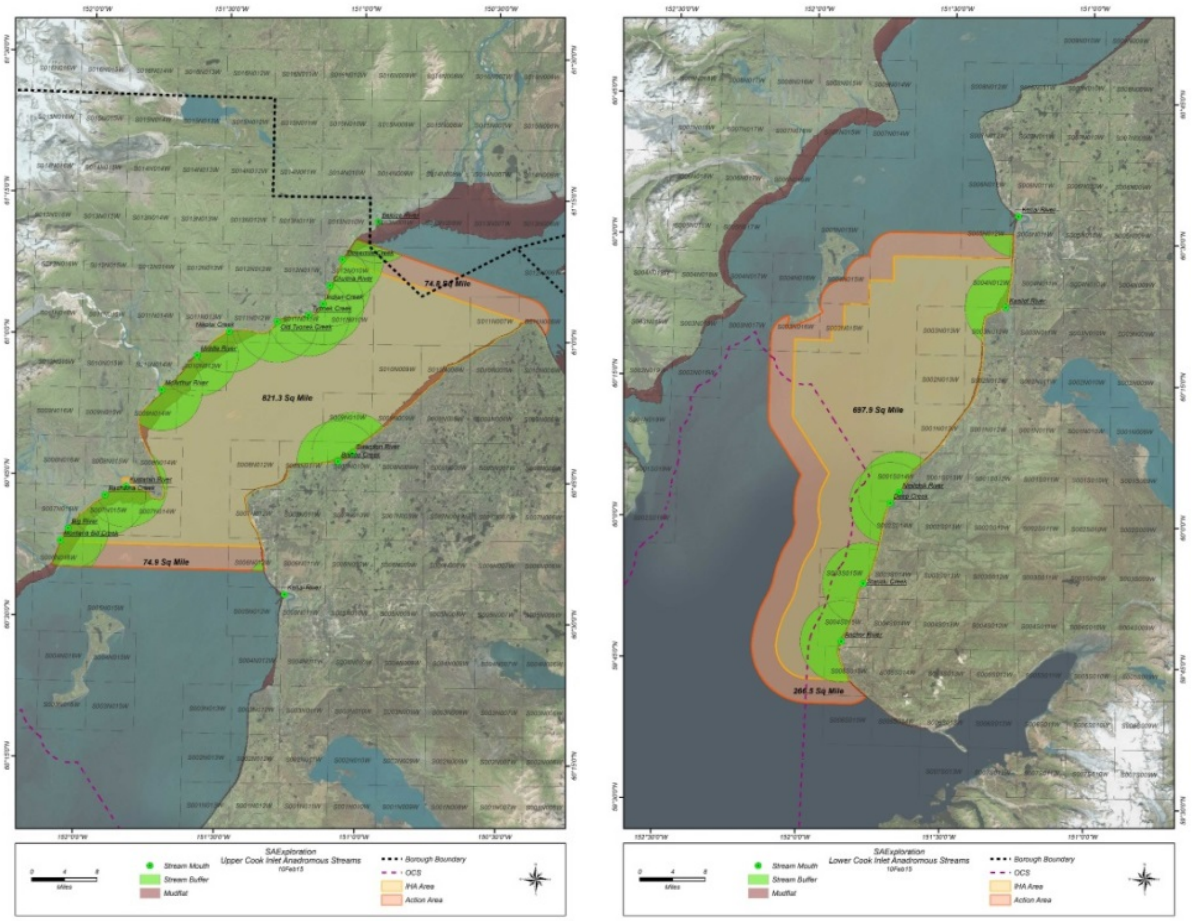

Figure 8a and 8b. PCE 1 intertidal and sub tidal waters of Cook Inlet with depths less than 9.1 m (30 ft.) MLLW, and within 8 km (5 mi) of high and medium flow of anadromous fish streams in the upper (Figure 8a) and lower (Figure 8b) Cook Inlet action area.

Commercial fisheries may compete with beluga whales in Cook Inlet for salmon and other prey species. In the summer, as eulachon runs begin to diminish, beluga whales rely on several salmon species as a primary prey resource (NMFS 2012). Beluga whales depend on access to high value prey that is found in relatively dense concentrations throughout the summer months. Any diminishment in the whales' ability to reach or use spring and summer feeding habitats, or any reductions in the amount of available prey, may impact the beluga whales' energetics and delay recovery. Summer feeding habitat occurs near the mouths of anadromous fish streams, which coincides with the adult salmon runs. Preferred habitat may change, as each salmon species, and often each particular river is characterized with individual run timing.

Table 3. Anadromous streams that are found in the action area within PCE 1.

Upper Cook Inlet	**Lower Cook Inlet**
Threemile Creek	Kenai River
Chuitna River	Kasilof River
Indian Creek	Ninilchik River
Tyonek Creek	Deep Creek
Old Tyonek Creek	Stariski Creek
Nikolai Creek	Anchor River
Middle River	
McArthur River	
Kustatan River	
Bachatna Creek	
Big River	
Montana Bill Creek	
Bishop Creek	
Swanson River	
Total Area: 736 km^2 (284 mi^2)	**Total Area:** 435 km^2 (168 mi^2)

The State salmon management plan oversees Cook Inlet fisheries in the lower, middle, and northern (upper Cook Inlet) districts. Although most recreational fisheries occur upstream from the river mouths and estuaries where beluga whales typically feed, the Cook Inlet commercial fisheries are offshore (drift gillnets) or close to shore (set net).

The State manages the salmon fisheries to meet escapement goals for various areas. The fisheries are open or closed throughout the season in an adaptive management fashion to reach escapement goals. Salmon hatcheries operate in Cook Inlet, which have measurably added to the adult fish returns to the inlet.

NMFS recognized and acknowledged that the current management structure for the salmon fisheries has generally provided for the sustained harvest and productivity of salmon in Cook Inlet (76 FR 20180, April 11, 2011). However, there is uncertainty inherent in fisheries management. Chinook salmon returns to many local waterways have declined precipitously since 2006, which resulted in closing the sport and commercial fisheries in the inlet (ADFG 2013). The Susitna River sockeye salmon runs failed to meet minimum escapement goals for five of the seven years during 2001-2007. Sockeye commercial harvests for the Northern District of Cook Inlet fell from an average of 180,000 fish in the 1980s to an average of 26,000 fish since 2002. Alaska Department of Fish and Game (ADFG) cited management decisions that lead to over escapement as a contributing factor in this decline. At this time NMFS does not have information to suggest that prey availability is or has been a factor in the beluga whales' decline or needs to improve to promote the Cook Inlet beluga whale's recovery. And while documented salmon escapement and commercial harvests numbers have fluctuated widely throughout the last 40 years, harvested and stranded beluga whale samples have shown consistent summer blubber thicknesses (NMFS 2012), suggesting that the whales have not been affected by these changes in prey abundance.

Eulachon return to Cook Inlet spawning areas during mid-May to mid-June. Particularly large eulachon runs are found in the Kenai, Susitna, and Twentymile rivers (Shields 2010), which are outside the action area. Commercial fisheries are open from May 1 to June 30 from the Chuitna River to the Little Susitna River. Using hand operated dip nets, 100 tons may be harvested annually (Shields 2010). The eulachon stocks in Cook Inlet appear to be in good condition. If there were indications that the eulachon stocks were in poor condition, there would be an emergency closure for commercial fishing by ADFG[6].

Cook Inlet marine waters support several cod (Gadidae) species, such as Pacific cod, walleye pollock, and saffron cod. Currently, there is little concern regarding the status of cod species. They are generally found in shallow coastal waters in depths less than 60 m and are found in brackish and fresh water, up rivers and streams (FAO 2011). These resources are split at 60^{o} N latitude: Cook Inlet waters north of 60^{o} (upper Cook Inlet) support lower abundances of Pacific cod and walleye pollock and waters south of 60^{o} N (lower Cook Inlet) support commercial stocks of Pacific cod[7] and walleye pollock.

Pacific cod is not overfished and is not approaching an overfished population in the Gulf of Alaska (GOA) (NPFMC 2010). Pacific cod are abundant in Cook Inlet and the overall health of the stock is in good condition[8].

Pollock is not subject to overfishing and is not being overfished in the GOA. The projected mean spawning biomass in 2013 is 272,877 tons, and therefore, is not approaching an overfished condition in the GOA (NPFMC 2010). ADFG's 2010 biomass estimate for Pollock was down 15 percent from 2009, but increased 60 percent from the previous three years (NPFMC 2010). Currently, there are no ongoing pollock fisheries in Cook Inlet[9].

Saffron cod ranges throughout all Cook Inlet waters. Saffron cod was present in upper Cook Inlet during the winter months (Houghton et al. 1981); however, information isn't available to determine how frequently this occurs. The frequency of saffron cod occurrence in beach seine catches in the lower Cook Inlet has increased from 1.5 percent in 1976 to 73 percent in 2008 (Johnson et al. 2009). According to ADFG, saffron cod are in good health in Cook Inlet[10].

In the GOA, yellowfin sole is managed as part of the shallow water flatfish complex, which includes northern rock sole (*Lepidopsetta polyxystra*), southern rock sole (*Lepidopsetta bilineata*), butter sole (*Isopsetta isolepis*), starry flounder (*Platichthys stellatus*), English sole (*Parophyrys vetulus*), sand sole (*Pegusa lascaris*), and Alaska plaice (*Pleuronectes quadrituberculatus*) (NPFMC 2014). The flatfish fishery in the GOA has undergone changes

[6] Hertzog, S. 2011. Alaska Department of Fish and Game, Anchorage, Alaska. Personal communication via L. Kendall, Alaska Pacific University

[7] In Lower Cook Inlet State of Alaska waters, a commercial Pacific cod fishery (pot and jig gear) exists. In 2012-2013, the approximate catch was 4 million pounds. An average commercially caught Pacific cod weighs 10 pounds, thus roughly 400,000 cod are harvested

[8] Trowbridge, C. 2011. Alaska Department of Fish and Game, Anchorage, Alaska. Personal communication via L. Kendall, Alaska Pacific University

[9] Chris Russ (Fisheries Biologist, ADFG) personal communication with Lindsey Kendall, May 25, 2011.

[10] Trowbridge, C. 2011. Alaska Department of Fish and Game, Anchorage, Alaska. Personal communication via L. Kendall, Alaska Pacific University

since 1977; and continues to be limited by the potential for high by-catches of Pacific halibut. The most recent documented commercial landings for yellowfin sole were 142,131 metric tons and 158,783 metric tons for 2012 and 2013, respectively.

PCE 3: Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.

The Cook Inlet region is the most populated and industrialized region of the state. Its waters receive various pollutant loads through activities that include urban runoff, oil and gas activities (e.g., discharges of drilling muds and cuttings, production waters, treated sewage effluent discharge, deck drainage), municipal sewage treatment effluents, oil and other chemical spills, fish processing, and other regulated discharges. Many pollutants are regulated by either the Environmental Protection Agency (EPA) or the Alaska Department of Environmental Conservation (ADEC), who may authorize certain discharges under the National (or Alaska) Pollution Discharge Elimination System (NPDES/APDES; section 402 of the Clean Water Act of 1972 [CWA]). It is necessary to manage pollutants and toxins to protect and maintain the biological, ecological, and aesthetic integrity of these waters.

Major sources of toxins and other agents in Cook Inlet include 10 wastewater treatment facilities, stormwater runoff, airport deicing, and military training at Eagle Bay (Moore et al. 2000; NMFS 2008a). Cook Inlet belugas have different concentrations and patterns of legacy compounds in their tissues compared to beluga whales elsewhere; with an annual increase in the concentrations of some compounds in the Cook Inlet beluga whale samples (Reiner et al. 2012).

Cook Inlet beluga whales are exposed to chemical concentrations that are typically lower than those observed in other arctic marine mammals (NMFS 2010; NISTIR 2001). Levels of heavy metals, pesticides, petroleum hydrocarbons, and polychlorinated biphenyl (PCB) compounds found in Cook Inlet's water column and sediments were below detection limits; and heavy metal concentrations were below management levels (KABATA 2004, NMFS 2008a, USACE 2008). ADEC designated upper Cook Inlet as Category 3 on the CWA section 303(d) list of impaired waterbodies (ADEC 2010) A Category 3 designation is the result of insufficient information in determining if the waterbody meets water quality standards. The lower Cook Inlet is not on the listed of impaired water bodies (ADEC 2012). In the action area, waters are generally free of toxins and other agents of a type and amount harmful to the Cook Inlet beluga whales.

PCE 4: Unrestricted passage within or between the critical habitat areas.

Potential barriers that could restrict beluga whale movement include physical and/or acoustic barriers within the action area, such as: port facilities, vessel traffic, and noise. Port facilities are located along the coast. Large cargo ships, commercial and recreational fishing boats, and other vessels pass through the action area. Noise from construction activities, oil and gas platforms, and coastal operations has the potential to restrict beluga whale movements. Most anthropogenic noise is found in upper Cook Inlet, near Anchorage, outside the action area. Currently, passage within or between the critical habitat areas is unrestricted in the action area.

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

Based on research and empirical data from beluga whales in the wild, NMFS has established in-water noise levels that define when these animals are harassed or injured. The current Level A (e.g., injury) threshold for impulse noise (e.g., seismic pulses) is 180 dB re 1 µPa RMS for cetaceans (e.g., whales, dolphins, and porpoises). The current Level B (e.g., disturbance) threshold for impulse noise is 160 dB 1 µPa RMS for cetaceans. The Level B threshold for continuous noise is 120 dB 1 µPa RMS for cetaceans. Beluga whale exposure to SPL depends on the source; the intensity, frequency, and duration of the sound; the animal's distance from the source; and the acoustic environment in which the sound was produced.

Beluga whales have been observed in different portions of the action area throughout different times of the year (Goetz 2012) when the activities are likely to take occur. Ship traffic includes vessels that 1) travel to and from the POA and smaller docks in Cook Inlet; 2) support oil and gas development; and 3) commercially fish. Many development activities occur along the coast of Cook Inlet, including activities that introduce noise into the waters (e.g., pile driving to build, repair, or expand the numerous small docks along the coastline). Noise associated with oil and gas development includes exploration and drilling activities, and operation noise on the platform itself. In 2012, there was noise associated with seismic activities (Apache 2014). Although there are numerous sources of in-water noise in Cook Inlet, there is no evidence that the noise levels have resulted in the abandonment of any critical habitat areas.

2.2.3 Cook Inlet Beluga Whale Additional Information

Additional information regarding Cook Inlet beluga whale can be found in the NMFS Stock Assessment Report at http://www.nmfs.noaa.gov/pr/sars/pdf/ak2013_final.pdf, as well as on the AKR web site at: http://alaskafisheries.noaa.gov/protectedresources/whales/beluga.htm.

2.3 Western DPS Steller sea lions

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 and habitat (including critical habitat) is available at: http://alaskafisheries.noaa.gov/protectedresources/stellers/default.htm The proposed project is located well outside Steller sea lion critical habitat, there are no recognized haul-outs or rookeries in the action area, and Steller sea lions are rarely observed in the action area.

2.3.1 Species Description and Taxonomy

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. The average standard length is 282 cm (9 ft.) for adult males and 228 cm (7.5 ft.) for adult females; while the average weigh for adult males is 566 kg (1,248 lbs.) and adult females is 263 kg (580 lbs.; Fiscus 1961; Calkins and Pitcher 1982; Loughlin and Nelson 1986; Winship et al. 2001). The pelage is light buff to reddish brown and slightly darker on the chest and abdomen. Naked parts of the skin are black (King 1954). Adult males have long, coarse hair on the chest, shoulders, and back; the chest and neck are massive and muscular.

Newborn pups are about 1 m (3 ft.) long, weigh 16-23 kg (35-51 lbs.), and have a thick, dark-brown coat that molts to lighter brown after six months (Daniel 2003).

2.3.2 Range

The range of the Steller sea lion extends across the North Pacific Ocean rim from northern Japan, the Kuril Islands and 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; Figure 9). 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^{o}W (NMFS 2008c).

The western DPS Steller sea lion occurs in Cook Inlet, primarily south of Anchor Point, around the offshore islands, and along the west coast of the inlet in the bays (Chinitna Bay, Iniskin Bay, etc.; Rugh et al. 2005). The occasional individual animal may wander into Cook Inlet river mouths during summer periods to seek seasonal runs of prey, such as salmon and eulachon. Haulouts do not occur in upper Cook Inlet, and Steller sea lions are rarely sighted north of Nikiski (Rugh et al. 2005; LGL 2006). Since 1994, NMFS systematic Cook Inlet aerial surveys documented only one Steller sea lion observation within the action area, when a group of 20 animals were observed on 10 June, 2006 (NMFS unpublished data). Opportunistic sightings reported to NMFS have sporadically documented single Steller sea lions in Knik or Turnagain Arms and an average of 0.5 animals per year (from 2003-2013) were reported to NMFS by other observers within the action area (NMFS unpublished data).

During Cook Inlet beluga whale monitoring efforts associated with Apache's seismic survey operations in 2012, Steller sea lions were observed on three separate occasions: May (one animal), June (two animals), and August (one animal) (Lomac-MacNair et al. 2013). All Steller sea lion sightings were made by vessel-based observers when there was no seismic airgun activity occurring. During aerial surveys in June 2012, observers documented approximately 75 pinnipeds hauled out on the banks of the Beluga River (north of the operational area). Because the observers were unable to clearly identify the species from air, the sighting was noted as "unidentified pinnipeds", but there was some speculation that they could be Steller sea lions given they appeared larger and lighter in color than harbor seals observed in the area at the same time (Lomac-MacNair et al. 2013). Lacking evidence beyond speculation on the identity of the unidentified pinnipeds, NMFS considers it unlikely that these animals were Steller sea lions; the observation of that many Steller sea lions so far north in Cook Inlet is, as far as we are aware, unprecedented.

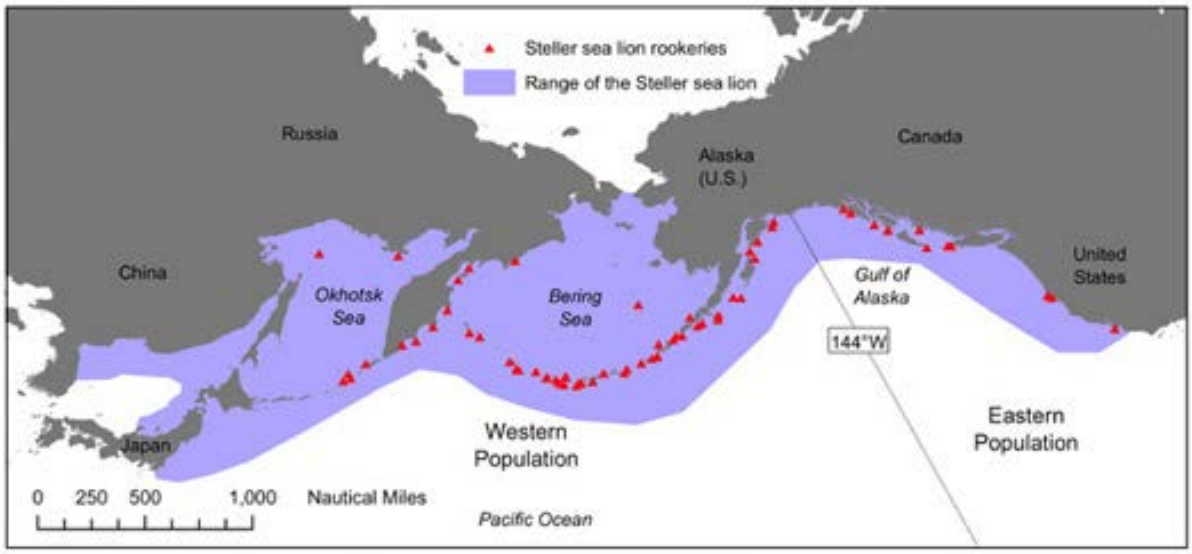

Figure 9. Range of the Steller sea lion.

2.3.3 Distribution and Movements

Prior to the Steller sea lion decline in the west, most large rookeries[11] were in the Gulf of Alaska and Aleutian Islands (Kenyon and Rice 1961; Calkins and Pitcher 1982; Loughlin et al. 1984, 1992; Merrick et al. 1987). Historically, these areas supported very large numbers of Steller sea lions; however, as the decline continued, rookeries in the west became progressively smaller. Consequently, the largest rookeries are now in Southeast Alaska and British Columbia.

Most adult Steller sea lions occupy rookeries during the pupping and breeding season, which extends from late May to early July (Pitcher and Calkins 1981; Gisiner 1985). However, during the breeding season, some juveniles and non-breeding adults occur at or near the rookeries. Adult males, in particular, may disperse widely after the breeding season. During fall and winter, many Steller sea lions disperse from rookeries and increase their use of haulouts, particularly terrestrial sites but also sea ice in the Bering Sea.

Steller sea lions are not known to make regular migrations, but they do move considerable distances (Baba et al. 2000). Animals marked as pups on rookeries in the Gulf of Alaska have been sighted in Southeast Alaska and British Columbia; some sea lions marked in British Columbia have been seen at Cape Saint Elias, Alaska; others marked in the eastern Aleutians have been seen in eastern Bristol Bay, Alaska; and some Steller sea lions marked in Oregon have been seen in northern California, Washington, British Columbia, Southeast Alaska, and the northern Gulf of Alaska (Calkins and Pitcher 1982; Calkins 1986; Loughlin 1997). Raum-Suryan et al. (2002) analyzed resightings of pups branded during 1975-1995 on rookeries in Alaska and reported that almost all resightings for young-of-the-year pups were within 500 km (311 mi) of the rookery where the pup was born. Subsequent observations documented pup movements with mothers of more than 800 km (497 mi). Juvenile animals were seen at much greater distances from their rookery of birth, up to 1,785 km (1,109 mi). Sightings of adult Steller sea lions were

[11] A rookery refers to a site where pups are born (usually a count of 50 or more pups), breeding occurs, and sea lions may haulout during the non-breeding period; a site designated as a rookery will be referred to as a rookery the entire year, even though breeding occurs there only from late May to early July.

generally less than 500 km (311 mi) away from their natal rookery, although adult males have since been seen more than 1000 km (621 mi) from the rookery where they held a territory.

2.3.4 Biology and Behavior

Female Steller sea lions may live up to 30 years, while males rarely survive beyond their mid to late teen years. Sexual maturity is at 3-7 years. Sea lions typically give birth to a single pup in May-July, after a gestation period of about 11 months. The young pups are nursed for 1-3 years.

The ability to detect sound and communicate underwater is important for a variety of Steller sea lion life functions, including reproduction and predator avoidance. Steller sea lions have similar hearing thresholds in-air and underwater to other otariids. In-air hearing ranges from 0.250-30 kHz, with their best hearing sensitivity at 5-14.1 kHz (Muslow and Reichmuth 2010). An underwater audiogram shows the typical mammalian U-shape. Higher hearing thresholds, indicating poorer sensitivity, were observed for signals below 16 kHz and above 25 kHz (Kastelein et al. 2005).

2.3.5 Feeding Behavior and Habitat

Steller sea lions consume a variety of demersal, semi-demersal, and pelagic prey, indicating a potentially broad spectrum of foraging styles, probably based primarily on availability. Overall, the available data suggest two types of distribution at sea by Steller sea lions: 1) less than 20 km (12 mi) from rookeries and haulout sites for adult females with pups, pups, and juveniles, and 2) much larger areas (greater than 20 km [12 mi]) where these and other animals may range to find optimal foraging conditions once they are no longer tied to rookeries and haulout sites for nursing and reproduction. Loughlin (1993) observed large seasonal differences in foraging ranges that may have been associated with seasonal movements of prey, and Merrick (1995) concluded on the basis of available telemetry data that seasonal changes in home range were related to prey availability. The occasional individual Steller sea lion may swim into rivers in upper Cook Inlet seeking the seasonal runs of salmon and eulachon, but this is rarely observed.

2.3.6 Breeding and Pupping Habitat

Most adult Steller sea lions occupy rookeries during the pupping and breeding season, which extends from late May to early July (Pitcher and Calkins 1981; Gisiner 1985). During the breeding season some juveniles and non-breeding adults occur at or near the rookeries, but most are on haulouts. Adult males, in particular, may disperse widely after the breeding season. During fall and winter many Steller sea lions disperse from rookeries and increase use of haulouts, particularly terrestrial sites but also sea ice in the Bering Sea.

The closest rookery to the action area is Sugarloaf Island; one of the Barren Islands at the entrance to Cook Inlet, more than 193 km (120 mi) from East Foreland, the southernmost boundary of the action area.

2.3.7 Population Abundance and Trends

The 2013 Stock Assessment Report for the western DPS of Steller sea lions indicates an abundance estimate of 79,300 individuals in this stock, with Russia and U.S. surveys combined (Allen and Angliss 2013). During 2008-2012, the U.S. portion of this stock's minimum population estimate is 45,659 sea lions. 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. Currently, the overall western DPS Steller sea lions is estimated to be increasing at about 1.67 percent per year from 2000-2012 (Allen and Angliss 2013).

2.3.8 Threats

It is likely that multiple factors are affecting western DPS Steller sea lion population trends (NMFS 2008c). These factors include food web perturbations; predation (e.g., killer whales, sharks); nutritional stress due to competition for prey that is related to commercial fisheries and regime change; incidental take by commercial fisheries; subsistence harvest; illegal shooting; entanglement in marine debris and fishing gear; disease; parasitism; toxic substances; and anthropogenic disturbance (aircraft, vessels).

2.4 Humpback Whales

The humpback whale was listed as endangered under the Endangered Species Conservation Act (ESCA) on December 2, 1970 (35 FR 18319). Congress replaced the ESCA with the ESA in 1973, and humpback whales continued to be listed as endangered. 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 (including proposing threatened status for the Western North Pacific stock, which occurs in Alaskan waters including Cook Inlet) (80 FR 22304; April 21, 2015). Final action on that proposal is not expected until after this project occurs. Information on humpback whale biology and habitat is available at:
http://www.fisheries.noaa.gov/pr/species/mammals/whales/humpback-whale.html
http://www.nmfs.noaa.gov/pr/sars/2013/ak2013_humpback-wnp.pdf

2.4.1 Species Description and Taxonomy

The humpback whale is one of the larger rorqual whales. Adult males average 14 m (46 ft.) in length and adult female averages 15 m (49 ft.) in length. Humpback whales are sexually mature at 4-7 years.

2.4.2 Range

Humpback whales are distributed globally, wintering in tropical and subtropical waters to breed and give birth and feeding in the high latitudes on small schooling fish and euphausiid in the summer (Allen and Angliss 2013). The Central North Pacific stock can be found throughout southeast Alaska in the summer, as well as in central and western portions of the Gulf of Alaska (including Cook Inlet); throughout the Bering Sea, and into the southern Chukchi Sea.

The eastern portion of the range of the Western North Pacific humpback whale stock includes the proposed action area. This stock summers from Prince William Sound west to Kamchatka, Russia and Hokkaido, Japan. Most humpback whales that summer in Alaskan waters are thought to winter on the wintering grounds surrounding the Hawaiian Islands. Humpback whales also winter around Baja, Mexico and in Southeast Asian waters.

The 2013 NMFS stock assessment reports for these humpback whale stocks do not mention Cook Inlet as an area of high humpback whale density; although humpback whales have been reported in lower Cook Inlet near, or just south of, the action area. At least one humpback whale was observed in Upper Cook Inlet in 2014 (NMFS unpublished data).

2.4.3 Distribution and Movements

Humpback whales are rarely observed in the proposed action area, but they do occur there, primarily along the southern portion of the action area (Figure 10). In addition, NMFS is aware of at least one humpback whale having been observed and possibly taken in upper Cook Inlet (by harassment and/or injury) by Apache Alaska Corporation's (Apache) seismic operations on April 25, 2014 by the *M/V Peregrine Falcon* operating a 1,760 cui airgun array at full volume. The humpback whale was first observed 1.5 km (0.9 mi) from the sound source at a time when all whales within 1.84 km (1.1 mi) of the sound source would have been exposed to MMPA Level A take (sound impulses in excess of 180 dB). Although seismic operations were shut down immediately after observing this animal, the whale apparently was exposed to full volume seismic impulses during the time it transited from 1.84 km to 1.5 km (1.1 mi to 0.9 mi) from the sound source. Assuming seismic shots were fired at 15 second intervals, and the whale traveled directly towards the source at the average cruising speed of a humpback whale (4.0 km/hour [2.5 mi/hour]) (Noad and Cato 2007), then this whale would have been exposed to at least 19 shots while it was within the exclusion zone prior to shut-down; 19 shots exceeding the 180 dB threshold for Level A take.

2.4.4 Biology and Behavior

Humpback whales may live from 45-100 years and are sexually mature at 4-7 years. Humpback whales have hearing thresholds in-air and underwater similar to other mysticetes. An underwater audiogram from Houser et al. (2001) shows the typical mammalian U shape with sensitivity to frequencies from 700 Hz to 1 kHz, with maximum relative sensitivity between 2-6 kHz.

3. ENVIRONMENTAL BASELINE

By regulation, 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 the effects of several activities that affect the survival and recovery of threatened and endangered species and designated critical habitat in the action area.

3.1. Status of the Species within the Action Area

This section focuses on existing anthropogenic activities and their influences on Cook Inlet beluga whales, Cook Inlet beluga whale critical habitat, western DPS Steller sea lions, and humpback whales. Existing anthropogenic activity in the action area discussed in this section consists of past and present anthropogenic actions that may have affected listed species. Although some anthropogenic activities discussed below are outside the action area, they may still have an influence on the beluga whales, western DPS Steller sea lions, or humpback whales in the action area.

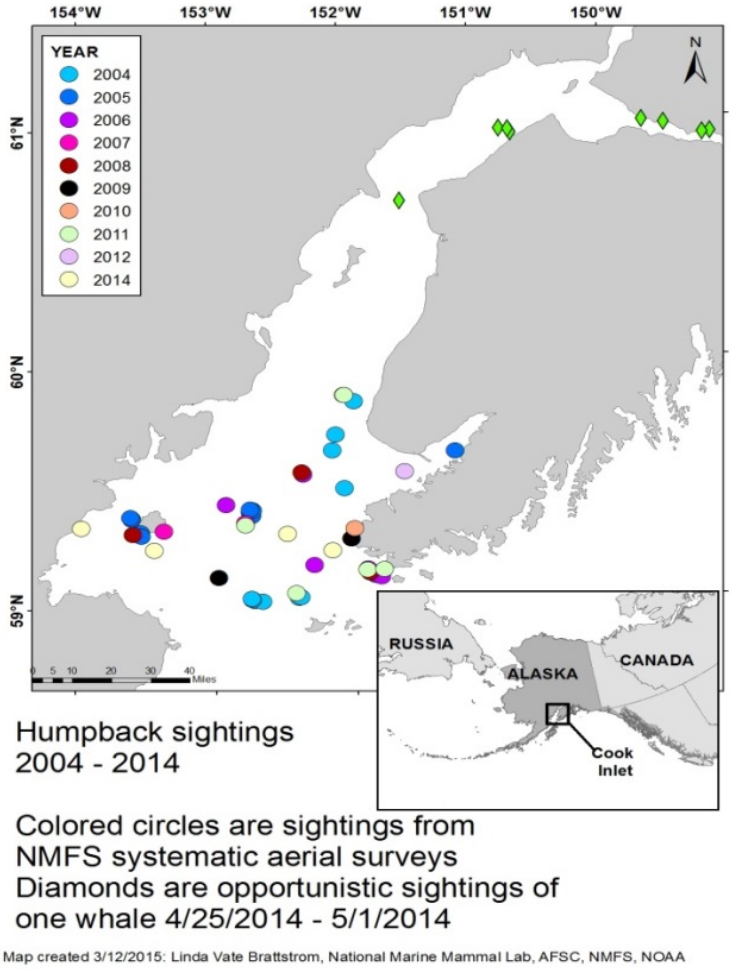

Figure 10. Humpback whale observations, as documented in Cook Inlet, 1994-2014. Green diamonds indicate opportunistic sightings of one whale, or possibly of an adult whale and calf, during April 25-May 1, 2014.

3.1.1 Cook Inlet Beluga Whales

The action area encompasses a large proportion of the Cook Inlet beluga whale range and designated critical habitat. Depending on the season, there may be times when the entire beluga whale population is located within the action area. As previously discussed, the beluga population numbers about 340 individuals, is trending downwards, and is constricting its summer range. Natural and anthropogenic factors may affect the Cook Inlet beluga whale population (NMFS 2008a). Natural factors include strandings, predation, parasitism, disease and environmental changes. Anthropogenic factors include subsistence harvest, poaching, pollution, contamination, fisheries interaction, vessel traffic, oil and gas development, tourism and whale watching, coastal zone development, noise, and research (NMFS 2008a; Table 4). The level of impact from these threats is not known and it is likely the combination of multiple threats that are affecting the Cook Inlet beluga whale population's recovery (NMFS 2008a).

Table 4. Synopsis of environmental baseline threats to Cook Inlet beluga whales that are entirely or partially anthropogenic in nature.

Threat Type	Past Mortality?	Likely to adversely affect?	Significance of threat to population[1]
Coastal development	None known	Yes	Medium
Marine-based oil and gas development	None known	Yes	Low
Transmission lines	None known	Unknown	Low
Ambient noise	None known	No	Low
Oil and Gas industrial noise	None known	Unknown	Low
Vessel noise	None known	Unknown	Low
Seismic exploration noise	None known	Yes	High
Aircraft noise	None known	Unknown	Low
Coastal development noise	None known	Unknown	Medium
Water quality	None known	Unknown	Low
Contaminants	None known	Unknown	Low
Stormwater runoff	None known	Unknown	Unknown
Aircraft de-icing	None known	Unknown	Unknown
Ballast water	None known	Unknown	High
Point-source releases	None known	Yes	High
Fishery interactions	None known	Unknown	Medium/High
Incidental take in fisheries	None known	No	Low
Poaching or illegal harassment	None known	Unknown	Medium
Subsistence harvest	High	Yes	Low
Live strandings	Moderate	Yes	High
Predation	Low	Yes	High
Ship strikes	Suspected	Yes	Medium
Research	Low	Yes	Low
Environmental change	None known	Unknown	Unknown

[1]Represents level of relative concern expressed in Draft Cook Inlet Beluga Recovery Plan (NMFS in preparation).

3.1.2 Steller Sea Lions

As with the Cook Inlet beluga whale, it is likely that multiple factors are influencing the recovery of western DPS Steller sea lions (Allen and Angliss 2013). Factors may include food web interactions, predation (killer whale and shark), subsistence harvest, incidental take by fisheries, illegal shooting, entanglement in marine debris, disease, parasitism, toxic substances, anthropogenic disturbances (aircraft, vessels), nutritional stress due to a reduction in prey, and climate change. However, the proposed project is located outside Steller sea lion critical habitat, as there are no haulouts or rookeries in the action area with large Steller sea lion concentrations. Steller sea lions are rarely observed in the action area; one group of 20 Steller sea lions was observed near the action area, off Anchor Point, on June 10, 2006 by NOAA aerial observers.

Overall, the abundance of western DPS Steller sea lions is increasing despite some localized areas of decline. The proposed project is located well outside Steller sea lion critical habitat, and there are no recognized haulouts or rookeries in the action area. Although Steller sea lions are

rarely observed in the action area, one group of 20 Steller sea lions was observed in the action area, off Anchor Point on June 10, 2006 by NOAA aerial observers. This is the only Steller sea lion observation recorded by NMFS observers in the action area on annual or biennial aerial surveys since 1994 (NMFS unpublished data). Four Steller sea lions were reported by Apache PSOs in 2012, and an average of 0.5 animals per year (from 2003-2013) were reported to NMFS by other observers (NMFS unpublished data).

3.1.3 Humpback Whales

The worldwide population is at least 80,000 humpback whales, while the best estimate for humpback whale abundance (excluding calves) for all feeding and wintering areas in the North Pacific is 21,808 animals (Barlow et al. 2011). The abundance estimates for the entire Central North Pacific stock is 7,469 animals, of which 2,845 are included in the Gulf of Alaska feeding area (Allen and Angliss 2013). The smaller Western North Pacific stock is thought to contain 732 animals (Allen and Angliss 2013). Mobley et al. (2001) estimated a population growth trend of 7 percent per year for 1993-2000 using data from aerial surveys that were conducted in a consistent manner for several years across all Hawaiian Islands; and were developed specifically to estimate a trend for the Central North Pacific stock. Mizroch et al. (2004) estimated survival rates for North Pacific humpback whales using mark-recapture methods; and a model fit to data (1980-1996) from Hawaii indicated an estimated population increase of 10 percent per year (95 percent C.I. of 3-16 percent). For shelf waters in the northern Gulf of Alaska, Zerbini et al. (2006) estimated a 6.6 percent per year (95 percent CI: 5.2-8.6 percent) annual rate of increase for humpback whales during 1987-2003. The annual population growth rate for the western North Pacific stock is less robust, but is estimated at 6.5 percent.

According to the recovery plan for this species (NMFS 1991), threats include: ship strikes, fisheries interactions (including gear entanglement), subsistence hunting, acoustic disturbance, habitat degradation due to pollution, coastal development, competition with humans for resources. Critical habitat is not designated in Alaska for this species. With respect to this proposed action and its effects to humpback whales, the threats of concern derive primarily from acoustic disturbance caused by seismic exploration activities and associated support activities (e.g., aircraft and vessel traffic).

3.2 Factors Affecting Species Environment within the Action Area

The upper Cook Inlet region is the major human population center of Alaska, with the 2013 Municipality of Anchorage population at 300,950, Matanuska-Susitna Borough at 95,192, and Kenai Peninsula Borough at 57,147.[12]

The Cook Inlet beluga whale, humpback whale, and Steller sea lion may be affected by various natural and anthropogenic factors, including: coastal development; ship strikes; noise pollution; water pollution; prey reduction; direct mortalities; research; and environmental change. While a number of known and potential threats have been identified, there is not enough known about the effect of each specific threat to definitively know the level of impact that each threat has on the Cook Inlet beluga whale, Steller sea lion, or humpback whale. In addition, these species may be

[12] U.S. Census Bureau accessed January 31, 2015 at http://quickfacts.census.gov/qfd/states/02/02020.html).

affected by multiple threats at any given time, compounding the impacts of the individual threats (NMFS 2008a, 2008c).

Beluga whales are not uniformly distributed throughout Cook Inlet; they are predominantly found in nearshore waters, and concentrate in the upper Inlet in summer. Where beluga whales must compete with people for nearshore habitats, coastline development leads to the direct loss of this preferred habitat. Indirect alteration of habitat may occur due to bridges, boat traffic, in-water noise, and discharges that affect water quality. Most beluga habitat in Cook Inlet remains essentially intact, however, extensive sections of Turnagain Arm and Anchorage shorelines have been developed (e.g., rip rap, road, and railroad construction); 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. Humpback whales and western DPS Steller sea lions are rare in upper Cook Inlet, including most of the action area.

3.2.1 Coastal Development

Southcentral Alaska is the State's most populated and industrialized area. Many cities, villages, ports, airports, treatment plants, oil and gas platforms and refineries, highways, and railroads are situated adjacent to, and in some cases in, Cook Inlet. This development has resulted in both the loss and alteration of near shore beluga whale habitat and changes in habitat quality due to vessel traffic, noise, and pollution. There is concern that increased development may prevent beluga whales from reaching important feeding and breeding areas. Frequent use of shallow, near shore, and estuarine habitats makes beluga whales particularly prone to regular interaction with human activities (Perrin 1999), and thus beluga whales area likely to be affected by those activities.

<u>Port Facilities</u>

Port facilities in Cook Inlet are found at Anchorage, Port Mackenzie, Tyonek, Drift River, Nikiski, Kenai, Anchor Point, and Homer.

The Port of Anchorage (POA) is Alaska's largest seaport and the main port of entry for southcentral and interior regions. It is a deep draft facility that exists along eastern lower Knik Arm, an area that is commonly used by beluga whales. 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). Construction associated with the current Marine Terminal Development Project has been ongoing on a seasonal basis since 2006, including both in-water and out-of-water activities, although no work is planned during 2015. The POA Intermodal Expansion Project will add 135 acres of useable land to the current 129 acre POA (total area of 264 acres). The POA Intermodal Expansion Project will: rebuild and enlarge docking facilities; improve loading and unloading facilities; provide additional working space to handle shipped fuel, freight, and other materials; and improve access by road and rail transportation serving the POA. The expanded POA would provide efficient transport for the goods into and out of Anchorage for the next 50 years and more. In-water activities during the POA Intermodal Expansion received authorization for an annual take by harassment of 34 beluga whales. During the 2009 construction season, 23 beluga whales were reported taken; in 2010, 13 whales were reported taken; in 2011, four whales were reported taken. These takes derive from beluga whale presence within the designated 160 dB disturbance zones. The future status of the POA Intermodal Expansion is unknown.

One Steller sea lion was sighted at the POA in June 2009. However, rapid implementation of mitigation measures avoided a take by harassment, and the animal eventually left the action area. Because Steller sea lions are rarely sighted in upper Cook Inlet, the POA did not request, nor did NMFS recommend, authorization to take Steller sea lions.

Varying amounts of POA maintenance dredging have occurred annually since 1965. The current operations and maintenance plan at the POA authorizes the U.S. Army Corps of Engineers (USACE) to dredge to 11 m (-35 ft.) Mean Lower Low Water (MLLW). The footprint dredged at the POA fluctuates annually, varying from 95 acres in 1999 to 117 acres in 2004. During the past several years, the average size of the dredged footprint has been about 100 acres. The dredging amount required to maintain the POA varies from year to year, with a maximum of about 1.6 million cubic meters (m^3) (2.1 million cubic yards [cy^3]) of material dredged in 2004. Maintenance dredging is conducted by one or more dredges, and occurs from mid-May through November, depending on the weather. The 2-5 barge trips per day transported about 1,147 m^3 (1,500 cy^3) of material from each dredge to the disposal site (USACE 2008). Dredging along coastal waterways was identified as a concern with respect to the Saint Lawrence beluga whales (DFO and WWF 1995). There, dredging up to 600,000 m^3 (784,770 yd^3) of sediments re-suspended contaminants into the water column and seriously impacted the beluga whales. The Saint Lawrence beluga whale recovery plan contains recommendations to reduce the dredge amount and to develop more environmentally sound dredging techniques (DFO and WWF 1995). While the volume of dredging in Cook Inlet is comparable to Saint Lawrence, the material in Cook Inlet does not appear to contain harmful levels of contaminants (USACE 2005, 2008).

Port MacKenzie is along western lower Knik Arm and development began in 2000 with the construction of a barge dock. The first shipments arrived in July 2001. 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; however, plans call for a bulk loading facility with deep draft capability.

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. Nikiski is home to several privately owned docks (including those belonging to oil and gas companies). 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.

3.2.2 Marine 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. Transmission lines for electricity and communications cross Cook Inlet in a few locations, but are not considered to be a notable threat. Due to their infrequent occurrence in Cook Inlet, Western DPS Steller sea lions and humpback whales likely experience insignificant impacts from the existing marine development in this area.

Oil and Gas Development

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 2014) and 387 active oil and gas leases that total approximately 1,102,563 acres of State leased land, where 423,167 acres are onshore and 679,396 acres are offshore (ADNR 2014). ADNR plans to conduct annual Cook Inlet area wide oil and gas lease sales during the next five years.

BOEM is responsible for oil and gas leasing in federal waters of Cook Inlet. During October 23-December 8, 2014, BOEM gathered public comments on Cook Inlet Lease Sale 244 to prepare developing an environmental impact statement (BOEM 2014).

Significant oil and gas development in Cook Inlet takes place within the proposed Cook Inlet 3D seismic program action area (Figure 11). Stanley et al. (2011) provide U.S. Geological Survey point estimates for undiscovered volumes of hydrocarbons in Cook Inlet as follows:

- 5.39 cubic kilometer (19.04 trillion $ft.^3$) of natural gas
- 599 million barrels of oil
- 46 million barrels of natural gas liquids

Oil and gas development will likely continue in Cook Inlet; however, the overall effects on the Cook Inlet beluga whale are unknown (NMFS 2008a). Potential impacts from oil and gas development on the Cook Inlet beluga whale include increased noise from seismic activity, vessel and air traffic, and well drilling; discharge of wastewater; habitat loss from constructing oil and gas facilities; and contaminated food sources and/or injury from a natural gas blowout or oil spill (NMFS 2008a).

Increased noise from seismic activity, vessel and air traffic, and well drilling could result from gas and oil development. Seismic surveys use high energy, low frequency sound in short pulse durations to determine substrates below the seafloor, such as gas and oil deposits (Richardson et al. 1995). These short pulses of sound increase noise levels near the seismic activity. Airguns have been previously used in Cook Inlet for seismic exploration (JASCO 2007, ASRC 2014) and will be used for the proposed Cook Inlet seismic program. Vessel and air traffic are required for support during oil and gas development. Oil produced on the western side of Cook Inlet is presently 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 2009). Offshore drilling is generally conducted from drilling vessels or platforms.

Figure 11. Oil and gas operations in the Cook Inlet.[13]

Underwater Transmission Lines

In 2009, Alaska Communications Systems Group, Inc. installed a fiber optic cable from Florence, Oregon to Anchorage, Alaska to improve communication between Alaska and the other states. The portion the fiber optics cable that is located in the action area is the submarine cable that extends from Nikiski, on the Kenai Peninsula, to Point Woronzof, Anchorage. Potential impacts from the fiber optic cable included a temporary increase in vessel traffic and noise during the cable installation. During installation, vessels generally operated at speeds of 1-2 knots as the cable was buried 1.2 m (3.9 ft.) below the seafloor (ACS 2008). After installation,

[13] http://dog.dnr.alaska.gov/GIS/Data/ActivityMaps/CookInlet/CI_OilandGasActivity_20130724.pdf

the fiber optic cable rests along the seafloor with a minimal footprint. As a result, the direct loss of habitat was minimal and did not likely have an adverse effect on beluga whales.

3.2.3 Ambient Noise and Noise Pollution

Beluga whales greatly rely on sound to meet basic biological needs such as communicating, foraging, and navigating (Richardson et al. 1995); especially in the turbid waters of Cook Inlet. In general, Cook Inlet is a noisy environment and noise has the potential to disrupt beluga whales' ability to meet these basic biological needs. Noise sources in Cook Inlet that could be found in the action area include ambient sound (e.g. flow noise, wind), large and small vessels, aircraft, oil and gas exploration and production, and construction activities (e.g. dredging and pile driving; NMFS 2008a). Noise studies in Cook Inlet have focused on areas in upper Cook Inlet, many outside the action area (Blackwell and Greene 2003; Blackwell 2005; URS 2007; SFS 2009; Širović and Kendall 2009); however, these studies can indicate anticipated noise in other areas of the Inlet.

Ambient noise is environmental background noise that includes sources such as wind, waves, ice, current, and tidal flow (Richardson et al. 1995). Sound levels from ambient noise vary at different locations in Cook Inlet. Blackwell and Greene (2003) recorded ambient noise levels at five locations in Cook Inlet in areas known to have high beluga whale concentrations; and at three locations near anthropogenic activities. The mouth of the Little Susitna River and Birchwood areas are known to have high concentration of beluga whales; and were found to have the lowest levels of ambient noise. There are many anthropogenic noise sources that occur in Cook Inlet, including some activities outside the action area (Table 5).

<u>Oil and Gas Exploration and Production Noise</u>

Increased noise from seismic activity, vessel and air traffic, and well drilling could result from gas and oil 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 to other parts of Alaska. Liquid gas is also transported via tankers once it is processed (ADNR 2009). Offshore drilling is generally conducted from drilling vessels or platforms.

Blackwell and Greene (2003) recorded underwater noise produced at Phillips A oil platform at six locations at distances ranging from 0.3-19 km (0.2-12 mi). The highest recorded sound level was 119 dB at a distance of 1.2 km (0.75 mi; Table 6). The noise measurements from the oil platform were operating noise not drilling noise; and were generally below 10 kHz. In general, noise from the platform itself is thought to be very weak because the surface area (the four legs) in contact with the water is small (Richardson et al. 1995); and the majority of the machinery is on the platform deck, above the water. However, noise carried down the platform's legs likely contributed to the high levels documented by Blackwell and Greene (2003). 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. This noise is audible to beluga whales, but does not fall within the whale's most sensitive hearing range.

Table 5. Sound measurements from various noise sources in Cook Inlet.

Source	Received Level (dB re 1 µPa)	Distance	Frequency (kHz)
Ambient Noise[1]			
Knik Arm (Outside the Action Area)			
Birchwood	95	-	-
Mouth of Eagle River	118	-	-
Joint Base Elmendorf-Richardson	119	-	-
Port of Anchorage	113	-	-
Anchorage International Airport	105	-	-
Upper Cook Inlet (Outside the Action Area)			
Mouth of Little Susitna River	100	-	-
Between Fire Island and the Mouth of Susitna River	113	-	-
North of Point Possession	120	-	-
Vessel Noise[1]			
Cargo Freight – Northern Lights (docked)	126	100-400 m	Generally <1 kHz
Cargo Bulk Carrier – Emerald Bulker (with two tugs)	134	>200 m	
Tug – Leo (pushing gravel barge Katie II)	149	100 m	
Small Boat – Boston Whaler (drive by)	138	13 m	
Small Rigid Hull Inflatable (drive by)	142	8.5 m	
Aircraft Noise[1]			
Joint Base Elmendorf-Richardson	128.0 ± 9.0	-	Generally <2 kHz
DC-10	124[3]	-	
Landing Military Jet	134	-	
Anchorage International Airport	118.4 ± 5.7[2]	-	
Oil and Gas Drilling Noise[1]			
Philip A Oil Platform	119[3]	1.2 km	<10 kHz

[1]Blackwell and Greene (2003)
[2]Mean and standard deviation
[3]Maximum values

Table 6. Noise levels from construction activities that were measured in Cook Inlet.

Study	Pile	Vibratory	Impact	Dredge
Blackwell 2005	91cm diameter	162 and 164 dB re 1 µPa at 56 m[1]	190 and 189 dB re 1 µPa at 62 m[1]	-
URS 2007	35 cm diameter	120-168 dB re 1 µPa at 600 and 10 m respectively	160-177 dB re 1 µPa at 300-19 m respectively	-
SFS 2009	76 cm diameter	144 dB_{rms} at 35 m	-	156.9 dB re 1 µPa at 30m
SFS 2009	sheet	141 dB_{rms} at 757 m	167 dBrms re 1 µPa at 301 m	-
Širović and Kendall 2009	unknown	183.2 ± 4.8[2] dB re 1µPa at 1 m	196.9 ± 6.1[2] dB re 1 µPa at 1 m	-

[1]Depths of the hydrophone ranged from 1.5-10 m respectively
[2]Standard deviation

Seismic surveys

SAE seismic exploration in Cook Inlet will involve both state and federal waters. 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.

Geophysical seismic activity has been described as one of the loudest man-made underwater noise sources, with the potential to harass or harm marine mammals, including beluga whales, humpback whales, and Steller sea lions. The acoustics study by Blackwell and Greene (2003) did not address marine geophysical seismic activity in Cook Inlet. Seismic surveys use high energy, low frequency sound in short pulse durations to determine substrates below the seafloor, such as oil and gas deposits (Richardson et al. 1995). These short pulses of sound increase noise levels near the seismic activity. Airguns have been previously and are presently being used in Cook Inlet for seismic exploration. Apache's seismic program, during 2012, involved source levels up to 237 dB associated with using the 0.04 m^3 (2,400 cui) airguns. Apache conducted the first portion of its 3D marine seismic surveys in Cook Inlet during May-September 2012. In 2012, they completed a total of 1,841.7 hours of seismic activity, with 1,252.6 hours using the 0.04 m^3 (2,400 cui) airguns. During these 2012 surveys, Apache was authorized to take, by acoustic harassment, up to 30 Cook Inlet beluga whales and 20 western DPS Steller sea lions. During their 2012 operations, Apache did not take Cook Inlet beluga whales or Steller sea lions (Lomac-MacNair et al. 2013). To accomplish this, Apache implemented mitigation measures which, during the course of the season, meant they had five delays in 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).

Vessel Traffic Noise

Vessel traffic includes large shipping, commercial and support vessels, commercial fishing vessels, and personal water craft. Vessel traffic can produce noise that disturbs beluga whales. Blackwell and Greene (2003) recorded underwater noise produced by both large and small vessels near the POA (Table 5). The *Leo* tugboat produced the highest broadband levels, 149 dB, at a distance of approximately 100 m (328 ft.), while the docked Northern Lights (cargo freight ship) produced the lowest broadband levels at 126 dB at 100-400 m (328-1,312 ft.). Ship noise was generally below 1 kHz. SAE's seismic program requires approximately 10 vessels, which will add noise to the environment.

Aircraft Noise

Cook Inlet experiences significant levels of aircraft traffic. The Ted Stevens Anchorage International Airport (ANC) is directly adjacent to lower Knik Arm, with its high volume of commercial and cargo air traffic. Joint Base Elmendorf Richardson (JBER) has a runway near and airspace directly over Knik Arm. Lake Hood and Spenard Lake, Anchorage are regularly used by recreational seaplanes. Other small public runways are found in: Knik Arm (Birchwood, Goose Bay), Merrill Field, Girdwood, Kenai, Ninilchik, Homer, and Seldovia.

Even though sound is attenuated by the water surface, Blackwell and Greene (2003) found aircraft noise can be loud underwater when jet aircraft are directly overhead. Aircraft noise was recorded underwater near ANC and JBER, outside the action area. Recordings included 15

commercial aircraft and 11 F-15 military jets. Eleven of the 15 commercial aircrafts and two of the 11 military jets were detectable underwater due to sound transmission across air and water. Results indicated that aircraft and ambient noise levels at JBER were higher than at ANC. The sound energy recorded from the aircrafts were generally broadband, and below 2 kHz.

Richardson (1995) discovered that beluga whales in the Beaufort Sea will dive or swim away when low-flying (less than 0.3 mi [500 m]) aircraft passed directly above these whales. However, during the Cook Inlet beluga whale survey, aircraft flying at approximately 244 m (800 ft.) observed little or no change in beluga whale swim directions (Rugh et al. 2000). This is probably because beluga whales in Cook Inlet have habituated to routine small aircraft over flights. 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.

Coastal Development Noise

Construction noise in Cook Inlet is associated with activities such as dredging and pile driving. The majority of construction activities occurred near Anchorage; therefore, most studies that documented construction noise in Cook Inlet were from outside the action area. Additionally, these studies focused on pile driving activities, because in-water noise produced by this activity is a major concern (Table 6).

3.2.4 Water Quality and Water Pollution

The Conservation Plan (NMFS 2008a) states that contaminants are a concern for the sustained health of Cook Inlet beluga whales. The principal sources of pollution in the marine environment are: 1) discharges from industrial activities not entering municipal treatment systems; 2) discharges from municipal wastewater treatment systems; 3) runoff from urban, mining, and agricultural areas; and 4) accidental spills or discharges of petroleum and other products (Moore et al. 2000).

Upper Cook Inlet was designated as a Category 3 on the Clean Water Act Section 303(d) list of impaired water bodies (ADEC 2010). Lower Cook Inlet is not listed as an impaired waterbody; however, it was included in the Southcentral Alaska Coastal Survey that focused on coastal bays and estuaries. This survey included the Alaska Peninsula, Kodiak archipelago, Cook Inlet, Kenai Peninsula, and Prince William Sound. The Alaska Department of Environmental Conservation (ADEC determined that Southcentral Alaska coastal waters' overall condition rated good, based on examining water quality, sediment quality, and fish tissue contaminants collected from 55 local sites (ADEC 2010).

Potential sources of pollutants in Cook Inlet could include 1) discharge from industrial activities excluding wastewater treatment facilities; 2) discharge from community wastewater treatment facilities; 3) runoff from urban, agriculture and mining; and 4) accidental spills or discharge from oil and gas production (Moore et al. 2000; NMFS 2008a). Main sources of pollutants found in Cook Inlet likely include the 10 wastewater treatment facilities, stormwater runoff, airport deicing, and discharge from oil and gas development (Moore et al. 2000; NMFS 2008a). Within SAE's action area, the following activities occur: wastewater treatment facilities, stormwater runoff, airport deicing, and discharge from oil and gas development.

Wastewater discharge

Ten communities currently discharge treated municipal wastes into Cook Inlet. Wastewaters entering these facilities may contain a variety of organic and inorganic pollutants, metals, nutrients, sediments, bacteria and viruses, and other emerging pollutants of concern. Wastewater from the Municipality of Anchorage, Nanwalek, Port Graham, Seldovia, and Tyonek receive primary treatment; wastewaters from Homer, Kenai, and Palmer receive secondary treatment; and wastewaters from Eagle River and Girdwood receive tertiary treatment.

Wastewater treatment facilities undergo primary, secondary, or tertiary treatment prior to being discharged into a water body. Primary treatment involves sedimentation that includes removing 30-50 percent of the solid particulate from the wastewater prior to discharge (Viessman and Hammer 1998). In addition to sedimentation, secondary treatment involves adding a biological component to remove the remaining organic matter. Tertiary treatment involves both primary and secondary treatment, as well as additional processes to increase the water quality of the discharge (Viessman and Hammer 1998).

The Native Village of Tyonek wastewater treatment facility receives primary treatment prior to discharging their wastewater. Tyonek operates on a gravity fed sewer that drains into a community septic tank. Every spring and fall, the solids are collected by a pump truck and taken to a sludge lagoon for dewatering. The effluent is then discharged into Cook Inlet. The village uses approximately 60 gallons of water per day, most of which is effluent.

Although the Anchorage John M. Asplund Wastewater Treatment Facility (AWTF) is outside the action area, it is the largest wastewater facility in Alaska and is located in upper Cook Inlet. AWTF receives primary treatment only and removes approximately 80 percent of its solids prior to discharge (AWWU 2014). It was built in 1972, upgraded in 1982 (28 million gallons per day [mgd]), and again in 1989 (58 million mgd). EPA issued a waiver to AWTF for secondary treatment and allows the direct discharge of primary treated wastewater into Cook Inlet, near Point Woronzof. AWTF is allowed to discharge primary treated wastewater due to the levels of sediment they are able to extract, and the extreme tides and currents of Cook Inlet (AWWU 2014). Once the sediment is removed from the wastewater, the sludge is incinerated.

The City of Kenai wastewater facility is one of the larger wastewater treatment facilities in Cook Inlet. The Kenai wastewater treatment facility discharges secondary treated wastewater from its treatment plant directly into Cook Inlet, and the sludge is taken to the Soldotna landfill (EPA 2007a). The facility's design flow is 1.330 mgd with an average daily flow of 0.573 mgd (EPA 2007a). The City of Kenai is planning to upgrade the facility by 2018 (ADEC 2014).

Wastewater discharge from oil and gas development could increase pollutants in Cook Inlet. Discharge includes, but are not limited to, drilling fluids (muds and cuttings), produced water (water phase of liquid pumped from oil wells), and domestic and sanitary waste (EPA 2007b). Under the NPDES permit issued by EPA, oil and gas facilities are required to monitor the effluent for pollutants and meet standards specified in the permit before it is discharged into Cook Inlet (EPA 2007b).

Contaminants found in Beluga Whales

Studies conducted in upper Cook Inlet, areas with high concentrations of beluga whales, found levels of polychlorinated biphenyls (PCBs), pesticides, and petroleum hydrocarbons in the water column and sediment were below detectable limits, and heavy metal levels were below management levels (KABATA 2004; NMFS 2008a; USACE 2008).

Becker et al. (2000) compared beluga whale tissue samples taken from Arctic Canada, two Alaska beluga whale populations, Greenland, and Saint Lawrence Estuary. They compared levels of PCBs, chlorinated pesticides, heavy metals, and other elements between the populations. The results indicated that Cook Inlet whales had the lowest concentrations of PCBs, pesticides, cadmium, and mercury than the other populations; but had higher concentrations of copper. Becker et al. (2000) suggested the difference in toxin levels was likely related to a difference in source (geographic or food web), and the whales' age distribution. A follow up study conducted by Becker et al. (2010) did not find significant changes in contaminant levels in the Cook Inlet beluga whale population with the inclusion of additional samples collected during the past decade; however, they did identify and document increasing levels of chemicals of emerging concern (e.g. polybrominated diphenyl ether, hexabromocyclododecane, and perfluorinated compounds) in the Cook Inlet population. Although the contaminants levels found in the Cook Inlet beluga whale population are comparably lower than levels found in other populations, the effects on this population are unknown (Becker et al. 2000; NMFS 2008a).

Stormwater Runoff

Stormwater pollutants may include street deicer, oil, pesticides and fertilizers, heavy metals, and fecal coliform. Watershed Management Services and Alaska Department of Transportation are responsible to identify, monitor, and control pollutants in stormwater. Stormwater from other communities in the action area (e.g., Kenai) may also contribute to pollutants that enter Cook Inlet. The effects from stormwater on the Cook Inlet beluga whale have not been studied and are unknown (NMFS 2008a).

Numerous releases of petroleum hydrocarbons have been documented from the POA, JBER, and the Alaska Railroad Corporation (ARRC). The POA transfers and stores petroleum oils, as well as other hazardous materials; and since 1992, all significant spills and leaks have been reported. Past spills have been documented at each of the bulk fuel facilities within the POA and also on JBER's property (POA 2003). JBER is listed on the National Priorities List under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, because of known or threatened releases of hazardous substances, pollutants, or contaminants. Spills were also reported at the ARRC rail yard. In 1986, petroleum seeped into Ship Creek from the nearby rail yard and several oil spills occurred in 2001 (U.S. Army 2010). Freight handling activities have historically caused numerous surface stains and spills at the rail yard.

Aircraft De-icing

Deicing and anti-icing of aircraft and airfield surfaces are required by the Federal Aviation Administration to ensure the safety of passengers. Deicing and anti-icing chemicals are used from October through May, and may be used on aircraft, tarmacs, and runways. Depending on the application, deicing material is comprised of different chemicals. Ethylene glycol and propylene glycol are used on aircraft for anti-icing and deicing purposes; whereas potassium acetate and urea are used to deice tarmacs and runways. Much of the deicing materials or their

breakdown products eventually enter Cook Inlet. No studies exist analyzing the potential impacts on beluga whales from these deicing agents.

Airport deicing contributes to the levels of pollutants found in Cook Inlet. ANC and JBER airport are the largest airports in Cook Inlet. Other smaller airports exist throughout Cook Inlet including Merrill Field, Lake Hood, Lake Spenard, and Kenai Municipal Airport (NMFS 2008a). The Federal Aviation Administration requires airports to use deicing chemicals (e.g., ethylene glycol, propylene glycol, potassium acetate, and urea) on their aircrafts and runways for safety purposes. It is known that these deicing chemicals, or their break down products, end up in Cook Inlet; however, the amount of break down that occurs prior to entering Cook Inlet is unknown (NMFS 2008a).

Ballast Water Discharges

Waste discharges from vessels are regulated by the U.S. Coast Guard. Potential discharges include oily waste; sewer water; gray water (e.g., shower water); ballast water that may contain invasive marine species; and garbage. Gray water and sewer water, provided they are free from oil waste, may be discharged in the open sea. However, by law, discharges of any kind are not allowed within three miles of land.

Ships can potentially release pollutants and non-indigenous organisms into Cook Inlet by discharging ballast water. It is a recognized worldwide problem that aquatic organisms picked up in ship ballast water, transported to foreign lands, and dumped into non-native habitats, are responsible for significant ecological and economic perturbations costing billions of dollars. The National Ballast Information Clearinghouse reported that more than five million metric tons of ballast water was released in Cook Inlet, from Homer to Anchorage, during 1999-2003. Invasive species were found just off the POA in a 2004 survey by the Smithsonian Environmental Center. The effect of discharged ballast water, and possible invasive species from such discharges, on western DPS Steller sea lions and Cook Inlet beluga whales and their habitat is unknown.

Point Source Contaminant Spills/Releases

Research has shown that while cetaceans are capable of detecting oil, they do not seem to avoid it (Geraci 1990). The paucity of data on oiled beluga whales makes it difficult to predict spill effects on these whales. Oil spills that occur in or upstream of Cook Inlet beluga whale habitat could result in the whales experiencing direct contact with the oil, with possible effects to skin and/or respiratory system. Prey contamination is likely, but the effects from contaminated prey on beluga whales remains unknown. Spill cleanup efforts could displace whales from feeding areas.

Cook Inlet beluga whales could be affected through residual oil from a spill even if they were not present during the oil spill, due to the highly mobile nature of oil in water and the extreme tidal fluctuations in Cook Inlet (NMFS 2008a).

Polycyclic aromatic hydrocarbons (PAHs), a group of contaminants found in petroleum products, combined with other contaminants may cause cancer in beluga whales (Kingsley 2002); and are thus a concern with respect to the Cook Inlet beluga whale's conservation and recovery. Cook Inlet beluga whales appear to bioaccumulate PAHs from the environment and prey (Reynolds

2010). A spill with petroleum products during project construction might increase the release of PAHs into the environment. PAHs, however, generally do not easily dissolve in water and the fast currents and assimilative capacity of Cook Inlet could reduce impacts on water quality that might result in the event of a spill. Because of the physical and chemical properties of PAHs, it is unlikely the project will result in adverse impacts on Cook Inlet beluga whales.

Oil has been implicated in the deaths of pinnipeds (St. Aubin 1990). Pinnipeds exposed to oil at sea through incidental ingestion, inhalation, or limited surface contact do not appear greatly harmed by the oil; however, pinnipeds found close to the source or who must emerge directly in oil appear substantially more affected.

Toxic substances, such as oil, may be a contributing factor in the decline of Steller sea lion population (NMFS 2008c). Sea lions exposed to oil through inhalation, dermal contact and absorption, direct ingestion, or through the ingestion of prey may become heavily contaminated with PAHs. The Exxon Valdez oil spill occurred after the decline began in the Steller sea lion population, with mortalities from toxic contamination following this event. Twelve sea lion carcasses were found in Prince William Sound and 16 carcasses were found near Prince William Sound, along the Kenai coast, and at the Barren Islands. The highest PAH levels were in the animals found dead after the spill (NMFS 2008c). While the Exxon Valdez oil spill likely resulted in these mortalities, this project is unlikely to result in an oil spill, and there are significantly fewer sea lions in Cook Inlet than in Prince William Sound.

While construction of an oil/gas facility may temporarily result in habitat loss, an oil spill could severely impact the beluga whales and put the population at risk. The degree of risk posed by natural gas leaks is not known.

On October 31, 2012, the State of Alaska assumed primacy for Clean Water Act administration and enforcement. During 1984-1994, approximately 10,500 gallons of oil spilled from oil platforms. Four gas blowouts occurred since 1962 (Moore et al. 2000). Offshore oil spill records in Cook Inlet during 1994-2011 (ADNR unpublished data) show only three spills during oil exploration: two oil spills at the UNOCAL Dillon Platform in June 2011 (two gallons) and December 2001 (three gallons); and one oil spill at the UNOCAL Monopod Platform in January 2002 (one gallon). During the same time, 71 spills occurred offshore during oil production. Most oil spills ranged: 0.0011-1 gallon (42 spills); with three spills larger than 200 gallons: 210 gallons in July 2001 (Cook Inlet Energy Stewart facility); 250 gallons in February 1998 (King Salmon Platform); and 504 gallons in October 1999 (UNICOL Dillon Platform). All 71 crude oil spills from the offshore platforms, both exploration and production, totaled less than 2,140 gallons. Related effects tot 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 (NMFS 2008a).

3.2.5 Fisheries Interactions

Fishing is a major industry in Alaska. As long as fish stocks are sustainable, commercial, personal use, recreational, and subsistence fishing will continue to take place in Cook Inlet. 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. Given that beluga whales concentrate in upper Cook Inlet during summer (Rugh et al. 2010), fisheries that occur in these waters during spring and summer could have a high likelihood of interacting with beluga whales. As a result, there will be continued potential for: prey competition, harassment, risk of ship strike, entanglement in fishing gear, and displacement from important foraging habitat for the beluga whales. NMFS and ADFG will continue to manage fish stocks, and monitor and regulate fishing in Cook Inlet to maintain sustainable stocks.

Personal use and subsistence are only allowed for Alaskan residents. Personal use fisheries require a valid Resident Sport Fishing License; whereas subsistence fisheries do not (ADFG 2011a). Popular recreational streams within the action area include anadromous streams along the west coast of Cook Inlet (NMFS 2008a; ADFG 2011b). Eulachon harvest locations within the action area include areas from the Chuitna to the Susitna and Little Susitna rivers (NMFS 2008a; ADFG 2011b). Groundfish (e.g., halibut [*Hippoglossus stenolepis*], lingcod [*Ophiodon elongates*], rockfish [*Sabastes*]) may be harvested within the action area. Additionally, littleneck, butter, and razor clams (*Siliqua patula*) are harvested along Cook Inlet intertidal areas (NMFS 2008a). Potential impacts to the beluga whale from personal use, recreational, and subsistence fishing include operating small watercrafts in the river mouths and shallow waters, which could lead to displacement from important habitat, harassment, prey competition, and ship strikes (NMFS 2008a). The overall impacts from personal use, recreational and subsistence fishing on the Cook Inlet population recovery is low (NMFS 2008a).

Commercial Fisheries

Cook Inlet is comprised of several commercial fisheries, all of which require permits. The Cook Inlet commercial fisheries have three management areas: lower, middle, and northern (upper Cook Inlet) districts (ADFG 2011c, d). Portions of the upper Cook Inlet district management areas are within the proposed Cook Inlet seismic program action area. The upper Cook Inlet commercial fishing region consists of all waters north of Anchor Point Light, which is further divided into the Northern (north of East and West Foreland) and Central Districts (south of the Forelands to Anchor Point Light). Species commercially harvested in upper Cook Inlet include all five Pacific salmon species (drift and set gillnet), eulachon or smelt (dip net), Pacific herring (gillnet), and razor clams (hand-digging); however, sockeye salmon is the most economically valuable fishery (Shields 2010; ADFG 2011c).

In 2013, approximately 2.7 million salmon were harvested commercially in upper Cook Inlet, just under the average annual harvest during 1966-2012 (2.9 million salmon) (Shields and Dupuis 2013). Approximately 95.4 tons of smelt (100 tons is the maximum allowable harvest), 35.6 tons of herring, and 172,819 kg (381,000 lbs.) of razor clams were commercially harvested in 2013 (Shields and Dupuis 2013).

ADFG has management responsibility for most commercial fisheries in Cook Inlet, with the exception of halibut and a few federally managed fisheries in lower Cook Inlet. The state managed fisheries in the upper and mid inlet include salmon (i.e., set and drift gillnet), herring (gillnet), a recently reopened dip net fishery for eulachon (hooligan or smelt), and a razor clam fishery. The largest fisheries in Cook Inlet, in terms of participant numbers and landed biomass, are the State managed salmon drift and set gillnet fisheries concentrated in the Central and

Northern Districts (mid and upper Cook Inlet). Even though all five Pacific salmon species are caught in the upper inlet, sockeye salmon is the primary target for the salmon commercial fisheries. Operation dates change depending upon management requirements, but in general, the drift fishery operates from late June through August; and the set gillnet fishery during June-September.

Salmon fishery efforts vary between years, and within-year effort can be temporally and spatially directed through salmon management regulations. While the permit numbers fished in Cook Inlet salmon gillnet fisheries has been relatively constant, the actual amount of fish caught has fluctuated greatly during the past 20 years (a high of 10.6 million salmon in 1992 to a low of 1.8 million salmon in 2000). The 2007 commercial harvest of salmon in upper Cook Inlet was 3.6 million salmon, slightly higher than the 10 year average of 3.5 million harvested salmon. Many Chinook salmon returns to Alaska's waters have declined precipitously in recent years. Chinook salmon returns in Cook Inlet have been greatly reduced, leading to closures in both sport and commercial fisheries in 2012.

The sac roe herring fisheries are located in four sub-districts of the mid and northern inlet (upper, West, Kalgin Island, and Chinitna Bay sub-districts); however, the upper sub-district fishery is the most productive. In 2007, the herring catch was 11793 kg (26,000 lbs.). The commercial razor clam fishery, along the west side of Cook Inlet, is the only remaining commercial fishery for razor clams in Alaska.

There has been a sporadic fishery for eulachon since 1978 (taking 136-45,359 kg [300-100,000 lbs.] in 1978, 1980, 1998 and 1999). NMFS made recommendations to the Board of Fisheries to discontinue this fishery effective in 2000, due to the lack of information on the eulachon runs into the Susitna River and the absence of evaluating the effects from this fishery on beluga whales, in terms of disturbance, harassment, or competition for these fish. Additionally, it was noted beluga whales may be greatly dependent on the oil-rich eulachon early in the spring (preceding salmon migrations) and that large eulachon runs may occur in only a few upper inlet streams. The commercial fishery for eulachon was reopened in 2005, but is restricted to hand operated dip nets in saltwater between the Chuitna and Little Susitna rivers, with a total harvest at 100 tons or less. During 2006-2013, commercial eulachon harvest ranged from 39.1-100.8 tons harvested on 3-11 permits (Shields and Dupuis 2013).

Potential impacts from commercial fishing on Cook Inlet beluga and humpback whales include harassment, gear entanglement, ship strikes, reduction in prey, and displacement from important habitat. Adverse interactions with gear during 2007-2011 caused one mortality of a Western North Pacific humpback whale in the Bering Sea/Aleutian Islands pollock trawl fishery and one mortality in the Bering Sea/Aleutian Islands flatfish trawl fishery. Average minimum annual mortality from observed fisheries was 0.40 humpbacks from this stock (Allen and Angliss 2013). There are no known occurrences of fishery-related take of humpback whales in the proposed action area.

An observer program for the Cook Inlet salmon set and drift gillnet fisheries was implemented during 1999-2000 in response to concerns that there may be significant numbers of marine mammal injuries and mortalities incidental to these fisheries. Observer coverage in the Cook

Inlet drift gillnet fishery was 1.75 percent and 3.73 percent in 1999 and 2000, respectively. The observer coverage in the Cook Inlet set gillnet fishery was 7.3 percent and 8.3 percent in 1999 and 2000, respectively (Manly 2006). There were no mortalities of Steller sea lions observed in the set and drift gillnet fisheries in either 1999 or 2000 (Manly 2006).

The likelihood of a lethal incidental take of a beluga whale from commercial fishing is low; however, the likelihood of prey reduction substantially impacting the recovery of the Cook Inlet beluga whale population is high (NMFS 2008a). Commercial fisheries may compete with beluga whales in Cook Inlet for salmon and other prey species. 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.

Personal Use, Recreational, and Subsistence Fisheries

It is difficult to overestimate the popularity of recreational fishing in Alaska, as evidenced by the combat fishing conditions that people tolerate during salmon runs and the large number of charter fishing operations. There are many recreational fishing opportunities, primarily for salmon, which includes the hundreds of drainages feeding into Cook Inlet. Some important salmon streams within the action area include the Susitna, Little Susitna, and Kenai rivers. Outside the action area, Ship Creek is the most popular fishing location in Anchorage. In 2005, anglers fishing in Anchorage represented four percent of the total statewide sport fishing effort. In lower Cook Inlet, recreational fishing for groundfish such as halibut, lingcod, and rockfish are very popular. While pursuit of shellfish is popular at many Cook Inlet beaches, razor clam populations near Ninilchik have declined precipitously in recent years.

Personal use gill net fisheries occur in Cook Inlet and have been subjected to many changes since 1978 (Ruesch and Fox 1999), which are summarized in Brannian and Fox (1996). Dip net salmon is a summer ritual for many resident Alaskans. Since 2003, dip-netters on the Kenai River have harvested 130,000-540,000 sockeye salmon.[14]

Fishing for eulachon is popular in Turnagain Arm, with no bag or possession limits. The most popular areas to harvest eulachon in the personal use fisheries are: 1) Twentymile River and Turnagain Arm shoreline, near the river; and 2) Kenai River. Eulachon are also harvested at the Susitna and Little Susitna rivers and their tributaries; Placer River and Turnagain Arm shoreline, near the river; and north of the Ninilchik River. Annual harvests ranged 2.2-5 tons during the past decade. The personal use harvest of eulachon is possibly under reported as some participants may confuse their harvests as being subsistence, and not personal use. Subsistence records for eulachon and herring harvests are not kept (ADFG 2004). NMFS has received reports that spring (April) boat traffic in the Twentymile River (thought to be bear hunters and possibly early eulachon fishers) are periodically causing Cook Inlet beluga whales to exit the stream and swim back out into Turnagain Arm. The reason for beluga's presence in the Twentymile river at that time is uncertain.

[14]http://www.adfg.alaska.gov/index.cfm?adfg=PersonalUsebyAreaSouthcentralkenaiSalmon.main

3.2.6 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.

Subsistence Harvest

The MMPA provides an exemption from its prohibitions that allows Alaska Natives to harvest marine mammals for subsistence purposes and for traditional handicrafts. There were no reported takes of humpback whales by subsistence hunters in Alaska or Russia during 2007-2011 (Allen and Angliss 2013). Subsistence hunters in Alaska are not authorized to take humpback whales, and none have been reported (Allen and Angliss 2013). Average annual subsistence take of western DPS Steller sea lions during 2004-2008 (the only time for which region-wide estimates are available) was 136.9, with an additional average of 35.3 struck and lost animals (Allen and Angliss 2013). This take estimate excludes animals taken on St. Paul Island, where limited data suggest a mean annual take of 199 animals. There are no reported subsistence take of Steller sea lions in the proposed action area.

The effect from past subsistence harvests on the Cook Inlet beluga whale population was significant. While a harvest occurred at unknown levels for decades, the subsistence harvest levels increased substantially in the 1980s and 1990s. Reported subsistence harvests during 1994-1998 can account for the stock's decline during that interval. The observed decline during that time and the reported estimated harvest rates (including estimates on whales that were struck and lost, and assumed to have perished) indicate these harvest levels were unsustainable (Figure 12).

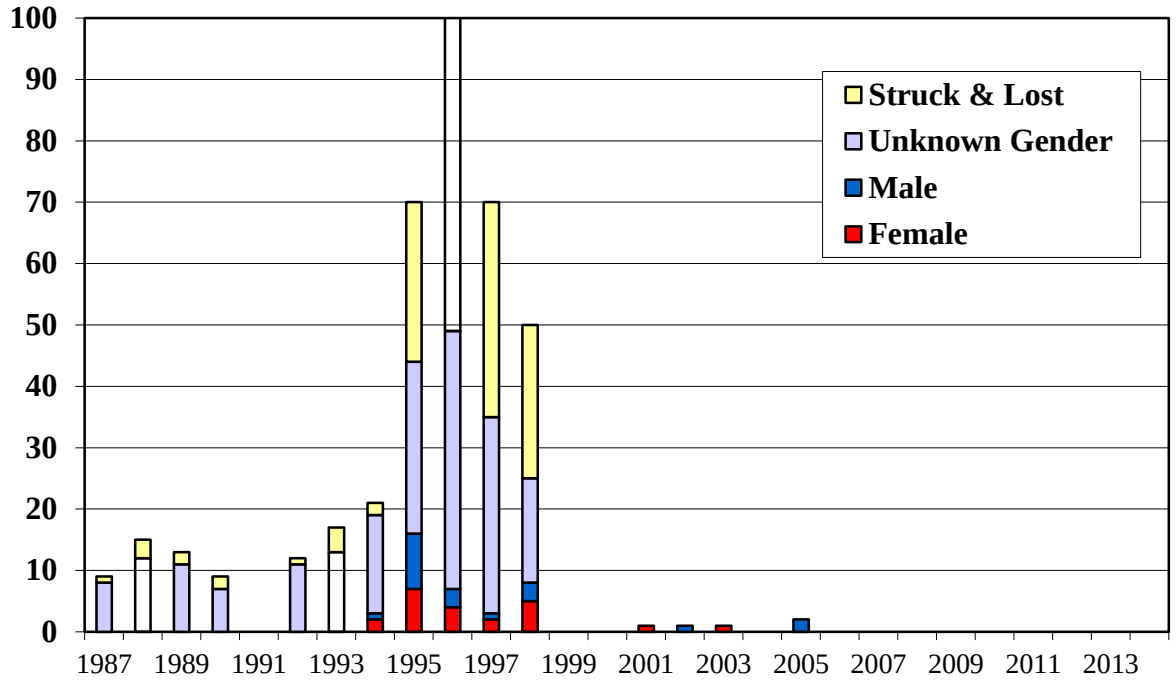

Figure 12. Cook Inlet beluga whale subsistence harvest, 1987-2014 (CIMMC 1996, 1997; Angliss and Outlaw 2008; NMFS 2008b; NMFS unpublished data).

The known subsistence harvest by Alaska Natives during 1995-1998 averaged 77 beluga whales annually. The harvest, which was as high as 20 percent of the population in 1996, was sufficiently high to account for the 14 percent annual rate of decline in the population during 1994-1998 (Hobbs et al. 2000). 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. Currently, there is no Alaska Native organization with an approved MMPA co-management agreement with NMFS regarding Cook Inlet beluga whales.

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 still exists. Although NMFS maintains an enforcement presence in upper Cook Inlet, effective enforcement on such a large area is difficult. While poaching is a theoretical threat, no poaching incidents have been confirmed to date. NMFS Enforcement has investigated several reported incidences on Cook Inlet beluga whale harassment, but to date there are no convictions. However, the threat of illegal harassment exists.

Incidental Take by Fisheries

Incidental take in regards to commercial fishing typically refers to the catch or entanglement of animals that were not the intended target for the fishing activity. Marine mammal injury or mortality reports incidental to commercial fishing operations in Cook Inlet have been obtained from fisheries reporting programs (self-reporting or logbooks), observer programs, and literature. The only reports where Cook Inlet beluga whales were fatally taken incidental to the commercial salmon gillnet fishing are from the literature. Murray and Fay (1979) stated that salmon gillnet fisheries in Cook Inlet caught five beluga whales in 1979. Incidental take by commercial salmon gillnet fisheries in the inlet were estimated at 3-6 beluga whales per year during 1981-1983 (Burns and Seaman 1986). Neither report, however, differentiated between the set gillnet and drift gillnet fisheries. There have been sporadic reports over the years that a single beluga whale was entangled in fishing nets (drift net and set gillnet); however, mortalities could not be confirmed.

NMFS placed observers in the commercial Cook Inlet salmon drift net, and upper and lower inlet set gillnet fisheries in 1999 and 2000. During the two observation seasons, only three beluga whale sightings occurred, and there were no reports on beluga whale injuries and/or mortalities. Furthermore, during 1990-2000, fishermen's voluntary self-reports indicated there were no beluga whale mortalities from interactions with commercial fishing. NMFS found the current rate of direct mortality from commercial fisheries in Cook Inlet appears to be insignificant and should not delay recovery of these whales.

In the spring of 2012, a young beluga whale was found dead in 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.

Stranding

Beluga whale strandings in Cook Inlet are not uncommon, with most reported in Turnagain Arm. More than 800 whales stranded (alive and dead) in Cook Inlet since 1988 (NMFS unpublished data). Mass strandings (two or more whales) primarily occur in Turnagain Arm and Knik Arm, and often coincided with extreme tidal fluctuations (spring tides); and twice, since 1999, coincided with a killer whale sighting report (NMFS unpublished data). NMFS recognized that strandings are a constant threat to the Cook Inlet beluga whale recovery; and determined this declining population could not easily recover from multiple mortalities that may result from a mass stranding event (Hobbs et al. 2006).

Prolonged stranding events that last more than a few hours may result in significant mortalities. During the past 10 years (2004-2014), reported dead stranded beluga whales averaged 10 whales per year. During the past 15 years (1999-2014), about 319-331 beluga whales were reported to have stranded alive in upper Cook Inlet. The annual abundance estimates continue to confirm a declining whale population. Beluga whale stranding events may represent a significant threat to the conservation and recovery of this stock.

Predation

Although infrequent, killer whales have been documented to prey upon beluga whales in Cook Inlet (witnessed and necropsy determinations). Few killer whales are reported in the upper inlet. However, given the small population size of the Cook Inlet beluga whales, predation may have a significant effect on recovery. On average, one Cook Inlet beluga whale is estimated to be killed per year by killer whales (Shelden et al. 2003). Killer whale predation effects were addressed in the status reviews where the models demonstrated that killer whale predation on an annual basis could significantly impact recovery (NMFS 2008a). In addition to directly reducing the beluga population, killer whale presence in upper Cook Inlet may also affect the resident beluga population by causing live stranding events. Since 2001, there have been only three reports where killer whales preyed upon these whales. Witnesses reported killer whales in Turnagain Arm during the live stranding events in August 1999 (58-70 whales) and September 2000 (15–20 whales); and one witness reported a killer whale attacking a beluga whale in Turnagain Arm, September 2008. However, the rate at which preyed upon beluga whales become beached, and are subsequently reported, is unknown. Presumably, the beluga whale carcasses that were preyed upon by killer whales are sufficiently stripped of blubber that the carcass sinks. NMFS considers killer whale predation to be a potentially significant threat to the conservation and recovery of Cook Inlet beluga whales.

3.2.7 Ship Strikes

Potential impacts from vessel traffic on the Cook Inlet beluga whale, humpback whale, and western DPS Steller sea lion include ship strikes, increased noise levels, and displacement from important habitat. Ship strikes with large vessels are not likely to occur or significantly affect beluga whales, humpback whales, and sea lions because large ships travel at slower speeds and in a direct route. However, ship strikes with smaller vessels are more likely to occur and have a

greater impact on the whales because the small vessels tend to travel at higher speeds and often change direction (NMFS 2008a).

Cook Inlet is mostly navigable and used by various classes of water craft. There are eight port facilities and numerous improved and unimproved small boat launches located in Cook Inlet. Commercial shipping occurs year round, with containerships transiting between the Seattle/Puget Sound, WA areas and Anchorage, AK. Other commercial shipping includes bulk cargo freighters and tankers. Currently, with the exception of the Fire Island Shoals, Port MacKenzie, and POA, no other large vessel routes or port facilities in Cook Inlet occur in high value beluga whale habitat. Beluga whales are regularly sighted in and around the POA (Rugh et al. 2005; Cornick and Kendall 2008; POA 2009) passing near or under vessels (Blackwell and Greene 2003), indicating that these animals may have a tolerance for large vessel traffic.

Various commercial fishing vessels operate throughout Cook Inlet, with some very intensive use areas associated with the salmon and herring fisheries. Sport fishing and recreational vessels travel between Anchorage and several popular fishing streams that enter the upper inlet. Vessels are also present in Cook Inlet as support vessels for development activities, including the vessels planned for SAE's seismic activities.

While ship strikes have not been definitively confirmed in a Cook Inlet beluga whale death, in October 2007 a dead whale washed ashore with "wide, blunt trauma along the right side of the thorax" (NMFS unpublished data), which suggested a ship strike as the cause of the injury. High speed vessels operating in beluga whale concentration areas have increased their probability in striking a whale, and Cook Inlet beluga whales with propeller scars have been observed (Burek 1999; McGuire et al. 2009, 2011a). Small boats and jet skis, which are becoming more abundant in Cook Inlet, are also able to quickly approach and disturb these whales in their preferred habitat (shallow coastal areas).

3.2.8 Research

Research studies on Cook Inlet beluga whales and their habitat within Cook Inlet can also disturb these whales. Research often includes surveys, which requires boats and/or planes, adding to the vessel traffic, noise, and pollution near the action area. Research conducted in the action area includes aerial abundance surveys, satellite tagged whales, land- and boat based visual surveys, and passive acoustic monitoring.

Aerial abundance surveys conducted by NMFS occurred every June during 1994-2012 and 2014, except July 1995; and since 2012 have a biennial schedule. The primary goal for these surveys is to document Cook Inlet beluga whale abundance and distribution (Rugh et al. 2000, 2005; Shelden et al. 2013). Aerial surveys were flown every 1-2 months during June 2001 and June 2002 (Rugh et al. 2004). A small fix-winged aircraft is used to fly these surveys at 244 m (800 ft.) to reduce in-water noise from the survey plane (Rugh et al. 2005; Hobbs et al. 2009).

During 1999-2002, NMFS placed satellite tags on 18 beluga whales in upper Cook Inlet (Goetz 2012). Shortly after a tagging event in 2002, a beluga whale was found dead and reported one month later. Although NMFS was unable to recover the carcass, a flipper band that identified the tagged whale was recovered from the animal. This tag transmitted for only 32 hours. Information

was analyzed from the other seven whales tagged during that project. Another two beluga whales transmitted data for less than 48 hours, with similar dive patterns; it was assumed they too had died.

Since 2005, beluga whales have been photographed in upper Cook Inlet as part of a photographic identification project (McGuire et al. 2014). Photographs taken from small boats and land were later analyzed and cataloged into an extensive database (McGuire et al. 2008, 2009, 2011a, 2011b, 2014). In 2011, this project was expanded to include waters of the Kenai Peninsula Borough. Boat based surveys, such as the photo-identification study; often requires the boat to come within close proximity to a whale or whale group, likely increasing noise in the immediate area.

Various researchers have deployed hydrophones and collected acoustic data at and near Eagle Bay, Cairn Point (POA), Fire Island, Beluga River, Trading Bay, Kenai River, Tuxedni Bay, and Kachemak Bay (e.g., Širović and Kendall 2009; ADFG 2011e; HDR 2011). Passive acoustic monitoring required a boat to deploy and recover hydrophones. The boat temporarily increases noise in the immediate area during deployment and recovery, which may cause disturbance to nearby beluga whales. However, once the instruments are deployed, this type of monitoring remains noninvasive because the recording devices are generally anchored on the seafloor, or suspended in the water column, passively recording sound from the environment.

Several development projects (ongoing and planned) researched or monitored the presence of Cook Inlet beluga whales and marine mammals in their respective action area. For instance, the Knik Arm Bridge and Toll Authority (KABATA) collected baseline environmental data on beluga whale activity that evaluated the potential impacts from their proposed bridge crossing in Knik Arm, north of Cairn Point. Boat and land based observations were conducted in Knik Arm from July 2004 through July 2005 (Funk et al. 2005). In the fall of 2011, KABATA conducted a 'Proof of Concept' study that tested the visual and acoustic methods' abilities to detect beluga whales near the project site, prior to the full scale monitoring, once construction begins (HDR 2011). In addition to KABATA's studies, land based PSOs were used for other development projects. For example, the POA utilized PSOs during their in-water work, and sponsored research on Cook Inlet beluga whales presence and habitat use, near the POA's expansion site (Cornick and Kendall 2008; Cornick and Saxon-Kendall 2009; Cornick et al. 2010). During 2009-2011, Ocean Renewable Power Company (ORPC) sponsored land observations from Fire Island that documented beluga whales near a potential hydro-tidal project site (McGuire et al. 2011b).

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).

3.2.9 Environmental Change

There is overwhelming data that indicate the planet is warming (IPCC 2014). With this warming comes a changing weather pattern, which tends towards more extreme events (IPCC 2014). 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. For example, an experienced and knowledgeable Alaska Native beluga hunter observed that the Susitna River (frequented by beluga whales, especially during anadromous fish runs) has filled in considerably during the past 40-50 years.[15] This hunter mentioned one persistent river channel that was more than 12 m (40 ft.) deep, but is now filled with sediment. Since beluga whales are still seen in the area today, they must be able to adapt to physical changes in their habitats.

The climate in Cook Inlet is driven by the Alaska Coastal Current (a low salinity river like water body that flows through the Pacific Ocean, along the coast of Alaska, with a branch that flows into Cook Inlet) and the Pacific Decadal Oscillation (PDO). PDO is similar to El Niño, except it lasts much longer (20-30 years in the 20th century) and switches between a warm phase and a cool phase. PDO's phase changes have been correlated with changes to marine ecosystems in the northeast Pacific: warm phases have been accompanied by increased biological productivity in coastal waters off Alaska and decreased productivity off the west coast of Canada and the U.S.; and cold phases have been associated with the opposite pattern.

The change in water temperature may in turn affect zooplankton biomass and composition. Plankton is mostly influenced by changes in temperature, which may affect their metabolic and developmental rates, and possibly survival rates (Batten and Mackas 2007). Data collected by Batten and Mackas (2007) demonstrated that mesozooplankton (planktonic animals size range is 0.2-20 mm) biomass was greater in warm conditions, and zooplankton community composition varied between warm and cool conditions, thus potentially altering their quality as a prey resource. In Cook Inlet, mesozooplankton biomass has increased each year during 2004-2006; however, sampling from late 2006 to early 2007 suggests biomass values are decreasing; a change most certainly driven by changes in climate (Batten and Mackas 2007). Therefore, changes in temperature effect changes in zooplankton, which in turn may influence changes in fish composition; and hence, alter the fish quality and types available for beluga whales. While El Niño events have the potential to affect sea surface temperatures, the effects from the 1998 El Niño warming event in lower Cook Inlet were lessened by upwelling and tidal mixing at the entrance to Cook Inlet (Piatt et al. 1999). It is likely that Cook Inlet's physical structure of and its dominance by freshwater input act to buffer these waters from periodic and short-term El Niño events.

Beluga whales' use of Cook Inlet, and particularly, feeding habitat in Cook Inlet, has been correlated to the presence of tidal flats and their associated bathymetry. Beluga whale preference for shallow waters found in Knik Arm, Turnagain Arm, and the Susitna delta undoubtedly relates to a feeding strategy, as was reported for beluga whales in Bristol Bay (Fried et al. 1979). Frost et al. (1983) theorized beluga whales' feeding efficiencies improve in relatively shallow channels where fish are confined or concentrated. Some have hypothesized that these feeding habitats are being lost through the deposition of glacial materials. The senescence of these habitats will likely reduce upper inlet's capacity to provide the needs for this population. At this time however, the data are insufficient to assess effects, if any exist, from environmental change on Cook Inlet beluga whale abundance, distribution, survival, or recovery.

[15] Blatchford, P. 1999. Cook Inlet Marine Mammal Council. Personal communication via B. Smith (NMFS)

4. EFFECTS OF THE ACTION

Here we consider the specific aspects of the 3D Seismic Program that are likely to adversely affect Cook Inlet beluga whales, humpback whales, western DPS Steller sea lions, and critical habitat for Cook Inlet beluga whales. These effects include both direct and indirect effects, which are effects that occur later in time.

Components of the seismic program would result in impacts that would co-occur in space and time with western Cook Inlet beluga whales, humpback whales and western DPS Steller sea lions. In this section, we describe the probable risks the seismic program has on individual beluga whales, Steller sea lions, and humpback whales; then integrate those individual risks to identify consequences to the populations. The best scientific and commercial data available are examined to determine whether and how these individuals and this population are likely to respond, given the adverse impacts associated with the seismic program. Risks were measured to individuals using their 'fitness,' the ability to survive and reproduce. In particular, we examine the scientific data available to determine if an individual's probable responses to the action's effects are likely to have consequences for the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When individual animals exposed to an action's effects are expected to experience reductions in fitness, we would expect reductions in the abundance, reproduction rates, or growth rates (or increase the variance in these measures) of the population those individuals represent. On the other hand, when animals are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the population's viability (i.e., reduce appreciably the likelihood of the listed species' survival or recovery).

In determining whether individual Cook Inlet beluga whales or western DPS Steller sea lions would be affected, it is necessary to analyze when, where, and how an animal would be exposed to the various activities associated with the seismic program. Many biological aspects of Cook Inlet beluga whales are not well known or understood. During the analysis, several assumptions were made about their habitats, hearing abilities, and behaviors to reach the conclusions. For most situations, there is some information to apply to Cook Inlet beluga whales; but for those with little to no data, we erred on the side of species. To avoid Type II errors, i.e., concluding the animal was not affected when in fact it was in situations with many unknowns or uncertainties, we assumed an effect would occur, thereby giving the 'benefit of the doubt' to the species.

4.1 Direct Effects

Direct effects defined under the ESA are immediate effects caused by the proposed action and occurring concurrently with the proposed action. The proposed seismic program may directly affect Cook Inlet beluga whales, western DPS Steller sea lions, and humpback whales by introducing noise into the environment; increasing the potential for direct injury from ship strikes and falling/ascending nodes; increasing the vessel use in Cook Inlet and thus, potential for oil spills from vessels; and creating temporary habitat disturbance.

Parente et al. (2007) suggested humpback whales have been displaced from feeding and breeding areas along the Brazilian coast as a result of increased seismic activity. It is not known if seismic surveys in or near the action area have affected whales in this manner, but there is evidence that

humpback whale behavior was likely affected by previous seismic surveys in Cook Inlet, as evidenced by contemporaneous movement into, and temporary stranding in, Turnagain Arm (NMFS unpublished data).

4.1.1 Noise

Marine mammals use hearing and sound transmission to perform vital life functions. Introducing sound into their environment could disrupt those behaviors. Sound (hearing and vocalization/ echolocation) serves four primary functions for marine mammals, including: 1) providing information about their environment, 2) communication, 3) prey detection, and 4) predator detection. The distances to which airgun noise and other noise associated with the Cook Inlet seismic program are audible depend upon the source levels, frequency, ambient noise levels, environmental propagation characteristics, and receptor sensitivity (Richardson et al. 1995).

The effects of sounds from anthropogenic noise, such as airguns, explosions, aircraft, and vessels on marine mammals might include one or more of the following: tolerance, masking natural sounds, behavioral disturbance, and temporary or permanent hearing impairment, or non-auditory physical effects (Richardson et al. 1995). In assessing potential effects from noise, Richardson et al. (1995) suggested four criteria for defining zones of influence. These zones are described below from greatest influence to least influence:

Zone of Hearing Loss, Discomfort, or Injury

Hearing loss, discomfort, or injury, is the area within which the received sound level is potentially high enough to cause discomfort or tissue damage to auditory or other systems. This includes temporary threshold shifts (TTS, temporary loss in hearing) or permanent threshold shifts (PTS, loss in hearing at specific frequencies or deafness). Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage.

Zone of Masking

The zone of masking is the area within which the noise may interfere with detecting other sounds, including communication calls, prey sounds, or other environmental sounds.

Zone of Responsiveness

The zone of responsiveness is the area within which the animal reacts behaviorally or physiologically. Marine mammal behavioral responses to sound are dependent upon many factors, including: 1) acoustic characteristics of the noise source of interest; 2) animal's physical and behavioral state at the time of exposure; 3) environment's ambient acoustic and ecological characteristics; and 4) context of the sound (e.g., whether it sounds similar to a predator) (Richardson et al. 1995; Southall et al. 2007). However, temporary behavioral effects are often simply evidence that an animal has heard a sound and may not indicate lasting consequence for exposed individuals (Southall et al. 2007).

Zone of Audibility

The zone of audibility is the area within which the marine mammal might hear the noise. Marine mammals, as a group, have functional hearing ranges of 10 Hz to 180 kHz, with best thresholds

near 40 dB (Ketten 1997, 1998; Kastak et al. 2005; Southall et al. 2007). Hearing capabilities of the beluga whale and Steller sea lion are discussed in their respective sections. There are no applicable criteria for the zone of audibility due to difficulties in human ability to determine the audibility from a particular noise for a particular species.

Since 1997, NMFS has been using generic sound exposure thresholds to determine when an activity in the ocean produces sound potentially resulting in impacts to a marine mammal and causing MMPA Level B take by harassment (70 FR 1871) (i.e., the zone of responsiveness and zone of masking). NMFS has used 160 dB as a threshold level of sound intensity for Level B 'take' for impulse sounds under the MMPA. New thresholds to improve and replace the current generic exposure level thresholds may be considered in the future, but new criteria have not been finalized (Southall et al. 2007). The current Level A (injury) threshold for impulse noise (e.g., seismic airgun shots) under the MMPA is 180 dB for cetaceans (whales, dolphins, porpoises) and 190 dB for pinnipeds (seals, sea lions) (i.e., the zones for hearing loss, discomfort, or injury). These criteria were established before information was available about minimum received levels of sound that would cause auditory injury in cetaceans. The criteria are not frequency specific and therefore, the decibel level thresholds may be lower than levels that would actually induce the indicated level of take; they are intended to be precautionary levels below which the indicated level of take will occur (Southall et al. 2007).

Southall et al. (2007) proposed acoustic guidelines for 126 marine mammals species, divided into five functional hearing groups, for three categories on anthropogenic noise: single pulse, multiple pulse, and non-pulse. According to this study, animals exposed to either natural or anthropogenic sound may experience physical and psychological effects, ranging in magnitude from none to severe; depending upon spatial relationships between the sound source and the animal receiver, sensitivity of the receiver, received exposure level, duration, and many other factors (Southall et al. 2007; Richardson et al. 1995). The same acoustic source may have radically different effects depending on operational and environmental variables, and on the physiological, sensory, and psychological characteristics of exposed animals. In many cases, specific acoustic features of the sound and contextual variables (e.g., proximity, subject experience and motivation, duration, or recurrence of exposure) may be of considerably greater relevance to the behavioral response than simple acoustic variables, such as the received sound level. These factors make it difficult to base broad, objective determinations about impact thresholds on received levels alone (Southall et al. 2007).

There are reviews of research and literature which suggest that the 160 dB behavioral harassment and 180 dB injury levels currently accepted by NMFS might be significantly below the noise levels that actually harass or injure beluga whales (Abgrall et al. 2008). Southall et al. (2007) estimated that beluga whales subjected to single pulse or multiple pulse events would theoretically not be injured until SPLs reached 230 dB or greater, well above NMFS's 180 dB threshold. For behavioral disturbances from multiple pulse events, Southall et al. (2007) provided a severity scale, which suggests that mid-frequency cetaceans, such as beluga whales, do not display responses that would likely affect vital rates (foraging, reproduction, survival) until sounds were much higher than 160 dB.

In Cook Inlet, marine mammals compete acoustically with natural and anthropogenic sounds. Human-induced noises include large and small vessels, aircraft, oil and gas drilling, marine seismic surveys, pile driving, shore based activities, dredging, filling, and other events. The effects from human caused noise and associated increased background noises on beluga whales, humpback whales, and Steller sea lions depend on several factors including: the noise's intensity, frequency, and duration; the animal's location and behavior; and the nature of the acoustic environment. High frequency noise diminishes more rapidly than low frequency noises. Sound also dissipates more rapidly in shallow waters and over soft bottoms (sand and mud). Much of Cook Inlet is characterized by its shallow depth, sand/mud bottoms, and high background noise from currents and glacial silt (Blackwell and Greene 2003); thereby making it a poor environment for propagating acoustics.

4.1.1.1 General Effects of Noise

Janssen (1980) describes three levels of noise impacts on wildlife. Primary effects result in damage to hearing organs and a temporary or permanent hearing loss. Secondary effects result in behavior alteration (including startle response or movement away from the noise) or inducement of the physiological stress response. Tertiary effects result in population level changes, including increased mortality, reduced reproductive rate, or habitat abandonment. The potential for these effects is extremely hard to quantify since there are many variables affecting the exposure of marine mammals at any given time; and marine mammal sensitivity to specific sounds at specific frequencies is not well understood. For example, while some observers have noted that beluga whales are very sensitive to noise, in areas frequently subjected to anthropogenic ensonification there is evidence that beluga whale habituate.

Primary Effects

According to Southall et al. (2007), no data exist on exposures that would cause permanent auditory injury to odontocetes (primary effects). Limited data on captive marine mammals exposed to various noise types suggest that auditory fatigue, an increased hearing threshold, (i.e., poorer sensitivity temporarily for some period of time following exposure) onset occurs at levels that may be below those required for direct non-auditory physiological trauma.

Secondary Effects

Secondary effects (those resulting in behavior alteration or inducing the physiological stress response) are generally more variable, context-dependent, less predictable than effects from noise exposure on hearing or physiology, and dependent on a suite of internal and external factors that may result in varying degrees of significance (NRC 2005; Southall et al. 2007). Internal factors include: 1) individual hearing sensitivity, activity pattern, and motivational and behavioral state (e.g., feeding, traveling) at the time it receives the stimulus; 2) the animal's past exposure to the noise, which may lead to habituation or sensitization; 3) individual noise tolerance; and 4) demographic factors such as age, gender, and presence of dependent offspring. External factors include: 1) non-acoustic characteristics from the sound source (e.g., if it is moving or stationary); 2) environmental variables (e.g., substrate) that influences sound transmission; and 3) habitat characteristics and location (e.g., open ocean vs. confined area). Thus, behavioral responses to sound are highly variable and context-specific. It has proven to be exceedingly challenging to establish a generally accepted definition of biologically meaningful

behavioral disturbance (NRC 2005). Peak sound pressure values of 224 dB are recommended as 'behavioral' disturbance criteria for beluga whales (Southall et al. 2007).

Tertiary Effects
Tertiary effects (i.e., those resulting in population level changes that include increased mortality, reduced reproductive rate, or habitat abandonment) are also not well understood. A metric for the impacts from noise exposure on critical biological parameters such as growth, survival, and reproduction is needed. Unfortunately, as Wartzok et al. (2004) points out, no such metric is currently available, and it is likely to take decades of research to provide the analytical framework and empirical results needed to create such a metric, if one in fact is ultimately even viable (Southall et al. 2007).

The distances to which sounds are audible depend on source level and frequency, ambient noise levels, physical habitat characteristics (e.g., water temperature, depth, substrate type), and sensitivity of the receptor (Richardson et al. 1995). Impacts to beluga whales, humpback whales, and sea lions exposed to loud sounds include possible mortality (either directly from the noise or indirectly based on the reaction to the noise), injury, and/or disturbance that ranges from severe (e.g., permanent abandonment of vital habitat) to mild (e.g., startle).

Seismic survey activities could cause behavioral harassment; however, neither physical injury nor mortalities (often described as Level A takes) are anticipated due to the nature of the operations (e.g., use of observers on vessels, land, and in aircraft), and mitigation measures (e.g., shut-down and power-down procedures in place to prevent take when animals are observed approaching ensonified areas).

In general, noise associated with seismic surveys has the potential to harass beluga whales, sea lions, and humpback whales that may be present around the specific action area. Marine mammals use sound for vital life functions, and sounds introduced into their environment could disrupt those behaviors. Sound (hearing and vocalization/echolocation) serves four main functions for odontocetes (toothed whales and dolphins), which include: 1) providing information about their environment; 2) communication; 3) enabling remote prey detection; and 4) enabling detection of predators. Introducing noise into the environment may cause hearing impairment, non-auditory physiological effects, or behavioral effects.

<u>Hearing Impairment</u>
Temporary or permanent hearing impairment is possible when marine mammals are exposed to very loud sounds. Hearing impairment is measured in two forms: TTS and PTS.

TTS is the mildest form of hearing impairment that can occur during exposure to loud sound (Kryter 1985). It is not considered to represent physical injury, as hearing sensitivity recovers relatively quickly after the sound ends. It is, however, an indicator that physical injury is possible if the animal is exposed to higher sound levels. The onset of TTS is defined as a temporary elevation of the hearing threshold by at least 6 dB (Schlundt et al. 2000).

Because noise from the seismic survey would not be a onetime exposure, as with most human development and exploration activities, a time component must be incorporated into any effects

analysis. Experiments with marine mammals show a nearly linear relationship between sound exposure level (SEL) and exposure duration: the longer an animal is exposed, the lower the level required to produce TTS (Kastak and Schusterman 1999; Schlundt et al. 2000; Nachtigall et al. 2003). Using auditory evoked potentials methods, Natchigall et al. (2003) found TTS at approximately 4-8 dB, following nearly 50 minutes of exposure to the same frequency noise (center frequency 7.5 kHz) at 160 dB (193-195 dB re 1 μPa2-s [SEL]). TTS recovery occurred within minutes or tens of minutes.

PTS is defined as "irreversible elevation of the hearing threshold at a specific frequency" (Yost 2000). It involves physical damage to the sound receptors in the ear and can be either total or partial deafness, or impaired ability to hear sounds in specific frequency ranges (Kryter 1985). Some causes for PTS are severe extensions of effects underlying TTS (e.g., irreparable damage to sensory hair cells). The onset of PTS is determined by pulse duration, peak amplitude, rise time, number of pulses, inter-pulse interval, location, species, and health of the receivers ear (Ketten 1994). PTS is presumed to be likely if the hearing threshold is reduced by 40 dB (i.e., 40 dB of TTS) (Southall et al. 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) harassment threshold. During 2013 seismic operations in Cook Inlet, at least 29 marine mammals experienced level A or level B take due to operations similar to those proposed in this action (Table 7).

Non-Auditory Physiological Effects

Non-auditory physiological effects or injuries that theoretically might occur in beluga whales, humpback whales, or Steller sea lions exposed to strong underwater sound, include: stress, bubble formation, neurological effects, resonance effects, and other types of organ or tissue damage.

Romano et al. (2004) demonstrated that beluga whales exposed to seismic water gun and/or single pure tones (SPLs up to 201 dB) resembling sonar pings, showed increased stress hormone levels of norepinephrine, epinephrine, and dopamine. However, in two studies, captive beluga whales exposed to playbacks of drilling noise did not result in increased levels of stress-related hormones (API 1986; Thomas et al. 1990). Wright et al. (2007) concluded that anthropogenic noise, both by itself or in combination with other stressors, can reduce the fitness in individual marine mammals and decrease the viability in some marine mammal populations. The available literature suggests stress hormone levels may be affected by noise exposure, but the results are highly variable and dependent (in part) upon factors such as: duration, marine mammal species, intensity of sound, frequency, individual's response, and amount of control the individual has over the stressor. The physiological effects from any elevation in hormone levels are equally variable.

Studies have also demonstrated that animal reactions to sounds could result in physical injury. It has recently been reported that stranded deep diving marine mammals displayed physical attributes similar to the bends (e.g., in vivo gas bubble formation) (Fernández et al. 2004, 2005). Marine mammals may experience these symptoms if surfacing rapidly from deep dives in response to loud sounds. However, because Cook Inlet is generally a shallow water estuary,

marine mammals found in the inlet are not considered deep divers, and due to proposed mitigation measures, non-auditory physiological impacts, other than stress, are not expected.

Table 7. Summary of the number of individual marine mammals observed within the 160 dB disturbance zone and 180 dB (cetacean) and 190 (pinniped) exclusion zones (Lomac-MacNair et al. 2014).

Marine Mammal Species		Total Number of Observed Exposures in the Disturbance Zone	Total Number of Observed Exposures in the Exclusion Zone	Total Number of Observed Exposures
ESA Listed Species				
	Beluga Whale	12	-	12
	Humpback Whale	-	2	2
	Steller Sea Lion	-	-	-
Non ESA Species				
	Harbor Porpoise	4	2	6
	Harbor Seal	9	-	9
	Killer Whale	-	-	-

Behavioral Effects

Behavioral responses of marine mammals to noise are highly variable and depend on a suite of internal and external factors, which in turn results in varying degrees of significance (Southall et al. 2007). Internal factors include: 1) individual hearing sensitivity, activity pattern, and motivational and behavioral state (e.g., feeding, traveling) at the time it receives the stimulus; 2) past exposure of the animal to the noise, which may lead to habituation or sensitization; 3) individual noise tolerance; and 4) demographic factors such as age, sex, and presence of dependent offspring. External factors include: 1) non-acoustic characteristics of the sound source (e.g., if it is moving or stationary); 2) environmental variables (e.g., substrate) that influence sound transmission; and 3) habitat characteristics and location (e.g., open ocean vs. confined area). There are no consistent observed threshold levels at which beluga whales respond to an introduced sound. Beluga whale responses to sound stimuli have been noted to be highly dependent upon behavioral state and motivation to remain or leave an area. Few field studies involving stationary industrial sounds have been conducted on beluga whales. Reactions by beluga whales in those studies varied. For example, in Awbrey and Stewart (1983) (as summarized in Southall et al. [2007]), noise recordings from SEDCO 708 drilling platform (non-pulse) were projected underwater at a source level of 163 dB.

Beluga whales less than 1.5 km (0.9 mi) from the source usually reacted to onset of the noise by swimming away (received levels approximately 115.4 dB). In two instances, whale groups that were at least 3.5 km (2.2 mi) from the noise source when playback started, continued to approach (received levels approximately 109.8 dB). One group approached within 300 m (0.2 mi) (received levels approximately 125.8 dB) before all or part of the group turned back. The second group submerged and passed within 15m (49 ft.) of the projector (received levels approximately 145.3 dB). TTS experiments have also documented behavioral responses by trained beluga whales. These responses included reluctance to return to experimental stations when exposed to water gun pulse sounds projected 4.5 m (15 ft.) from the subject at approximately 185.3 dB (171 dB re 1 μPa2-s [SEL]) (Finneran et al. 2002) and behavioral changes when exposed to sounds

from the explosion simulator at approximately 200 dB (177 dB re 1 μPa2-s [SEL]) (Finneran et al. 2000). In a non-pulse exposure experiment (i.e., 1 second tones), beluga whales displayed altered behavior when exposed to 180-196 dB (180-196 dB re 1 μPa2-s [SEL]) (Schlundt et al. 2000).

Many marine mammals, including beluga whales, perform vital functions (e.g., feeding, resting, traveling, socializing) on a diel (i.e., 24-hour) cycle. Repeated or sustained disruption of these functions is more likely to have a demonstrable impact than a single exposure (Southall et al. 2007). However, it is possible that marine mammals exposed to repetitious sounds from the proposed seismic program may become habituated or tolerant after initial exposure to these sounds, as demonstrated by how beluga whales tolerate vessels (Richardson et al. 1995; Blackwell and Green 2003). Habituation is found to be common in marine mammals faced with introduced sounds in their environment. For example, bowhead whales (*Balaena mysticetus*) continued to use pathways where drilling ships were working (received levels: 131 dB), so they continued their eastward migration (Richardson et al. 1995). Harbor porpoise (*Phocoena phocoena*), dolphins (*Delphinidae*), and seals have become habituated to acoustic harassment deterrent devices, such as pingers and seal bombs, after repeated exposure (Mate and Harvey 1987; Cox et al. 2001). Beluga whales appear to be relatively tolerant of intensive fishing vessel traffic in Bristol Bay, Alaska, and beluga whales are commonly seen during the summer at the POA, even during periods of intensive construction (Cornick and Kendall 2008; Cornick and Saxon-Kendall 2009; Cornick et al. 2010).

Masking whale calls or other sounds potentially relevant to whale vital functions may occur. Southall et al. (2007) defines auditory masking as the partial or complete reduction in the signals audibility due to the presence of interfering noise, with the degree of masking dependent on the spectral, temporal, and spatial relationships between signals and masking noise, as well as the respective received levels. Masking occurs when the background noise is elevated to a level that reduces an animal's ability to detect relevant sounds. Beluga whales are known to increase their levels of vocalization as a function of background noise by: shifting to higher frequencies, increasing call repetition and amplitude, and changing structure of call content (Lesage et al. 1999; Scheifele et al. 2005). Another adaptive method to combat masking was demonstrated in a beluga whale that reflected its sonar signal off the water surface to ensonify an object on which it was trained to echolocate (Au et al. 1985). Due to low frequencies of the seismic noise, intermittent use of the seismic airguns (2.5 hours around slack tides), and the beluga whale's ability to adapt vocally to increased background noise, it is anticipated that the interruption of behaviors such as feeding and communication due to masking are unlikely to occur.

Observers stationed on seismic vessels operating off the United Kingdom from 1997-2000 have provided data on the occurrence and behaviors of various toothed whales exposed to seismic pulses (Stone 2003; Gordon et al. 2004; Stone and Tasker 2006). Data were collected on responses to arrays with large volumes of airguns (peak source level of approximately 250 dB) and low power output arrays (peak source levels of approximately 235 dB). Both killer whales and harbor porpoises were found to be significantly farther from large airgun arrays during periods of shooting compared with periods of no shooting. The displacement of the median distance from the array was about 0.5 km (0.3 mi) or more. No significant difference in closest distance of approach to the sound source was found for either species during surveys using low

power arrays. Significant differences in travel direction by harbor porpoises were observed for both large and small volume array surveys. Fewer animals were observed travelling towards the survey vessel and/or more were observed travelling away from the vessel during periods of shooting. Killer whales appear to be more tolerant to seismic shooting in deeper water. A captive harbor porpoise showed aversive behavior when exposed to a single pulse from a small airgun with received levels above 174 re 1 μPa peak-to-peak. The animal also avoided approaching the source prior to further exposures and during control experiments (Lucke et al. 2009).

In 2014, 57 beluga whale groups (estimated about 170 individuals) were observed from vessel and land platforms during a 2014 seismic survey in Cook Inlet. More beluga whale groups (about 41 groups) were observed during non-seismic periods (2,273.0 hours of PSO effort) than during seismic periods (about 16 groups with 716.8 hour PSO effort) (Lomac-MacNair et al. 2014).

4.1.1.2 Effects from Airgun Noise

Marine mammals close to underwater detonations of high explosives can be killed or severely injured, and the auditory organs are especially susceptible to injury (Ketten et al 1993; Ketten 1995). However, explosives are no longer used in marine waters for commercial seismic surveys or (with rare exceptions) for seismic research; they have been replaced by airguns and other non-explosive sources. Airgun pulses are less energetic and have slower rise times, and there is no direct evidence they cause serious physical injury, death, or stranding to any marine mammal, including beluga whales, even in the case of large airgun arrays.

Studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers (Richardson and Würsig 1997; Goold and Fish 1998), but they do not necessarily cause behavioral disturbances. Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, environmental conditions, and many other factors (Richardson et al. 1995; Southall et al. 2007). If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a short distance, the impacts from this change are unlikely to be significant to the individual, let alone the stock or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on the animals could be significant (e.g., Weilgart 2007). Displacement from important feeding/breeding areas is not anticipated from the proposed seismic activity because most primary feeding and suspected breeding areas are located outside the action area.

Little systematic information is available about beluga whale reactions to noise pulses. Beluga whales exhibit changes in behavior when exposed to strong, pulsed sounds, similar in duration to those typically used in seismic surveys (Finneran et al. 2000, 2002, 2005). Captive beluga whales sometimes vocalized after exposure and were reluctant to station at the test site for subsequent exposures (Finneran et al. 2002). However, the animals tolerated high received levels of sound (peak-peak level more than 200 dB re 1 μPa) before exhibiting aversive behaviors (Richardson et al. 1995). Some beluga whales summering in the eastern Beaufort Sea may have avoided the specific seismic operations area (two arrays with 24 airguns per array), which used a larger array than the SAE proposed program (two arrays of 16 airguns per array), by 10-20 km (6.2-12.4 mi), although beluga whales occurred as close as 1,540 m (957 mi) to the line of seismic operations (Miller et al. 2005).

Numerous studies showed that marine mammals at distances more than a few kilometers from operating seismic vessels often show no apparent response. That is often true even when pulsed sounds must be readily audible to the animals, based on measured received levels and the hearing sensitivity of that marine mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to temporarily react behaviorally to airgun pulses under some conditions, at other times, they have shown no overt reactions. In general, pinnipeds and small odontocetes are more tolerant of exposure to airgun pulses than baleen whales. The sound criteria used to estimate how many marine mammals might be disturbed to some biologically important, but unknown, degree by a seismic program are based on behavioral observations while studying several marine mammal species, including gray whales, bowhead whales, and ringed seals. The criteria established for these marine mammals, which are applied to other marine mammals, are conservative and have not been demonstrated to significantly affect individuals or marine mammal populations in Alaska waters. For example, monitoring seismic work within the Beaufort and Chukchi seas indicated that exposures to these noise levels have not resulted in serious injury or mortality, changes in localized abundance, or changes to the stocks' growth or recovery.

Behavioral Responses of Cook Inlet Beluga Whales

Airgun induced masking of marine mammal calls and other natural sounds are expected to be limited in geographic extent. Some whales are known to continue calling in the presence of seismic pulses, as their calls were heard between seismic pulses (e.g., Richardson et al. 1986; McDonald et al. 1995; Greene et al. 1999; Nieukirk et al. 2004). Masking effects from seismic pulses are expected to be negligible with the beluga whale, given the intermittent nature of seismic pulses and the sounds important to beluga whales are predominantly much higher frequencies than are airgun sounds. Therefore, the potential problem from auditory masking for beluga whales is diminished by the small amounts of frequency overlap between sounds produced by airguns (less than 1 kHz), those produced by beluga whale calls (0.26-20 kHz), and echolocation sounds (40-60 kHz and 100-120 kHz) (Blackwell and Greene 2003).

In auditory studies that exposed captive beluga whales to strong, pulsed sounds similar in duration to those typically used in seismic surveys, the whales exhibited changes in behavior (Finneran et al. 2000, 2002, 2005). Sometimes the beluga whales vocalized after such exposure and were reluctant to return to the test site for subsequent exposures (Finneran et al. 2002). However, some animals tolerated high received levels of sound (peak-peak level, more than 200 dB) before exhibiting aversive behaviors (Richardson et al. 1995).

Beluga whales' response to a seismic program is difficult to accurately predict. The most likely response to seismic noise is expected to be short-term, localized avoidance. For example, beluga whales in the Mackenzie River estuary, eastern Beaufort Sea, moved away during construction on an artificial island, but did not leave the construction area (Richardson et al. 1995). Some beluga whales summering in the eastern Beaufort Sea may have avoided a specific seismic operation area (2 arrays with 24 airguns per array) by 10-20 km (6.2-12.4 mi), although the whales occurred as close as 1,540 m (0.96 mi) to the seismic operations (Miller et al. 2005). It is unclear, however, if beluga whales truly avoided the seismic operations in the eastern Beaufort Sea, or if the observed movement was natural offshore migration during that time of year.

Examples from scientific studies and opportunistic sightings suggest that beluga whales are tolerant of in-water noise. Cook Inlet whales continue to use habitats in Knik Arm, despite heavy disturbance and underwater noise from maritime operations, maintenance dredging, aircraft operations, and pile driving for the POA expansion. This beluga whale behavior may, however, be taken as evidence for extreme motivation to reach important habitats in Knik Arm, rather than an indication that noise does not bother the whales. Some beluga whales repeatedly exposed to noise may habituate to the sounds and, upon subsequent exposures, may not change their behavior or distribution when exposed to those sounds; the proposed seismic activities may not have substantial effects on these habituated individuals.

A seismic program in Cook Inlet during 2012 operated a boat and land-based monitoring program that documented behavior when whales were first sighted, regardless of airgun activity (Lomac-MacNair et al. 2013). Of the 55 Cook Inlet beluga whale sightings, 17 (31 percent) were made when the airguns were operational. All documented behaviors without airgun activity were also documented when the airguns were operating, and included, in order of most frequently observed to least frequently observed behavior: traveling, milling, unknown behavior when whales were too far, swimming, foraging, and diving (Figure 13). It is possible that some individual Cook Inlet beluga whales avoided areas actively or recently surveyed by seismic in 2012; however, the observed behaviors did not suggest there was a significant or meaningful alteration in behavior. The end-of-season or '90 Day' report on the 2012 monitoring program for seismic activities compared the beluga whales' location (closest approach distance) relative to the seismic vessel (Lomac-MacNair et al. 2013). These data clearly indicated that beluga whales were locally more abundant and closer when there was no seismic activity, than when seismic activity occurred, with avoidance at distances out to 5 km (3.1 m) from the array; however, no relationship beyond this distance is apparent (Figure 14). Beluga whales' fidelity to feeding, molting, and calving areas, coupled with the beluga whale's exhibited tolerance to in-water noise, indicates they will likely continue to access these sites once the surveys in the area are completed.

During June 2012, NMFS's annual aerial survey consistently documented Cook Inlet beluga whales near West Foreland and MacArthur River, Trading Bay. Beluga whales have not been sighted in this general area during NMFS surveys since 2001; and consistent sightings have not been documented since 1995 (Shelden et al. 2013). NMFS does not evidence to explain the cause or the circumstances that resulted in consistent beluga whale sightings in this area in 2012.

However, potential explanations for this occurrence include: natural behavior of beluga whales, which historically were documented in the Trading Bay region; available and adequate food sources in the MacArthur River area in June; or an acoustic or other perceived barrier affecting the whales' movements into the uppermost portions of Cook Inlet (i.e., critical habitat area 1), resulting from the 2012 seismic program. Although evidence does not demonstrate a causal relationship between the circumstances present in 2012, one possible explanation is that the repeated beluga whale sightings near West Foreland/Trading Bay during June 2012 resulted from the seismic program. Regardless of explanation, there was no indication that displacement was permanent and we consider any effects from this incident to be insignificant.

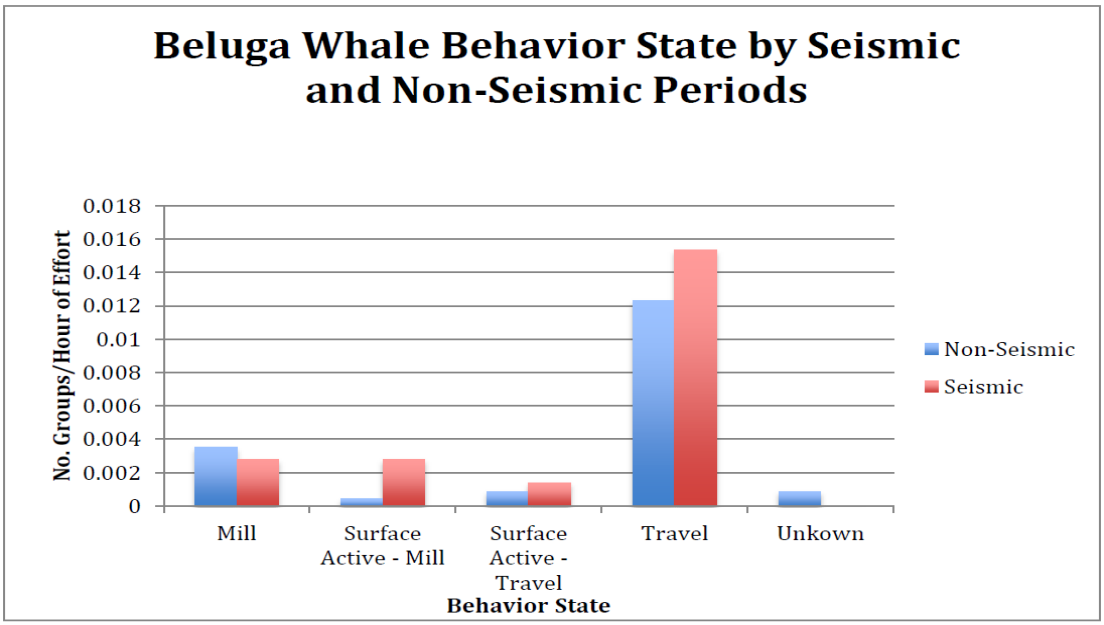

Figure 13. Initial behaviors by Cook Inlet beluga whales observed during times with and without seismic airgun activity during May 6-September 30, 2012. Approximately 3,029.2 hours of effort were expended in obtaining this data (Lomac-MacNair et al. 2013).

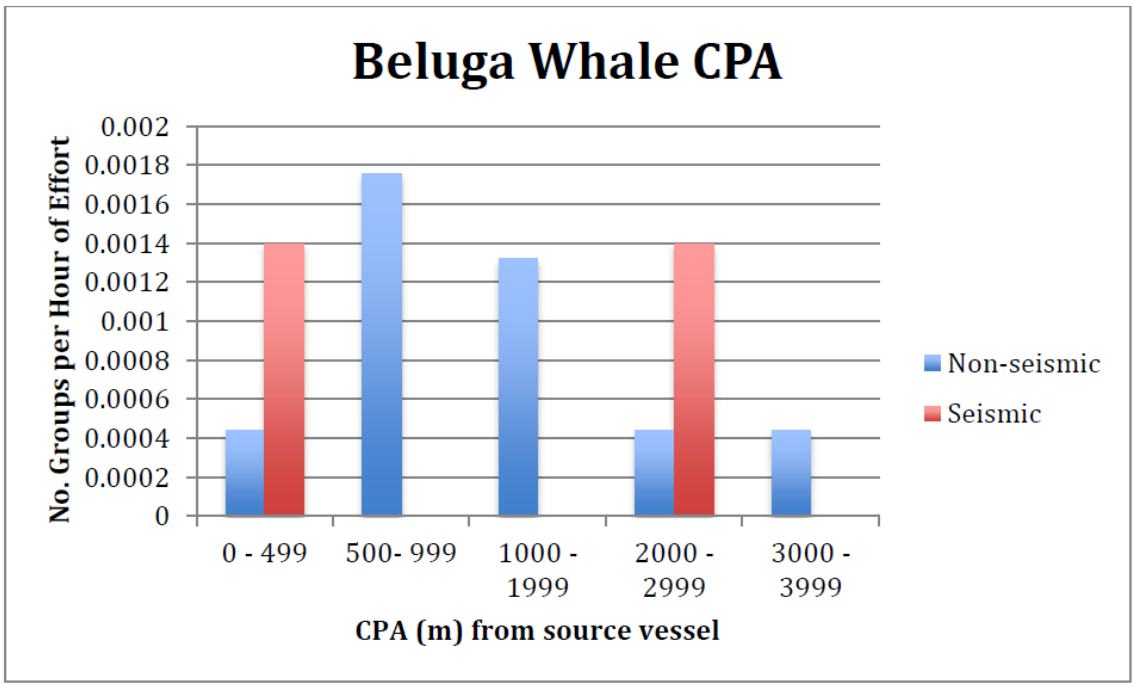

Figure 14. The closest point of approach (CPA) by beluga whales to the source vessel(s) during times with and without seismic airgun activity during 2014, with 3,029.2 hours of observational effort (Lomac-MacNair et al. 2013).

Hearing Impairment in Cook Inlet Beluga Whales

The RMS level of an airgun pulse is typically 10-15 dB higher than the SEL for the same pulse when received within a few kilometers of the airguns. Therefore, a single airgun pulse might

need to have a received level of approximately 196-201 dB to produce brief, mild TTS. Exposure to several strong seismic pulses, each with a flat weighted received level near 190 dB RMS (175-180 dB SEL) could result in the cumulative exposure of approximately 186 dB SEL, and thus slight TTS in a beluga. When estimating the amount of sound energy required for the onset of TTS, it is generally assumed that effects from a given cumulative SEL from a series of pulses is the same, as if that amount of sound energy were received as a single strong sound (Southall et al. 2007). However, some recovery may occur between pulses, and it is not currently known how this may affect TTS threshold. More data are needed in order to determine the received levels at which beluga whales would start to incur TTS upon exposure to repeated, low-frequency pulses of airgun sounds with variable received levels. For example, the total energy received by an animal will be a function of received levels from airgun pulses as an airgun array approaches, passes at various distances, and moves away (e.g., Erbe and King 2009).

Behavior Response of Steller Sea Lions

While there are no published data on seismic effects on sea lions, anecdotal data, and data on arctic seals, indicate that sea lions and other pinnipeds generally tolerate strong noise pulses (Richardson et al. 1995). Monitoring studies in the Alaska and Canada Beaufort Sea during 1996-2002 provided considerable information regarding arctic seal behaviors when exposed to seismic pulses (Miller et al. 2005; Moulton and Lawson 2002). These seismic projects usually involved arrays with 6-16 airguns, with as many as 24 airguns and with total volumes at 560-1500 cui. The combined results suggest that some seals avoid the immediate area around seismic vessels. In most survey years, ringed seal sightings tended to be farther away from the seismic vessel when the airguns were operating, than when they were not (Moulton and Lawson 2002). However, these avoidance movements were relatively small, on the order of 100 m (328 ft.) to (at most) a few hundred meters, and many seals remained within 100-200 m (328-656 ft.) of the trackline as the operating airgun array passed by them. Seal sighting rates at the water surface were lower during airgun array operations than without airgun periods in each survey year, except 1997. Miller et al. (2005) also reported higher sighting rates during non-seismic than during line seismic operations, but there was no difference for mean sighting distances during the two conditions; nor was there evidence ringed or bearded seals were displaced from the area by the operations. The operation of the airgun array had minor and variable effects on the seal behavior, visible at the surface, within a few hundred meters of the array. The behavioral data from these studies indicated that some seals were more likely to swim away from the source vessel during periods of airgun operations, and more likely to swim towards, or parallel to, the vessel during non-seismic periods. A consistent relationship was not observed between exposure to airgun noise and proportions of seals engaged in other recognizable behaviors (e.g., ‘looked,’ ‘dove’). Such a relationship might have occurred if seals tried to reduce exposure to strong seismic pulses, given the reduced airgun noise levels close to the surface, where “looking” occurs (Miller et al. 2005; Moulton and Lawson 2002).

Hearing Impairment in Steller Sea Lions

The auditory response for pinnipeds to underwater pulsed sounds has been examined in only one study. Finneran et al. (2005) measured TTS onset in two captive California sea lions exposed to single underwater pulses produced by an arc-gap transducer. A measurable TTS was not observed following exposures up to a maximum level of 183 dB re 1 μPa peak-to-peak (SEL 163 dB re 1μPa2s).

The 2012 Apache seismic monitoring program observed four Steller sea lions, and only during periods without seismic airgun activity. Therefore, any hearing impairment was unlikely. There was speculation that a large group of unidentified pinnipeds hauled out at the Beluga River may have been Steller sea lions. While Steller sea lions are seen in lower Cook Inlet in large numbers, it would be highly unusual for many Steller sea lions to be in upper Cook Inlet, especially because all recent previous sightings have been sporadic and limited to 1-2 animals.

Hearing in Humpback Whales

Humpback whales produce a variety of vocalizations ranging from 0.02-10 kHz (Winn et al. 1970; Tyack and Whitehead 1983; Payne and Payne 1985; Silber 1986; Thompson et al. 1986; Richardson et al. 1995; Au 2000, Frazer and Mercado 2000; Erbe 2002; Au et al. 2006; Vu et al. 2012). As is the case for all baleen whales, direct data on humpback whale hearing sensitivity are not available. Houser et al. (2001) produced a mathematical model for humpback whale hearing sensitivity using the anatomy of the humpback whale ear. Based on the model, they concluded that humpback whales would be sensitive to sound in frequencies ranging from 0.7-10 kHz, with a maximum sensitivity between 2-6 kHz. Sounds produced by airgun arrays are broadband, with most energy below 1 kHz (ASRC 2014). Therefore, humpback whales would certainly be able to hear a portion of the energy produced by seismic airgun arrays. However, available information does not allow us to conclude what portion of that energy may fall within the most sensitive portion of the whale's hearing range.

Summary of Airgun Noise Effects

Most nearshore areas in Cook Inlet are poor acoustic environments because they have shallow depth, soft bottoms, and high background natural noise from currents and glacial silt. These factors greatly reduce the distance sound travels (Blackwell and Greene 2003).

Although seismic related activities will occur 24 hours per day, in-water airguns will be active for approximately 2.5 hours during each slack tide period (about four events per 24 hour period). Therefore, source acquisition may be active intermittently for 10-12 hours per day, not continuously for 24 hours per day, as the seismic activities in the Arctic. In addition, monitoring and mitigation measures implemented during seismic surveys are designed to detect cetaceans and other marine mammals near the airgun array, to avoid exposing them to sound pulses that may cause hearing impairment. For example, the seismic operator will gradually ramp-up airgun arrays after an extended shutdown, which should allow animals near the airguns at startup time to move away from the sound source before it reaches full level. These factors, combined with the fact that many marine mammal species avoid ships and/or seismic operations, should be sufficient to avoid causing hearing impairment in Cook Inlet beluga whales, humpback whales and western DPS Steller sea lions. If animals do incur TTS, it is a temporary and reversible phenomenon, unless exposure exceeds the TTS onset threshold by an amount sufficient to cause PTS. To date, PTS or TTS is not documented in free ranging marine mammals exposed to airgun pulses.

The noise from the seismic program and effects this activity would have on ambient underwater noise will be temporary. Seismic pulses would occur only for short intervals during a 24-hour period and, due to proposed mitigation cetaceans, are not likely to be exposed to sound levels at or above 180 dB; and pinnipeds are not likely to be exposed to sound levels at or above 190 dB.

NMFS AKR anticipates that TTS, if it does occur, would not last more than a few minutes, and would not likely result in impacts to vital life functions, such as communication and foraging.

The seismic program is not scheduled to occur in the upper Cook Inlet, a recognized beluga whale feeding and concentration area during the summer, when more than 95 percent of the whale population is concentrated in this limited portion of its range. During April 15 through October 15, airguns will not operate in the Susitna delta exclusion zone. Based on the best data available, NMFS AKR concludes that a 16 km (10 mi) Susitna delta exclusion zone in this location is likely to protect whales using the Susitna delta from acoustic related impacts, while they use this essential foraging and reproductive habitat.

Noise from the seismic surveys may result in temporary habitat loss by marine mammals. However, such avoidance behaviors are expected to be a short duration, because operation of the large airgun arrays will be sporadic (2.5 hours around slack tides) and localized. Mitigation measures are incorporated into the project description that reduce impacts to protected species, which includes not operating in important feeding areas and powering down or shutting down when protected species are observed. Given the apparent site fidelity beluga whales have to certain areas, it is anticipated that once the noise has ceased, displaced whales would quickly return to preferred habitats. Thus, we expect, at most, ephemeral displacement from habitat affecting small numbers of beluga whales, and even fewer humpback whales and western DPS Steller sea lions.

Noise from the airguns associated with the proposed Cook Inlet 3D seismic program will likely have a greater impact to listed species than will other activities associated with the proposed action. There is no direct evidence that noise from Cook Inlet seismic exploration activity has caused physical injury, death, or stranding to any marine mammal. However, evidence suggests a possible injury and stranding of a humpback whale resulting from 2012 seismic activities in Cook Inlet (NMFS unpublished data). In addition, the proposed seismic activity will be short term and localized, will avoid the critically important areas around the Susitna delta, and SAE will implement mitigation measures to reduce effects from noise associated with the seismic activity.

4.1.1.3 Effects from Vessel Noise

Vessels will be used for support and transport during the 2015 Cook Inlet 3D seismic program. Vessel noise associated with the seismic program will be transmitted through water and constitutes a continuous noise source (versus an impulse noise). Marine mammal responses to vessels are generally associated with noise and depend on changes in the engine and propeller speed (Richardson et al. 1995). As with aircrafts, visual cues may contribute to marine mammals' reactions to nearby vessels (Richardson et al. 1995). Broadband source levels for tug boats have been measured at 145-170 dB, and 170-180 dB for small ships and supply vessels (Richardson et al. 1995). Based on data for vessels proposed for use to build the Knik Arm Bridge, the loudest vessel noise associated with that project would be produced by ships ranging in length from 55-85 m (180-279 ft.), with source levels ranging from 170-180 dB. Sound from a vessel that size would attenuate below 125 dB between 86-233 m (282-764 ft.) from the source. All vessels used in the proposed seismic program will be smaller than 55-85 m (180-279 ft.). In fact, the largest

vessel proposed for the seismic program is 41-9 m (135 x 30 ft.), and will likely be quieter than the vessels proposed for the bridge construction.

Beluga responses to vessel noise

Odontocetes often show tolerance to vessel activity; however, they may react at long distances if they are confined by ice, shallow water, or were previously harassed by vessels (Richardson et al. 1995). Beluga whale responses to vessel noise vary greatly, from tolerance to extreme sensitivity, depending on whale activities and experience, habitat, boat type, and boat behavior (Richardson et al. 1995). Reactions may include behavioral responses, such as altered headings or avoidance (Blane and Jaakson 1994; Erbe and Farmer 2000); fast swimming; changes in vocalizations (Lesage et al. 1999; Scheifele et al. 2005); and changes in dive, surfacing, and respiration patterns.

Lesage et al. (1999) observed changes in the beluga whale's vocal behavior in the presence of a 7 m (23 ft.) vessel powered by two 70 horsepower (HP) engines; and a 2,173 gross ton ferry that was 80 m (260 ft.) long, with two 2,000 HP engines each fitted with a propeller 235 cm (7.7 ft.) in diameter. Vocal responses included a reduction in call rate, an increase in emitting certain call types, repeating specific calls, and a shift in frequency bands. Responses occurred more frequently when exposed to the ferry versus the small vessel. Scheifele et al. (2005) documented the Lombard vocal response in beluga whales exposed to different vessel traffic in the Saint Lawrence Estuary. The Lombard vocal response occurs when an animal increases the intensity of their vocalizations in response to a change in the environmental noise. Blane and Jaakson (1994) observed avoidance behavior by beluga whales in the presence of a 5 m (16 ft.) inflatable boat with an outboard motor. Avoidance behavior by beluga whales included decreased surfacing, increased speed, and bunching into groups. Once the disturbance ceased, beluga whales resumed their previous behavior. Additionally, Blackwell and Greene (2003) observed beluga whales in close proximity of the *Northern Lights* cargo freight ship docked with motors running (126 dB) at the POA; indicating that beluga whales were not particularly bothered by that ship noise.

Beluga whales in the Mackenzie Estuary appeared to react less to a stationary dredge, as opposed to a moving one, despite similar noise levels created by the vessels (Fraker 1977). With the frequency of marine traffic in their habitats, Cook Inlet beluga whales are familiar with large and small vessels being present. Beluga whales are frequently sighted in and around the POA, Port MacKenzie, and the small boat launch adjacent to the mouth of Ship Creek (Blackwell and Greene 2003; NMFS 2008a; Markowitz et al. 2005; Funk et al. 2005). For example, Blackwell and Greene (2003) reported that these whales did not appear to be bothered by the sounds from a passing cargo freight ship. Despite increased shipping traffic and maintenance operations (e.g., dredging) beluga whales continues to use waters within and surrounding the POA, and interacted with tugs and cargo freight ships (Markowitz and McGuire 2007; NMFS 2008a).

Steller sea lion responses to vessel noise

There are few data published on pinniped responses to vessel activity, and most information is anecdotal (Richardson et al. 1995). Generally, sea lions in water show tolerance to close and frequently approaching vessels, and sometimes show interest in fishing vessels. They are less tolerant when hauled out on land; however, they rarely react unless the vessel approaches within 100-200 m (330-660 ft.; Richardson et al. 1995). The risk from vessel activity threatening the

Steller sea lions' recovery has been ranked low in the Steller Sea Lion Recovery Plan (NMFS 2008c), with a high feasibility for mitigation.

Humpback whale response to vessel noise

Humpback whale response to vessel noise is inconsistent across space and time (Scheidat et al. 2004). Increases in swim speed or changes in direction of travel are common reactions of humpback whales to approaching vessels, with normal behavior resuming shortly after the vessel has passed. Other whales may approach vessels or show no reaction. Physiological reactions to the presence of vessels occur before behavioral changes are apparent to human observers (Scheidat et al. 2004). In a study on the effects from vessel noise on humpback whales summering in Alaska, Baker and Herman (1989) demonstrated a many significant responses, including increases in dive durations, and orientation away from the path of moving boats, often at ranges up to 3-4 km (1.8-2.5 mi).

Summary of responses to vessel noise

Noise associated with vessel activity will temporarily increase in the action area during the Cook Inlet 3D seismic program, as a result from the operation of eight vessels. To minimize the noise effects associated with vessel activity on beluga whales, humpback whales, and western DPS Steller sea lions in the area, SAE will follow NMFS's Marine Mammal Viewing Guidelines and Regulations (NMFS 2008d) and will alter heading or speed if a listed marine mammal gets close to a vessel. Adding vessel noise associated with the seismic program would not be outside the present experience for beluga whales, sea lions, and humpback whales in Cook Inlet; although vessel noise levels may increase locally. Given that many vessels use Cook Inlet (and the apparent habituation to vessels by Cook Inlet beluga whales), vessel noise associated with the proposed action is expected to have no more than an insignificant effect upon Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions.

4.1.1.4 Effects from Aircraft Noise

Helicopters will be used for support and transport during the Cook Inlet 3D seismic program. Noise associated with aircraft may affect marine mammals in the action area; however, most acoustic energy is reflected when sound is transmitted from air to water (Richardson et al. 1995; Blackwell and Greene 2003). Underwater received sound levels from noise associated with aircraft depends on the aircraft altitude, aspect and strength of the source; the marine mammal's depth; and the waterbody's propagation characteristics (e.g., bottom characteristics and water depth; Richardson et al. 1995). Sound is generally reflected at angles greater than 13 degrees and does not penetrate the water; this is particularly true with calm sea conditions, deep water, or shallow water with a non-reflective bottom (Richardson et al. 1995).

Marine mammal responses to aircraft noise depend on the aircraft type, flight pattern, altitude, and the activity of the animal (Richardson et al. 1995). However, visual cues may also play a role in marine mammal's reactions to nearby aircrafts (Richardson et al. 1995).

Beluga responses to aircraft noise

Responses to aircraft by odontocetes may include changes in surfacing intervals, direction, diving patterns, behavioral states, and temporary displacement (Richardson et al. 1995; Patenaude et al. 2002; Smultea et al. 2007). Beluga whale responses to aircrafts are variable

(Richardson et al. 1995). Some beluga whales reacted to aircrafts flying at altitudes of 500 m (1,640 ft.) by diving, while others did not respond. More often these whales responded when aircrafts flew altitudes at 150-200 m (490-690 ft.). Responses to aircrafts at this altitude included longer dives, shorter surfacing intervals, and displacement (Bel'koich 1960; Kleinenburg et al. 1964). Beluga whales engaged in foraging appeared less disturbed than individual whales. Individual whales often dove in the presences of the aircraft. Patenaude et al. (2002) observed beluga whale responses to both a helicopter (Bell 212) and a fixed-winged aircraft (Twin Otter). Whales responded more often to the helicopter than the fixed-winged aircraft. Responses to the helicopter included sudden dives, change in direction, displacement, and change in behavioral state. Responses to the helicopter occurred more frequently when the helicopter flew at altitudes less than 150 m (490 ft.) and a lateral distance less than 250 m (820 ft.). When the fixed-winged aircraft flew directly overhead at altitudes less than 182 m (600 ft.), whale responses included abrupt dives, change in swimming speed, and changes in behavioral states.

Steller sea lion responses to aircraft noise

The majority of pinniped observations reacting to aircraft noise are associated with haulout sites on land or ice. There are very little data describing the reactions of pinnipeds in water to aircraft (Richardson et al. 1995). With aircrafts, pinnipeds hauled out while pupping or molting generally became alert and then rushed or slipped (when on ice) into the water. The greatest reactions from hauled out pinnipeds were observed when low flying aircrafts passed directly above the animal(s) (Richardson et al. 1995).

Western DPS Steller sea lions have been observed rushing into the water at haulout sites in the presence of an aircraft (Calkins 1979; NMFS 2008c); however, immature or pregnant females entered the water more often than territorial males and females with pups (Calkins 1979). Withrow et al. (1985, as reported in Richardson et al. 1995) observed a large group of Steller sea lions rush from the beach into the water in response to a Bell 205 helicopter approximately 1.6 km (1 mi) away.

Humpback whale response to aircraft noise

As with watercraft, humpback whales react inconsistently to aircraft. Reactions are thought to depend upon whale group size and composition (Richardson et al. 1995), with larger groups tending to be less reactive and all-adult groups being more reactive. Humpback whales have been observed to react to aircraft at 305 m (1,000 ft.) altitude, but elsewhere showed no reaction to aircraft at half that height (Shallenberger 1978).

Summary of responses to aircraft noise

Noise associated with aircraft activity will temporarily increase in the action area during the Cook Inlet 3D seismic program since. Although noise associated with aircraft activity could cause hauled out Steller sea lions to rush into the water, it is unlikely that many Steller sea lions will be affected by the aircraft noise because there are no known haulout sites or rookeries in the action area. Additionally, SAE will follow NMFS's Marine Mammal Viewing Guidelines and Regulations, and will avoid flying directly over marine mammals. Thus, aircraft noise associated with the proposed project is expected to be insignificant, and the probability of take occurring as a result of aircraft noise is expected to be discountable for Cook Inlet beluga whales, humpback whale, and western DPS Steller sea lions in the action area.

4.1.1.5 Summary of Direct Effects from Noise

NMFS has been in the practice of using the 180 and 190 dB isopleths (cetaceans and pinnipeds, respectively) as the exclusion zone (injury), and the 160 dB isopleth for the behavioral disturbance zone for impulsive noises as proxies for defining "take" under the MMPA (70 FR 1871). That is, NMFS assumes a "take" occurs when an animal is exposed to these thresholds. There is recent research to suggest that the 160 dB and 180/190 dB harassment levels currently accepted by NMFS might be significantly below the noise levels that actually harass or injure marine mammals, and therefore, are conservative.

Several aspects of the planned monitoring and mitigation measures for the seismic program are designed to detect marine mammals in and near these exclusion zones (waters ensonified to 180 dB for cetaceans or 190 dB for pinnipeds) and disturbance zones (waters ensonified to 160 dB for all marine mammals); and to avoid exposing them to sound that could potentially cause hearing impairment (e.g., power down and shutdown zones) and minimize disturbance (e.g., avoidance of Susitna delta exclusion zone). In addition, to avoid exposure to full energy seismic surveys, marine mammals will be encouraged to leave or avoid the area by ramping-up the array after an extended shutdown, and by using a mitigation gun during times when the full array is not in use. In those cases, the avoidance responses of the animals themselves will likely reduce or eliminate any possibility of hearing impairment.

The proposed mitigation measures reduce the risk in exposing beluga whales, humpback whales, and western DPS Steller sea lions to noise exceeding 180 dB and190 dB; however, it is possible that undetected beluga whales, and to a lesser degree humpback whales and Steller sea lions, could be exposed to noise more than or equal to 180 dB and 190 dB. In 2013 and 2014, Apache requested MMPA authorization for 30 Cook Inlet beluga whales and 20 Steller sea lions behavioral harassment (Level B) takes; and due to mitigation and monitoring measures, Apache reported zero takes for both Cook Inlet beluga whales and western DPS Steller sea lions during those years. There was information reported by Apache suggesting repeated sighting of one or two (possible mother/calf pair) humpback whales that may have been exposed to sound source levels above 180 dB; they were within the 180 dB exclusion zone during full volume operations long enough to experience several seismic explosions. However, humpback whales had not been previously reported in this area, so we consider this an isolated and unlikely-to-be-repeated incident. SAE will mitigate and monitor for the 2015 activities. Temporary disturbances or localized displacements are the most likely reactions to occur.

Due to the past exposure, and perceived future probability of exposure, of Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions to noises at levels that cause harassment, NMFS AKR has determined that the effects of noise associated with this project on these species cannot be discounted.

4.1.2 Direct Injury

Ship Strikes

Vessel traffic in Cook Inlet will temporarily increase to support the seismic program. However, there will only be eight additional vessels necessary for this project. The increase in vessel activity will occur throughout the project area. Vessel collisions can result in possible serious injuries or death. Beluga whales, humpback whales, and Steller sea lions may display avoidance

reactions when approached by watercraft, particularly small, fast-moving craft that can maneuver quickly and unpredictably.

Larger vessels that do not alter course or speed around these whales seem to cause little, if any, reaction (NMFS 2008a). Beluga whales are regularly sighted in and around the POA (Rugh et al. 2005; Cornick and Kendall 2008; Cornick and Saxon-Kendall 2009; POA 2009; Cornick et al. 2010) passing near or under vessels (Blackwell and Greene 2003), indicating that these animals may have a high tolerance for large vessel traffic. However, smaller boats that travel at high speed and change direction often present a greater threat and can elicit a more pronounced reaction from the whales.

From 1978-2011, there have been 25 documented whale fatalities resulting from ship collisions in Alaska (Neilson et al. 2012); 86 percent of vessel strikes in Alaska involved humpback whales. In most cases, the fate of struck whales remains unknown, but 17 humpback whales are known to have been struck and killed, while three others suffered severe injuries (Neilson et al. 2012). Most of these collisions occurred in southeast Alaska, all of them outside of the proposed action area.

Despite regular vessel movement in and out of Cook Inlet, ship strikes have not been definitively confirmed as causing a Cook Inlet beluga whale death (NMFS 2008a) or humpback whale (NMFS unpublished data), although such a death is suspected in at least one instance. Because their slower speed and linear movement, large vessels, such as those to be used in the seismic program, are not expected to pose a substantial threat to Cook Inlet beluga whales (NMFS 2008a), humpback whales, or to western DPS Steller sea lions.

Project vessels will be operating at a slow speed (2-4 knots) and in a purposeful manner, transiting to and from work sites in as direct a route as possible. PSOs will alert vessel captains as animals are detected to ensure safe and effective measures are applied to minimize impacts. If necessary (and to reduce the potential for a marine mammal entering the 180 dB exclusion zone), the captains may alter course and speed to avoid a collision or encounter with a marine mammal.

Falling/Ascending Nodes

Given the low density of all protected marine mammals in Cook Inlet and the mitigation measures associated with this project, the probability that a marine mammal may be taken by a falling or ascending node is extremely small.

4.1.3 Water Pollution

Oil spills are a significant concern with regard to offshore oil and gas production, petroleum product shipment, and general vessel traffic. The marine vessels that operate during the seismic program will increase the risk for marine fuel spills from: leaks or breaks in vessel fueling equipment, vessel collisions or sinking, mechanical or structural failures, or human errors. Onshore fuel storage will also present a risk for spill of fuel or other hazardous materials. However, storage sites will be positioned away from waterways and lakes, and located in modern containment enclosures with a capacity 125 percent the total volume of stored fuel. Standard best management practices will be in place to reduce the potential for these accidents to occur.

4.1.4 Substrate Disturbance

While it is difficult to quantify the importance of various habitats with Cook Inlet beluga whale health, conservation, and recovery, NMFS believes certain areas are particularly important. The topography and water depth in river mouths is believed to be necessary to beluga feeding. Beluga whales use the shallow water and river channels to aid in chasing and trapping fish. Although most nearshore areas to be surveyed are shallow, it is available to beluga whales and assumed to provide some habitat values. Whales are generally shown to stay in the upper inlet during the summer; only to disperse across mid inlet and along the western shore during the fall and winter months. However, NMFS AKR believes there will always be beluga whales distributed throughout the action area. As previously discussed, humpback whales and Steller sea lions rarely use the habitats in the action area.

The seismic program will likely disturb Cook Inlet beluga whale critical habitat with placing and removing nodes on the seafloor. However, because Cook Inlet is a large and dynamic system, habitat disturbance from the nodes being placed on the seafloor is insignificant, and the probability of lasting effects is discountable. Furthermore, node placement will be localized as seismic activity will only operate in a small area (a patch) at a time, and will be scheduled to reduce the potential for significant impacts to individuals or groups of marine mammals.

4.1.5 Predation

Killer whales are the only natural predators for beluga whales, humpback whales, and western DPS Steller sea lions in Cook Inlet (Allen and Angliss 2013). Beluga whale stranding events have also been correlated with killer whale presence, and Native hunters believe that beluga whales intentionally strand themselves in order to escape killer whale predation (Huntington 2000). Killer whale predation has been reported to have the potential to significantly impact Cook Inlet beluga whale and western DPS Steller sea lion populations (Heise et al. 2003; Shelden et al 2003), but we are unaware of any such reports of significant impacts upon humpback whales.

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 and Mahoney 2000). However, during 2001-2012 only three Cook Inlet beluga whales were reported as preyed upon by killer whales (NMFS unpublished data). The observed reduction in killer whale presence in upper Cook Inlet is consistent with the lack of killer whales observations during almost 15,000 hours of land-based efforts in Knik Arm and Turnagain Arm, south towards Threemile Creek.[16] Should the proposed action result in temporary displacement by Cook Inlet beluga whales, the areas beluga whales typically use to escape killer whale predation, like the shallow waters in Knik Arm and Turnagain Arm, are outside the action area for SAE's proposed seismic surveys. Thus, Knik Arm and Turnagain Arm will still be available as escape habitat for Cook Inlet beluga whales. Given the low predation rates, few killer whale sightings in recent years, and available predator avoidance habitat, it is anticipated that effects from the proposed action on killer whale predation on Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions will be insignificant.

[16] McGuire, T. 2011. LGL Alaska Research Associates, Anchorage, Alaska. Personal communication via Mandy Migura (NMFS)

4.1.6 Stranding

There is no conclusive evidence that cetacean and sea lion strandings or deaths at sea result from exposure to seismic surveys; but a few cetacean strandings, in the general areas where seismic survey occurred, suggests a possible link between seismic surveys and strandings. In one case, the suggested link between a humpback whale stranding in Brazil and seismic surveys (Engel et al. 2004) was not well founded (IAGC 2004; IWC 2007). In September 2002, two Cuvier's beaked whales stranded in the Gulf of California, Mexico, when the L-DEO seismic vessel R/V *Maurice Ewing* operated a 20 airgun, 8,490 cui airgun array in the general area. Evidence to link the stranding to the seismic survey was inconclusive and not based on any physical evidence (Yoder 2002). The ship was also operating its multi-beam echo sounder at the same time; but this had much less potential than the naval sonars to affect beaked whales, given its downward directed beams, much shorter pulse durations, and lower duty cycle. Nonetheless, the Gulf of California incident, with the beaked whale strandings near naval exercises that involved using mid-frequency military tactical sonar, suggest a need for caution in conducting seismic surveys in areas occupied by beaked whales until more is known about seismic survey effects on that species (Hildebrand 2005). However, it is unlikely that effects such as gas bubble disease, observed in deep diving beaked whales, would be the same for marine mammals in the relatively shallow waters of Cook Inlet, and the relatively shallow diving Cook Inlet beluga whales.

Heide-Jorgensen et al. (2013) reported the deaths of narwhals, a toothed cetacean in the same family as the beluga whale, due to entrapment in sea ice in Baffin Bay, Canada. From the general proximity in space and time, they postulated these strandings were causally connected to the seismic surveys operating in the bay. Although the seismic operations were reported to be 200 km (124 mi) from the whales, the authors stated that 'there is little doubt that the pulses were audible to narwhals'. Although a clear relationship was not established between these events, the report recommended extreme caution in conducting seismic surveys in or in close proximity to narwhal summering grounds and migratory routes.

4.2 Indirect Effects of the Action

Indirect effects defined under the ESA are effects from the proposed action that occur later in time (after activity cessation), but are still reasonably certain to occur. Only a small fraction of the potentially available habitat in Cook Inlet would be impacted by the Cook Inlet 3D seismic program at any given time during seismic surveys. The constantly moving seismic vessels and the short duration of actual seismic activity would result only in short-term, temporary, and very localized impacts to prey species and habitat.

Indirect effects from the proposed Cook Inlet 3D seismic program may possibly reduce prey; but, as discussed in this opinion, impacts would be very localized and short term, and are not expected to last beyond the timing for this action. As such, the Cook Inlet 3D seismic program is not expected to have any indirect effects that could cause permanent or long-term consequences for beluga whales, humpback whales, or Steller sea lions.

4.3 Interrelated and Interdependent Effects

Interrelated actions are actions that are part of a larger action and depend on the larger action for their justification. Interdependent actions are actions that have no independent utility apart from the proposed action (50 CFR 402.02).

4.3.1 Future Oil and Gas Development in Cook Inlet

If oil and gas are discovered by the proposed Cook Inlet 3D seismic program in the action area, oil and gas development will likely take place. Oil and gas development companies could use existing structures found in the action area. Any associated oil and gas development would require federal authorization that is subject to consultation with NMFS to reduce impacts on listed and protected species. Future oil and gas development could result in the input of additional noise into the Cook Inlet environment of Cook Inlet that may affect beluga whales, humpback whales, and Steller sea lions.

Future Oil Spills

If, in the future, SAE provides information that creates an active oil and gas development program, there will be an increased potential for oil spills in Cook Inlet. However, the probability of an oil spill from future operations cannot be determined because it is unknown if SAE will discover viable quantities of oil or gas; and if others will pursue further development, and to what extent future developers will take measures to reduce the risk of spills. We anticipate that the effects to Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions will be similar to those described previously.

4.4 Summary of Effects of the Action on Listed Species

Sound

Due to the potential for exposure of Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions to noises at or above the 160 dB harassment level, NMFS AKR concurs with the determination that noise from the use of airguns associated with the proposed seismic program may affect, and is likely to adversely affect, these species. However, these effects are expected to result only in temporary changes in behavior. We expect the effects of vessel noise associated with the proposed action to be insignificant.

Aircraft associated with this action will undertake sufficient mitigation measures to minimize disturbance to listed species in Cook Inlet. The horizontal and vertical distances that will be maintained from observed animals lead us to conclude that aircraft will result in only insignificant levels of disturbance; a level of aircraft-induced disturbance that will be indistinguishable from disturbance caused by many lower-flying, larger, and louder aircraft.

Injury

While beluga whales exhibit some signs of vessel interaction in Cook Inlet (prop scars, possible blunt trauma), the mitigation measures including use of PSOs and slow vessel speeds make it extremely unlikely that vessels will strike any listed marine mammals, and thus the risk of injury associated with project vessel interactions is discountable. The proposed seismic program has the potential to cause direct injury to marine mammals if they are struck by a falling/ascending node. However, the probability of a listed marine mammal occupying the same space as a descending or ascending node moving through the water column next to a large vessel is extremely unlikely to occur and is therefore discountable.

Pollution

Increased vessel activity in the action area from the proposed Cook Inlet 3D Seismic Program will temporarily increase the risk of oil spills. Oil spills may occur from a vessel leak, if a vessel

runs aground, or from a leak in the onshore storage facility. Impacts from an oil spill of that size on beluga whales, western DPS Steller sea lions, or humpback whales in the action area are likely to be relatively small and the risk of such a spill occurring will be minimized by maintaining safe operational and navigational conditions and best standard operating procedures. The chance of an oil spill of sufficient size to affect Cook Inlet beluga whales, western DPS Steller sea lions, or humpback whales occurring in association with the seismic program is expected to be discountable. The pollution that results from normal operation of project vessels is expected to be insignificant.

Substrate Disturbance

The proposed action has the potential to affect beluga whales, western DPS Steller sea lions, and humpback whales through the disturbance of their habitat within the action area. Any habitat disturbance resulting from the placement and removal of the nodes will be temporary as the local natural processes are effective in restoring any alterations in the bottom topography the nodes may cause. Therefore, the habitat disturbance caused by this action is expected to be insignificant to the Cook Inlet beluga whales, western DPS Steller sea lions, and humpback whales.

Predation

The proposed action has the potential to mask the sounds of approaching killer whales; the primary beluga whale predator. In addition, the beluga whale conservation plan states that activities that restrict or deter access to Type 1 (critical) habitat could reduce beluga calving success impair their ability to secure prey, and increase their susceptibility to predation by killer whales (NMFS 2008a). Even if the proposed action should result in temporarily displacing Cook Inlet beluga whales from some areas, the areas where beluga whales typically go to escape killer whale predation (the shallow areas of Knik Arm and Turnagain Arm) are not in the action area. Thus, Knik Arm and Turnagain Arm will still be available as predation refuge habitat for Cook Inlet beluga whales. Given the low predation rates and few killer whale sightings in recent years, and continued presence of predator avoidance habitat, it is expected that the proposed action will have insignificant effects on the predation rate of killer whales upon Cook Inlet beluga whales.

We likewise consider the potential effects of this action upon predation of humpback whale and western DPS Steller sea lions to be insignificant due to the very low numbers of these species in the action area, and very low probability that these two species will encounter killer whales within the action area. There is no record of killer whale predation upon humpback whales or Steller sea lions within the action area. Therefore the likelihood of this proposed action affecting predation upon Steller sea lions or humpback whales is discountable.

Strandings

There is no definitive and only limited circumstantial evidence that airguns have caused strandings or mortalities for any cetacean. In addition, stranding is part of the natural history of Cook Inlet beluga whales. While preying upon fish in shallow waters near river mouths, they occasionally strand when the local extreme tides recede. Stranding most commonly occurs on exposed mudflats in Knik and Turnagain Arms of Cook Inlet, generally a result of tidal fluctuations or killer whale predation avoidance. In addition, SAE will avoid conducting seismic operations in areas where beluga whales typically strand. Stranding of Steller sea lions is not an issue of concern. However, stranding of humpback whales may be. There are conflicting reports

of whether one or two humpback whales stranded near in space and time to seismic operations in 2014. PSOs will remain vigilant in their watch for this large and rather easily seen whale. Therefore, we have determined that it is very unlikely that this rare-to-Cook Inlet-species stranding from seismic exploration will occur from the proposed action.

4.5 Effects on Cook Inlet Beluga Whale Critical Habitat

The Cook Inlet beluga whale critical habitat final rule (76 FR 20180) identified five Primary Constituent Elements (PCEs) deemed essential to the conservation of the CI beluga whale. These attributes are:

- Intertidal and subtidal waters of Cook Inlet with depths <30 feet (MLLW) and within five miles of high and medium flow anadromous fish streams.
- 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.
- Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.
- Unrestricted passage within or between the critical habitat areas.
- Effects of the Action on PCE5: Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.

4.5.1 Effects of the Action on PCE 1: Intertidal and subtidal waters of Cook Inlet with depths <30 feet (MLLW) and within five miles of high and medium flow anadromous fish streams.

There is a very small potential for alteration of this PCE due to the temporary disturbance caused by the placement and removal of seismic nodes on the seafloor. However, the areal extent of this disturbance and the dynamic nature of the substrate within this large estuary make the effects of this portion of the action extremely small and ephemeral.

SAE will not operate within 1 mi (1.6 km) of the mouths of any anadromous streams unless approved by ADFG on a case-by-case basis. SAE will be operating in approximately 754 mi^2 of marine waters between 1 and 5 miles of 20 anadromous stream mouths (assumes an average semi-circle shaped area of marine water associated with each stream). We do not know what portion of this area is less than 30 feet in depth. Airgun arrays will be discharged at depths of about 4 m, which is below the average swimming depth for smolt of sockeye, chum, and pink salmon, but not chinook salmon (to avoid interference or injury to out-migrating juvenile salmonids (Ogura and Ishida 2011).

Seismic noise does not affect the life stages, condition, or amount of food resources (fish, invertebrates, eggs) comprising habitats used by beluga whales, except when the food resources are exposed to sound levels within a few meters of the seismic source or in a few very isolated cases. Where fish or invertebrates did respond to seismic noise, the affects were of temporary and of short duration (SAE 2015). Consequently, disturbance to fish species would be short-term and fish would return to their pre-disturbance behavior once the seismic activity ceases. Therefore, the proposed seismic survey would have little, if any, impact on beluga whales to feed in the area where seismic work is planned.

Given the 1 mile setback, the depth of airgun operation, and the small area affected at any given time, we have determined that this action is not likely to destroy or adversely modify waters characterized by this PCE.

4.5.2 Effects of the Action on PCE 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.

Seismic exploration noise will radiate throughout the water from the airguns and pingers until it dissipates to background levels. Little is known about how noise affects fish (Hastings and Popper 2005; DFO 2004); salmon have been found to respond to low frequency sounds such as those created by the proposed action, but only at very short ranges, within distances of a few feet from the sound source.

Sound pressure levels greater than 150 dB are expected to cause temporary behavioral changes, such as a startle or stress response. Although these SPLs are not expected to cause direct injury to a fish, the functional effect of impaired sensory ability could potentially reduce survival, growth, and reproduction, increase predation, and alter foraging and reproductive behaviors. Although the airgun arrays used in this action are capable of producing survival-reducing levels of sound, it is also likely that fish will avoid the approaching sound sources and escape beyond ranges that may cause harm (McCauley et al. 2003).

Airgun arrays will be discharged at depths of about 4 meters, which is below the average swimming depth of most juvenile salmonids (Ogura and Ishida 2011).

Only a small fraction of the potentially available habitat in Cook Inlet would be impacted by noise from this proposed project at levels sufficient to harm beluga prey species. The movement of the seismic vessel and the short duration of seismic activity at each location would result in short-term, temporary, and very localized acoustic impacts on prey species. The speed of the approaching vessel should afford affected fish species the opportunity to escape the unknown but small radius (on the order of a few meters) of physiological effects. Therefore, we do not expect this action to destroy or adversely modify waters characterized by this PCE.

4.5.3 Effects of the Action on PCE 3: Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.

The only source of contamination to Cook Inlet beluga whale critical habitat that may result from this project is from accidental releases from the acoustic survey and observer vessels. The maximum amount of accidentally-released contamination is limited primarily to the fuel and lubricant capacity of these vessels. We have determined that it is extremely unlikely that this action will release contaminants into the waters of Cook Inlet in amounts sufficient to affect Cook Inlet beluga whale critical habitat. Therefore, we do not expect this action to destroy or adversely modify waters characterized by this PCE.

4.5.4 Effects of the Action on PCE 4: Unrestricted passage within or between the critical habitat areas.

Given the size of the airgun arrays to be used in this proposed action, the locations where it would be most likely to restrict passage between critical habitat areas are near Anchorage at the narrows between the Port of Anchorage and Point MacKenzie, and the waters of Turnagain and

Knik Arms. However, this action will not occur in any of these locations, and we therefore expect unrestricted passage of Cook Inlet beluga whales between Knik Arm and the remainder of Cook Inlet waters. Therefore, we do not expect this action to destroy or adversely modify waters characterized by this PCE.

4.5.5 Effects of the Action on PCE5: Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.

Beluga whales have been observed in different portions of the action area throughout different times of the year proximal to noise-producing anthropogenic sources (Hobbs et al. 2005), including commercial ship traffic, recreational boaters, oil and gas production facilities, and coastal development (pile driving). We have no information indicating that past seismic operations in Cook Inlet have caused abandonment of critical habitat. Taking into account the areas of operation for project vessels and the project mitigation measures, we do not expect this action to destroy or adversely modify waters characterized by this PCE.

5. CUMULATIVE EFFECTS

Cumulative effects 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.' Cumulative effects are defined differently under the ESA than they are under National Environmental Policy Act (USFWS and NMFS 1998).

Reasonably foreseeable future federal actions and potential future federal actions that are unrelated to the proposed action are not considered in the analysis of cumulative effects because they would require separate consultation, pursuant to section 7 of the ESA. Most major activities within Cook Inlet which can affect beluga whales, humpback whales, and Steller sea lions require federal authorizations from one or more agencies. Such actions require consultation under the ESA on their effects to listed species, and are therefore not addressed here as cumulative effects.

Although many actions without a federal nexus may represent threats to the Cook Inlet beluga whale, the degree of impact from these threats on an individual and/or population is poorly understood (NMFS 2008a). Therefore, it is difficult to determine the overall cumulative effects these threats have on the listed Cook Inlet beluga whale. The following discussion describes the cumulative effects based on the best scientific and commercial data available. The actions described below could result in additional pollutants, vessel traffic, gas and oil spills, displacement from or loss of habitat, and could contribute to the cumulative effects from the proposed Cook Inlet 3D seismic program; however, few of these planned activities will actually occur in 2015.

As with the Cook Inlet beluga whale, cumulative effects to western DPS Steller sea lions and humpback whales are likely a function of many factors, yet the degree of impact from these factors on an individual and/or population is poorly understood (NMFS 2008c). The proposed project is located outside Steller sea lion critical habitat; there are no haul-outs or rookeries in the action area with western DPS Steller sea lions concentrations. In addition, western DPS Steller

sea lions are rarely observed in the action area. Therefore, the cumulative effects discussed below from activities likely to take place in the action area will not contribute measurably to adverse effects on western DPS Steller sea lions. Likewise, humpback whales experience many potential stressors throughout their range, but they are rarely observed in the action area. The cumulative effects discussed below from activities likely to take place in the action area will not contribute measurably to adverse effects on humpback whales.

5.1 Fisheries Interactions

Fishing is a major industry in Alaska. As long as fish stocks are sustainable, commercial, personal use, recreational, and subsistence fishing will continue to take place in Cook Inlet. As a result there will be continued potential prey competition, ship strike, harassment, entanglement in fishing gear, and displacement from important foraging habitat for the Cook Inlet beluga whales and Steller sea lions. NMFS and the ADFG will continue to manage fish stocks and monitor and regulate fishing in Cook Inlet to maintain sustainable stocks.

5.2 Oil and Gas Development

Most existing oil and gas development in Cook Inlet occurs in the action area and it is likely that future oil and gas development will continue to take place in the action area. Impacts from oil and gas development include: increased noise from seismic activity; well drilling; vessel and air traffic; wastewater discharge; habitat loss from construction; and contaminated food sources and/or injury from a natural gas blowout or oil spill. The risk from these impacts may increase as oil and gas development increases; however, new development will be subject to environmental analyses and applicable consultations.

Support vessels are required for oil and gas development to transport supplies and products to and from the facilities. Noise will likely increase with the increase in support vessel numbers to accommodate the increased oil and gas development, but there is a potential for increased ship strikes with marine mammals, especially the beluga whales, and increased risk of spills.

5.3 Coastal Development

Coastal development may result in habitat loss, increased vessel traffic, increased pollutants, and increased noise associated with both construction and project activities (operations) after construction. In the action area, two large projects are being considered: PacRim LP Chuitna coal mine and ORPC Alaska tidal energy project. The POA is currently expanding its facilities and Port MacKenzie is scheduled to expand its facilities. These port facilities may have an effect on listed marine mammals in the action area due to increased vessel traffic in the area on their way to the ports. All of these projects would require federal permits and would be subject to future section 7 consultations.

5.4 Pollution

As the population in urban areas continue to grow, an increase in the amount of pollutants that enter Cook Inlet is likely to occur. Hazardous materials may be released into Cook Inlet from vessels and aircraft. It is possible that an oil spill could occur from vessels traveling within the action area, or that oil will migrate into the action area from a nearby spill.

Pollutants can pass from streets, construction and industrial areas, and airports into Cook Inlet and within the action area. Wastewater discharge, gas, oil, and coastal development projects also

contribute to pollutants that enter Cook Inlet through discharge. These activities will continue to take place in Cook Inlet; therefore, it would be expected that pollutants could increase in Cook Inlet. However, EPA and ADEC will continue to regulate the pollutant amounts that enter Cook Inlet from point and non-point 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.

There have been several past State oil and gas lease sales in the inlet. Annual sales are anticipated, including most submerged lands in Cook Inlet. While these sales are State matters, many or most of the subsequent actions that might impact listed marine mammals are likely to have a federal nexus. Drilling structure locations could require authorization from the USACE. Discharges such as muds and cuttings, or produced waters, require permitting through EPA or ADEC. Unauthorized activities, such as oil spills, could occur.

5.5 Tourism/Whale Watching

Currently there is no boat based commercial whale watching operations in upper Cook Inlet. The popularity of whale watching, and the close proximity of beluga whales to Anchorage make it reasonable to assume that Upper Cook Inlet whale watching operations may exist in the near future. However, it is unlikely this industry will reach the intensity observed elsewhere due to climate, extreme tides, strong currents, and navigation hazards.

Vessel based whale watching may cause additional stresses to the Cook Inlet beluga whale population through increased noise, and presence of boats in or near preferred beluga habitat that is not ordinarily frequented by boats. Avoidance reactions are often observed in beluga whales when approached by watercraft, particularly small, fast-moving craft that are able to maneuver unpredictably and quickly. Larger vessels usually do not alter course or motor speed frequently and appear to cause little, if any, reaction from these whales (NMFS 2008a). The beluga whale's small size and low profile, and the poor visibility within the Cook Inlet waters, may increase the temptation for whale watchers to approach these whales more closely than is permitted. General marine mammal viewing guidelines may be adopted, and possibly enhanced, for any commercial beluga whale watching tours. Humpback whales and Steller sea lions are unlikely to be a focal point for any such tours in the action area because they are uncommon.

5.6 Subsistence Hunting

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

6. SYNTHESIS AND INTEGRATION

Pursuant to Section 7(a)(2) of the ESA, federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed endangered and threatened species or result in the destruction or adverse modification of designated critical habitat. 'Jeopardize the continued existence of' is defined in regulations as 'to engage any action that

reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of listed species in the wild by reducing the reproduction, numbers, or distribution of that species' (50 CFR 402.02).

In this section, we assess the effects from the seismic program on Cook Inlet beluga whales, humpback whales, and Steller sea lions and integrate those effects with the environmental baseline and cumulative effects. Finally, we consider the implication of those effects on the continued existence for the whales and sea lions.

In particular, we examine the scientific data available to determine if an individual beluga whale, humpback whale, or Steller sea lion's probable responses to the action's effects are likely to have consequences for the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When individual animals exposed to an action's effects are expected to experience reductions in fitness, we would expect reductions in the abundance, reproduction rates, and/or growth rates (or increase the variance in these measures) of the population those individuals represent. On the other hand, when individual animals are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the population's viability.

In determining whether individual Cook Inlet beluga whales, humpback whales or Steller sea lions would be affected, it is necessary to analyze when, where, and how an animal would be exposed to the various activities associated with the seismic program. During the analysis, several assumptions were made about their habitats, hearing abilities, and behaviors to reach the conclusions. The ESA does not require scientific certainty. In this biological opinion, NMFS AKR used the best available scientific data to evaluate the consequences from the seismic program.

In considering uncertainty here, we are cautious not to draw upon speculation and unsupported assumptions. We remain unable to relate take by harassment to changes in survival, productivity, fitness, or population trend. However, a reasonable impact assessment can still be conducted by considering the populations' status, current growth trends, reactions to harassment, consequences from that reaction to individual animals, impact from those individual reactions to the population, and the uncertainty of the relationship between harassments and mortalities. Were we to find little likelihood in a relationship between harassment and mortality, for example, the overall impact to the listed species might be low or moderate.

Uncertainty is also considered as we manage risk. We know the Cook Inlet beluga DPS exists at a highly precarious state, having a 26 percent probability of extinction within 100 years. The consequence of uncertainty in our ability to promote the recovery of these whales is great. To avoid Type II errors, (i.e., concluding that the animal was not affected when in fact it was) in situations with many unknowns or uncertainties, we may assume an effect would occur, thereby providing the 'benefit of the doubt' to the species. The acceptability of risk is clearly dependent on the status of the species/habitat in question; the acceptability of risk is extremely low for populations such as the Cook Inlet beluga.

6.1 Synthesis

Humpback Whale

The action area is within the range of humpback whale stocks that number more than 8,000 animals and whose populations are increasing (minimum population estimates and trends: Central North Pacific population is 7,500 animals, with a 7 percent growth rate; Western North Pacific population is 732 animals, with a 6.5 percent growth rate). Humpback whale presence in the action area is rare, but has been documented. Most sightings were made by NMFS observers along the southern extent of the proposed action area. Lomac-MacNair et al. (2014) indicate that two humpback whales were subjected to Level A take in 2014 by Apache seismic surveys.

The proposed Cook Inlet 3D seismic program is likely to adversely affect individual humpback whales in small numbers through acoustic harassment or harm (likely in the form of TTS). However, it is unlikely to affect the Central North Pacific or Western North Pacific stocks at the population level because humpback whales are rarely observed within the action area and mitigation measures will be implemented to reduce impacts from seismic exploration activity on those whales that may be present during the activities. In the event that humpback whales were adversely affected by seismic activities, the resulting harm would likely be temporary (e.g., TTS, behavior change), would not affect the individual's overall fitness (ability to survive and reproduce), and the overall take of humpback whales due to the seismic activity would not rise to the level at which this growing population would be measurably affected.

Steller Sea Lion

The baseline condition for the western DPS Steller sea lions in the central Gulf of Alaska region is population growth near zero (Allen and Angliss 2013). The western DPS Steller sea lion population as a whole is estimated to be increasing at about 1.67 percent per year during 2000-2012. The presence of western DPS Steller sea lions in the action area is rare. Since 2004, NMFS systematic aerial surveys of Cook Inlet have documented one Steller sea lion within the action area; however, a group of 20 sea lions were observed on June 10, 2006 (NMFS unpublished data). Aerial surveys associated with past seismic efforts recorded four Steller sea lions in 2012. NMFS is aware of other Steller sea lion observation reports in the action area, which include a few individuals or pairs that average 0.5 Steller sea lions observed per year.

The proposed Cook Inlet 3D seismic program is likely to adversely affect Steller sea lions through acoustic harassment, but is unlikely to harm individuals or affect the western DPS at the population level because: 1) western DPS Steller sea lions are rarely observed within the action area, 2) the proposed project is located outside Steller sea lion critical habitat, 3) there are no haulouts or rookeries in the action area, and 4) mitigation measures will be implemented to reduce the impacts from seismic exploration activity on western DPS Steller sea lions. In the event that western DPS Steller sea lions are within the seismic vessels' 160 dB disturbance zone, noise from the airguns may adversely affect those individuals. However, the resulting take of Steller sea lions would be temporary in nature (e.g., behavior change), would not affect any individual's fitness, and would therefore not rise to the level at which this growing population would be measurably affected.

This project is expected to affect very low numbers of western DPS Steller sea lions (harassment of 25 or fewer animals). Because these effects are expected to be temporary in nature and of little consequence to an individual's fitness, we do not expect population level effects to this species resulting from the proposed seismic program.

Cook Inlet Beluga Whale

The baseline condition for Cook Inlet beluga whales is characterized by its very low abundance, no observable recovery within the population (NMFS's population viability model currently estimates an annual decline of 0.4 percent during the past 10 years), and a high (26 percent) probability of extinction within the next 100 years (Hobbs and Shelden 2008). The additional annual mortality of a single animal above those predicted in the population viability model would accelerate this extinction timeframe. At the same time, this population faces continuing, but unquantified, natural and anthropogenic threats.

The Cook Inlet beluga whale DPS can be considered to have collapsed and now lies within the 'small population dynamics' phase of a population (Figure 15). In this phase, stochastic (random) events can have disproportionally large impacts on the population. Management of such populations warrants a precautionary approach to minimize the likelihood of causing such a stochastic event or making the population even more vulnerable to extinction as a result of stochastic events.

Beluga whales have a low calving rate, and a mature female whale gives birth to a single calf about every 2-3 years. Cook Inlet beluga whales have a small range and appear confined to Cook Inlet. Because these whales occupy the most populated and developed region in the state, they must compete with various anthropogenic stressors, including habitat development, pollution, and harassment. These whales often occur in dense aggregations within small near shore areas, where they are predisposed to adverse effects such as oil spills, noise, poaching, pollution, ship strikes, and disease outbreaks. Live strandings are not uncommon for Cook Inlet beluga whales. A small proportion of stranded animals die as a result, primarily due to prolonged exposure or suffocation (NMFS unpublished data). Killer whales that foray into the upper inlet and prey on beluga whales demonstrate the disproportionate impact associated with the 'small population dynamics' phase. Should a killer whale pod take 10 whales annually, a population with 1,000 or more animals and a positive population growth rate could likely sustain that level of removal.

However, with a population of 340 animals, this predation rate would represent a significant portion of that year's recruitment (growth) rate. The longer a population exists within the 'small dynamics' area, the higher the extinction risk. Unfortunately, the Cook Inlet beluga whales may exist at this area for some time because they have: 1) low abundance, 2) low growth potential, and 3) lack observed recovery.

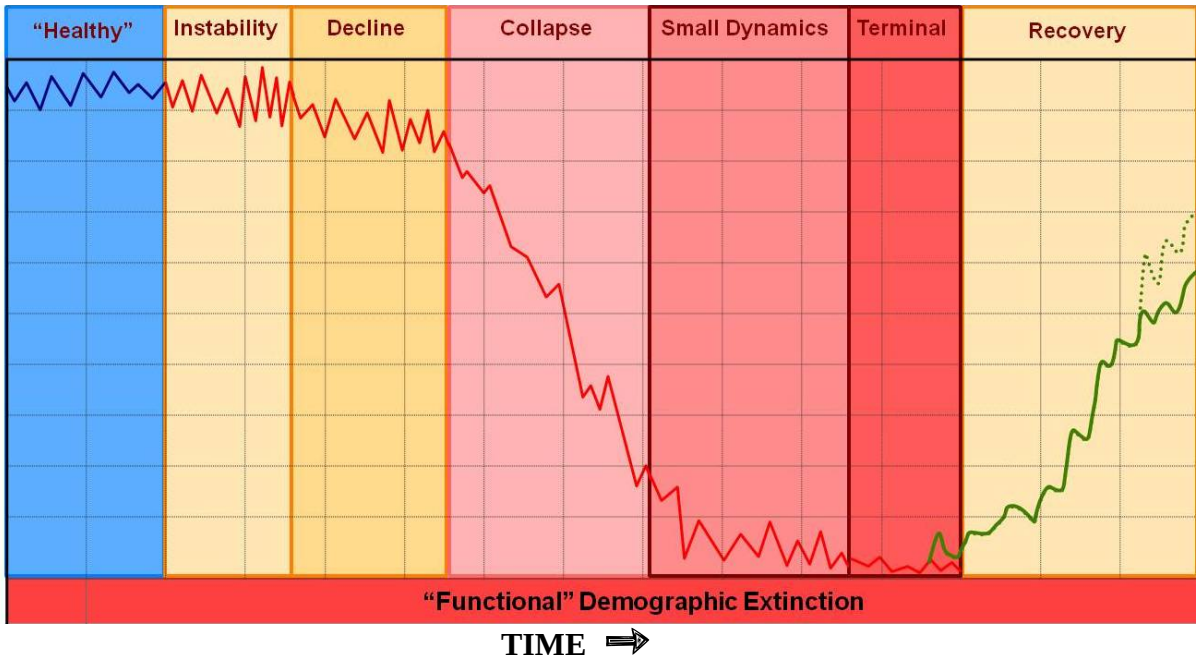

Figure 15. Population trajectory phases representing phases of the extinction process[17]

The draft Cook Inlet Beluga Whale recovery plan summarizes threats to the population (NMFS unpublished report). The only significant threat to the beluga whale population that rated high under noise type was seismic exploration noise. This biological opinion determined that the proposed action is not likely to affect the fitness of any individual Cook Inlet beluga whale and that effects will be temporary in nature (TTS and behavioral changes). This is a particularly important conclusion given recent population models for this species, which indicate the loss of one additional whale above the environmental baseline could measurably affect the recovery rate for Cook Inlet beluga whales.

In recent years, no lethal takes of Cook Inlet beluga whales have been authorized. A limited number of directed research projects received authorization to take non-lethally small numbers of Cook Inlet beluga whales, but most take authorizations have been for harassment only. Given NMFS AKR's extensive reviews of proposed activities in Cook Inlet, we are confident that the issuances of IHAs to date have not posed a threat to the survival or recovery of Cook Inlet beluga whales.

Unauthorized harassment likely occurs as a result of small vessel operations, aircraft overflights, and other human actions, but there are little data available to allow us to quantify the extent of, or effects of, this harassment. We assume that the effects from such actions at the population level are small. We are unaware of any ongoing lethal or injurious takes, although unobserved, unreported, and illegal harvests are possible, and observed propeller scarring suggests some interaction between Cook Inlet beluga whales and marine vessels.

[17] Johnson, C. NMFS, unpublished figure.

This project is expected to affect a low number (about 9 percent) of Cook Inlet beluga whales (harassment of 30 or fewer animals). Because these effects are expected to be temporary in nature and of little consequence to an individual's fitness, we do not expect population level effects to this species resulting from the proposed seismic program.

Cook Inlet Beluga Whale Critical Habitat

By way of review, the primary Constituent Elements of Cook Inlet Beluga Whale Critical Habitat include:

> PCE 1: Intertidal and subtidal waters of Cook Inlet with depths <30 feet (MLLW) and within five miles of high and medium flow anadromous fish streams.
>
> PCE 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.
>
> PCE 3: Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.
>
> PCE 4: Unrestricted passage within or between the critical habitat areas.
>
> PCE5: Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.

Earlier in our analysis, we determined that each primary constituent element would not be destroyed or adversely modified. We therefore conclude that this action will not destroy or adversely modify Cook Inlet beluga whale critical habitat.

Exposure Analysis

Effects from noise are the primary impacts from the proposed action on listed species. There remains uncertainty about the potential impacts of sound on marine mammals, on the factors that determine response and effects, and especially on the long term cumulative consequences from increasing noise in the world's oceans from multiple sources (e.g., NRC 2005). Anthropogenic noise can result in taking marine mammals through temporary or permanent hearing impairment or loss, discomfort, or injury. It can also result in take when it masks other sounds that inhibit the marine mammals' ability to communicate, detect threats, or echolocate. Beluga whales can adjust their echolocation and communication frequencies to compensate for masking sounds, but it is more difficult to mitigate for sounds that mask approaching predators. Erbe (2000) predicted low speed vessels could mask killer whale sounds at a range of 1 km (0.6 mi), possibly increasing the vulnerability of Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions to predation. However, we have no evidence that seismic activity makes these listed species more vulnerable to predation. In addition, killer whale predation on marine mammals in upper Cook Inlet is documented as very low.

Beluga whales' tendency to congregate increases the likelihood that exposure to large numbers of individuals will occur in a short amount of time. Studies have estimated 100 or more beluga whales may occur in Knik Arm at one time; approximately 30 percent of the total population.

The Susitna delta is heavily used by Cook Inlet beluga whales when nearby salmon runs are at their peak. Rugh et al (2010) reported that more than 95 percent of all beluga whales are found north of a line between the Beluga River and Point Possession during the summer. The applicant will avoid essential habitats during periods of high beluga whale concentrations, thereby reducing the likelihood that listed marine mammals will be exposed to harmful levels of underwater noise.

Take is less obvious, but may still occur, when exposure to anthropogenic sounds affects energetics, productivity, reproduction, and recruitment. NMFS is currently developing more comprehensive guidance on sound levels likely to cause injury and behavioral disruption to marine mammals. Until formal guidance is available, NMFS uses the following conservative thresholds for underwater SPLs from broadband sounds that cause behavioral disturbance (MMPA, Level B take thresholds):

- impulsive sound: 160 dB re 1: μPa_{rms}
- continuous sound: 120 dB re 1: μPa_{rms}

NMFS uses the following conservative thresholds for underwater SPLs that cause injury (MMPA, Level A take thresholds):

- for whales 180 dB re 1 μPa_{rms}
- for pinnipeds 190 dB re 1 μPa_{rms}

Far-Field Effects

There remains some concern about undetectable or difficult to detect far-field effects from anthropogenic noise on marine mammals, manifested as animal reactions well beyond the 160 dB disturbance zones. The animal that may exhibit such far-field effects is probably dependent on many factors, which includes: sound propagation characteristics in the regional marine system at that time, animal group size, location, age, and gender. There is concern that whales may not approach feeding areas if that would necessitate travelling close to, or past areas with anthropogenic noise. The beluga whale is a species that (at least at times) avoids seismic vessels from a long distance. Aerial surveys conducted in the southeastern Beaufort Sea in summer found that beluga whale sighting rates were significantly lower at distances 10-20 km (33-66 ft.), compared with 20-30 km (66-98 ft.), from an operating airgun array (Miller et al. 2005). The low number of beluga whale sightings by PSOs on the vessel seemed to confirm a strong avoidance response to the 2250 cui airgun array. However, it is unclear if the observed beluga whale movements were a direct consequence of the seismic surveys or related to the natural offshore migration at that time. More recent seismic monitoring studies in the same area seem to confirm the apparent displacement effect on beluga whales extends farther than has been shown for other small odontocetes exposed to airgun pulses (Harris et al. 2007).

However, as described previously, Cook Inlet beluga whales may exhibit tolerance to noise or disturbance in feeding areas and have remained in these areas despite significant disturbance (notably the continued occupation of the Susitna delta by feeding whales despite being actively pursued and hunted during past subsistence harvests). This persistent use may speak to the unusually high value of this habitat to the beluga whales. SAE will comply with the Susitna delta exclusion zone and commit to stop work when beluga whales use that area, which should sufficiently mitigate effects from this action on whales within that exclusion zone.

Beluga whales' reaction to sound stimuli is often associated with recent experiences with loud noise, and is not solely a reaction to the noise itself (Wartzok et al. 2004; Southall et al. 2007). Therefore, excluding seismic exploration activity within the Susitna delta exclusion zone during the high beluga whale use period will minimize stress to these animals and negative associations between those valuable habitats and presumably unwelcome anthropogenic noise. Given the proposed project's mitigation measures, it is unlikely that noise associated with the seismic program will cause beluga whales to abandon valuable Susitna delta habitat, or alter their feeding or breeding behavior to a level that would result in population level effects.

Ambient versus Anthropogenic Noise

It is likely that listed species reactions to in-water noise do not tightly follow the 120/160/180 dB cetacean, or 120/160/190 dB pinniped step function that NMFS currently recognizes as the thresholds for take by continuous noise harassment, impulsive noise harassment, and injury, respectively. This is especially true when one considers that ambient underwater sound levels in Cook Inlet can meet or exceed the 120 dB threshold for take by continuous sound source, depending on the region. Ambient noise in Cook Inlet, recorded as high as 132 dB (Blackwell and Greene 2003), is typically comprised of physical noise from wind, waves at the surface, currents, ice, and atmospheric noise. It may also include sounds produced by marine mammals, fish, and invertebrates. Lammers et al. (2013) summarizes the passive acoustic monitoring program conducted by ADFG throughout the Cook inlet, which shows there are areas in Cook Inlet that average 105 dB.

Despite the high ambient noise levels in Cook Inlet, anthropogenic noise associated with this project is likely to acoustically harass Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions due to the low frequency, high intensity, impulsive noise from the airguns, and pingers. Reactions by the listed species to anthropogenic noise are expected to vary, with some individuals possibly exhibiting a pronounced response, or possibly experiencing biologically significant harm (e.g. disrupt mating, PTS, temporary displacement from important habitat, reduce foraging efficiency, reduce ability to detect and avoid predators). However, most individuals will exhibit a moderate response, typically with difficult-to-measure biological consequences (e.g., small changes in direction, velocity, vocalization frequency, and/or breathing patterns) while some individuals exhibit no detectable response.

Changes in Habitat Use

Field observations (Funk et al. 2005) have noted more calves within beluga whale groups in Knik Arm than in the Susitna River area. Traditional ecological knowledge has identified upper Knik Arm as a traditional nursery site. The presence of juveniles and calves in Knik Arm indicates that the whales are able to swim past anthropogenic sound sources (e.g., noise from port construction and operations, vessel traffic, military training activities, aircraft) to access preferred habitats in Eagle Bay, Goose Bay, and other potential nursery areas in Knik Arm.

Morton and Symonds (2002) describe the effects from acoustic harassment devices on killer whales in Johnstone Strait near Vancouver Island. While operating these devices there was a marked decrease in the numbers of killer whales in the area. The harassment devices operated at 10 kHz, a frequency that would be particularly sensitive to mid-frequency cetaceans, such as killer whales and beluga whales. However, when the use of the devices ended, killer whale

occurrence re-established to baseline levels. The rapid response to the cessation of noise exhibited by killer whales is a trait we expect to be shared by Cook Inlet beluga whales. We similarly find that any diminished use of habitat in the action area due to seismic survey noise associated with this proposed action is likely to be temporary, reverting to normal upon cessation of seismic exploration activities. We therefore conclude that there is a low probability that whales would abandon or fail to reoccupy the survey sites upon the cessation of seismic activity.

Changes in Behavior

Behavioral changes that could result from exposure to the proposed action may include: avoiding the sound source by navigating around it, or altered swimming velocity or breathing patterns while passing through the ensonified area. Anthropogenic disturbance may evoke reactions similar to those associated with the appearance of a predator. High levels of predation risk (or human disturbance) may indirectly affect survival and reproduction by causing prey (e.g., beluga whales or Steller sea lions as prey of killer whales) to divert a large proportion of time and energy away from resource acquisition, so that body condition deteriorates and survival and reproductive success are reduced (Frid and Dill 2002). Similar effects can be induced by human activity that causes beluga whales or Steller sea lions to divert time and energy away from feeding or other critical life functions.

For the beluga whales, communication effects could be partially mitigated by their ability to adjust their call frequencies to minimize masking effects of seismic airgun noise. Beluga whales have been found to adjust their echolocation clicks to higher frequencies in the presence of background noise as well (Au et al. 1985).

The areas most affected by noise from the proposed seismic surveys do not include primary feeding habitats. Rather, the ensonified area is comprised of non-primary feeding habitat, waters used for transit between areas of high value, and resting habitats. Because the survey areas are not primary feeding areas, any diminished use of ensonified areas is not likely to result in detectable loss of productivity. We note that the observations from the POA monitoring and TEK indicate that some level of Cook Inlet beluga whale use of important habitats continues despite the presence of disturbing stimuli. Beluga hunters report that the whales did not leave the feeding areas off the Susitna River during the spring even as their hunt progressed. It is unknown whether persistent use of these areas in the presence of masking anthropogenic noise makes the animals more vulnerable to predation or increases deleterious stress hormones. It is also unknown whether any animals driven away from essential habitat due to anthropogenic activities experience reduced productivity due to reduced foraging efficiency or caloric intake. It is also unknown whether the presence of anthropogenic noise may discourage some animals from moving into essential habitats in the first place, with the anthropogenic noise creating something akin to a sonic barrier. We have no data to indicate whether these effects exist; they remain speculative, but plausible.

Our assessment of possible behavioral response to the proposed action also considered site fidelity by beluga whales. Site fidelity is likely within the Cook Inlet beluga whales, especially to several upper-Inlet sites during the ice-free months, but few data exist regarding any demographic divisions within this population. Fidelity to habitat sites is strong within some other beluga populations (e.g., St. Lawrence), and less so with other populations such as the Eastern

Beaufort Sea beluga whale stock. Rugh et al. (2010) found Cook Inlet beluga distribution has changed during the last decades and suggested this may be due to their reduced numbers, which allows the whales to select only the most productive habitat areas, manifesting as a reduction in range. This apparent redistribution to upper Cook Inlet during the summer indicates that site fidelity may be flexible for the Cook Inlet beluga whales. Any reduction in using mid and lower inlet areas may be offset by their preference for habitat in the extreme upper inlet, known feeding and possible breeding sites.

Risk Analysis

Numerous studies on the ecology of populations have demonstrated the relationship between a population's reproduction (which includes fecundity schedules, age at maturity, and reproductive lifespan), numbers (which includes age- or stage-specific abundance and survival rates), or distribution (which includes the number of populations and sub-populations, immigration rates, and emigration rates), and a population's risk of extinction. In the absence of behavioral responses that reduce a population's reproduction, numbers, or distribution, the information available leads us to conclude that exposure to the SAE seismic operation activities are likely to elicit short-term responses in Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions. The activities, as described, are not known to have any long-term adverse consequences for the biology or ecology of the individuals exposed. This expected temporary displacement from the immediate area around seismic operations is not likely to be life threatening and/or affect the recovery of these listed species.

We do not expect this exposure to translate into chronic or cumulative reductions in the current or expected future reproductive success for Cook Inlet beluga whales. Rather, any effects are expected to be temporary in nature (e.g., TTS, behavior changes). Therefore, we expect there is little risk that SAE's 3D seismic exploration operations would reduce the likelihood that Cook Inlet beluga whales would survive or recover in the wild.

While there is evidence that an adult humpback whale (and perhaps an associated calf) may have experienced seismic airgun array sound levels greater than 180 dB (sufficient to cause harm) from a recent seismic survey, sighting data indicates that such an event occurring in the first place was unlikely. By implementing mitigation measures outlined in this biological opinion, we conclude that a repeat of this most unusual and unexpected event is unlikely.

We expect take from SAE's proposed activities to be in the form of harassment, affecting 25 or fewer Steller sea lions, causing temporary changes in behavior or TTS. The risk of harm to individuals is extremely small due to the infrequent occurrence of Steller sea lions in the action area and the planned implementation of mitigation measures. The potential effects on the population would be very small: twenty five animals comprise about 0.03% of the western DPS Steller sea lions.

6.2 Integration

Upon integrating the effects from the proposed seismic program on beluga whales and their critical habitat with the environmental baseline and cumulative effects, we expect that individual or small groups of whales are likely to be harassed acoustically by the proposed action, but we do not expect this project will have population-level impacts. Similarly, we do not expect that

Cook Inlet beluga whale critical habitat will be destroyed or adversely modified. Beluga whales are unlikely to be killed or injured by this project, and harassment would be expected to be limited to MMPA Level B harassment that is localized and temporary. Whales will experience higher than ambient noise levels should they go undetected before and during seismic operations. The most pronounced increase in noise levels would occur from the use of the 1,760 cui airgun array. However, the use of this array will be intermittent, averaging 8 hours per day. While beluga whales are possibly being taken by factors considered in the environmental baseline and through cumulative effects, such takes are not likely to have population-level effects and are mostly due to harassment and disturbance by noise. We do not have data that enable us to translate the effects of this harassment into modeled extinction risk probabilities for this DPS. However, relying on the best scientific data available, we conclude that take in the form of harassment by activities associated with this proposed action is unlikely to affect the survival or recovery of the Cook Inlet beluga whales.

As discussed throughout this biological opinion, while we anticipate individual Cook Inlet beluga whales will be exposed to sounds greater than 160 dB as a result of the seismic program, it is difficult to quantify the impact of such exposure to an individual whale. As set forth above (Table 4), the factors that may affect recovery include: 1) noise that affects the ability to communicate, echolocate, and avoid predators; 2) prey availability; 3) access to breeding and foraging areas; 4) contaminants/pollution; 5) direct mortality (ship strikes, hunting); 6) live strandings, and 7) killer whale predation. It is unlikely that the proposed seismic surveys will affect these factors in a way that measurably increases the risk of extinction or reduces the projected time until recovery may occur.

We expect that nearly 9 percent of Cook Inlet beluga whales may experience Level B take in the form of harassment due to this action. This represents a temporary effect upon these whales, and no other form of take is expected. Therefore, we find that an individual beluga whale's growth, survival, and/or reproductive success will not be adversely affected by this proposed action. In the absence of a reduction to individual fitness, we do not anticipate reductions in the abundance, reproduction rates, or growth rates to the population as a whole, and thus, do not expect this action to affect this listed species' recovery.

While there is evidence that humpback whale take due to seismic exploration activities in Cook Inlet occurred recently, humpback whale aerial survey data indicate that the likelihood that such an event will reoccur is low. In integrating the effects from this proposed action on humpback whales with their environmental baseline and cumulative effects, we expect that very small numbers of this species may be subjected to take by this proposed action in the form of MMPA level B harassment; take that is localized in extent and temporary in duration. We expect no population level effects on humpback whales resulting from any aspect of this proposed action. There is no evidence that a single exposure or multiple exposures to a very small proportion of the population using Cook Inlet (5 animals) during 2015 would have a negative consequence to the fitness of the Central North Pacific or Western North Pacific humpback whale stocks. In a worst-case scenario, in which all 5 humpback whale takes were from the Western North Pacific population, the smallest population with a range that includes Cook Inlet, we expect only 0.5% of the population to be taken by this action (5 taken individuals out of a population of about

1100). Thus, NMFS AKR determined that the proposed seismic program would not affect the survival or recovery of the humpback whale.

Similarly, in integrating the effects from this proposed action on western DPS Steller sea lions with their environmental baseline and cumulative effects, we expect that very small numbers of western DPS Steller sea lions may be subjected to take by this proposed action in the form of MMPA level B harassment; take that is localized in extent and temporary in duration. At most, 0.03% (25 animals out of a population of 79,300) of western DPS Steller sea lions are expected to be taken by this action. Therefore, we expect no population level effects upon this DPS resulting from any aspect of this proposed action. There is no evidence that a single exposure, or multiple exposures in 2015, would have a negative consequence to the fitness of a western DPS Steller sea lion. Expected effects would be due to acoustic harassment, and would be limited to TTS and temporary behavioral changes. As such, it is unlikely that an individual sea lion's growth, survival, or reproductive success will be adversely affected by this proposed action. In the absence of a reduction to individual fitness, we do not anticipate reductions in the abundance, reproduction rates, or growth rates to the population as a whole. Thus, it is unlikely that the proposed seismic program would result in population level consequences to survival or recovery of western DPS Steller sea lions.

MMPA permit conditions and the mitigation measures described as part of the proposed action will all further reduce the probability of occurrence, and significance, of impacts to listed species and designated critical habitat.

We conclude that there is a low risk of adverse effects on Cook Inlet beluga whales, humpback whales, or western DPS Steller sea lions as a result of this action due to: 1) the limited geographic extent of Cook Inlet being ensonified as a result of the proposed action at any given time; 2) the spatial and temporal restrictions included in the mitigation measures designed to protect concentrations of Cook Inlet beluga whales using essential habitats during vital portions of their annual cycle; 3) the monitoring program designed to detect listed marine mammals that are within or approaching the defined 160 dB disturbance zones and exclusion zones (180 dB for cetaceans or 190 dB for pinnipeds); 4) the setbacks from specific anadromous streams and river mouths designed to protect valuable foraging habitat for Cook Inlet beluga whales; and 5) the extremely low density of humpback whales and western DPS Steller sea lions in the action area.

7 CONCLUSIONS

After reviewing the project description, mitigation measures, status of these species, effects from the action, environmental baseline for the action area, and cumulative effects, it is NMFS AKR's biological opinion that NMFS PR1's issuance of an IHA for the SAE's 3D seismic exploration activities in Cook Inlet for 2015 is not likely to jeopardize the continued existence of Cook Inlet beluga whales, humpback whales, and/or western DPS Steller sea lions, or result in the destruction or adverse modification of Cook Inlet beluga whale critical habitat. Similarly, BOEM's authorization of seismic exploration in federal waters is not likely to jeopardize the continued existence of Cook Inlet beluga whales, western DPS Steller sea lions, or humpback whales, or result in the destruction or adverse modification of Cook Inlet beluga whale critical habitat.

8. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

These discretionary measures are designed to minimize adverse effects to Cook Inlet beluga whales from in-water noise generated by the airguns used in the seismic program.

1. Evaluate and consider using new research and techniques (e.g., by the Joint Industry Program) for reducing the horizontal spread of noise associated with the airguns.

2. To reduce the total acoustic energy being put into the marine environment, do not use the mitigation gun between the main designated shooting periods as a means to avoid ramp-up procedures prior to subsequent seismic survey efforts. Instead, the mitigation gun should be used only during the active shooting period and the 2.5 hours around slack tides. The operator should initiate the ramp-up procedure at the start of each new shooting period. This will result in approximately 10-12 hours of noise from the airguns and 12-14 hours of 'quiet time' per 24 hour period of operations.

3. No airguns should be used as an energy source within 1.6 km (1 mi) of the mouth of any stream listed by the ADFG on the Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes; unless approved by ADFG and NMFS AKR on a case-by-case basis.

In order for NMFS AKR to be kept informed of actions minimizing or avoiding adverse effects or benefiting the endangered Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions, we request notification when implementing any conservation recommendation.

9. REINITIATION OF CONSULTATION

This concludes formal consultation on this action. As provided in 50 CFR §402.16, reinitiation of formal 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.

10 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species without special exemption. For certain species listed as threatened, NMFS has promulgated regulations pursuant to section 4(d) of the ESA applying those same section 9 take prohibitions to the threatened species. 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. Harm is further defined in regulations to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. 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 section 7(b)(4) and section 7(o)(2), any taking that would otherwise be prohibited by the ESA but is incidental to and not intended as part of the agency action and is in compliance with the terms and conditions of this incidental take statement (ITS) shall be considered to not be a prohibited taking of the species.

Section 7(b)(4)(C) of the ESA provides 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. Similarly, this biological opinion and ITS cover the entire scope of the proposed activities, the 2015 seismic survey operations in Cook Inlet. The operator will need MMPA authorization for this take statement to become effective. Take that is noted in this ITS is authorized only if MMPA authorization is also obtained.

10.1 Amount or Extent of the Take Authorized by this Biological Opinion

Available information indicates that incidental acoustic harassment of small numbers of Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions may occur during SAE's Cook Inlet 3D seismic program proposed for 2015. NMFS AKR does not expect beluga whales, humpback whales, or Steller sea lions to be injured or killed by SAE's seismic surveys; and injurious takings are not authorized. It is possible that marine mammals that are very close to an airgun, pinger, or vessel would risk temporary or permanent hearing impairment, and TTS is a possibility for animals in close proximity to the source. However, planned monitoring and mitigation measures are designed to avoid sudden onsets of seismic pulses at full power, detect marine mammals occurring near the seismic array, and avoid exposing them to sound pulses that may cause hearing impairment.

NMFS AKR anticipates and authorizes the non-lethal, incidental take in 2015 of no more than 30 Cook Inlet beluga whales, no more than 5 humpback whales, and no more than 25 western DPS Steller sea lions, as a result of this proposed action; primarily through exposure to impulsive sounds with received levels more than 160 dB. The logical foundation underlying these take estimates is discussed below.

Definition of Take

The ESA prohibits the unauthorized take of threatened or endangered species, and defines the term "take" to include harassment. The ESA, however, does not define harassment. The USFWS promulgated a regulation which defines it as "an intentional or negligent act or omission which

creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (50 C.F.R. § 17.3). Under the MMPA there is a definition of what is referred to as Level B harassment: "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." (16 U.S.C. §1362(18)(A)(ii)).

Here, NMFS AKR assumes a "take" occurs when a listed species is exposed to the respective sound thresholds, i.e., the 180 dB isopleth for cetaceans and 190 dB isopleth for pinnipeds as the (Level A, injury) exclusion zones; and the 160 dB isopleth as the (level B, behavioral harassment) disturbance zone for impulsive noises. As explained earlier, individual reactions may differ, but these thresholds reflect the best science that is currently available.

Determining Whether Take has Occurred

An animal will be considered taken if it is observed within the 160 dB disturbance zone during seismic exploration. The 160 dB disturbance zone distance thresholds for the pinger, mitigation gun, and the two anticipated airgun arrays appears in Table ITS 1.

If a cetacean enters the area ensonified to more than 180 dB, or a pinniped enters the area ensonified to more than 190 dB (Table ITS 1), then Level A take has occurred even if there are subsequent modifications to seismic survey activity (e.g. power-down, shut-down). Similarly, if any marine mammal enters the area ensonified to more than 160 (Table ITS 1), then Level B take has occurred, even if there are subsequent modifications to seismic survey activity (e.g. power down, shut-down).

Estimating Take

All authorized takes are for MMPA Level B harassment only; these takes are expected to result primarily from exposure to noise generated by airgun arrays. No Level A takes (exposure to sound levels more than 180 dB for cetaceans or 190 dB for pinnipeds) are expected, and none is authorized.

Instances of take for listed species resulting from this proposed action are expected to be few because the density of marine mammals in the action area is low, especially for humpback whales and Steller sea lions; and because the mitigation measures described in this biological opinion will greatly reduce the probability of animals encountering the 160 dB disturbance zone or the 180 dB cetacean exclusion zone and 190 dB pinniped exclusion zone.

Cook Inlet Beluga Whale Take

Estimates for take of Cook Inlet beluga whales were adopted from NMFS PR1's proposed MMPA authorization for this project. SAE intends to operate in a manner that limits their operation's temporal overlap with Cook Inlet beluga whales, and thus will harass, *i.e.*, take, no more than 30 Cook Inlet beluga whales in 2015. This method to calculate take is conservative because it does not consider the take reduction that derives from the mitigation measures, which are included in the description of the action.

Table ITS 1. Maximum threshold distances for the mitigation airgun and two airgun arrays. 90th percentile distances (the distance within which 90 percent of observations occur) are maximized with direction and environment for airguns, and correspond to 180/190 dB exclusion and 160 dB disturbance zone radii for marine mammals, as indicated. Data for 440 cui airgun array (Austin and Warner 2012). Data for 1760 cui airgun array from Heath et al. 2014.

SPL_{rms90} Threshold (dB re 1 μPa_{rms})	90th Percentile Distance (m)			
	Pinger[1]	10 cui	440 cui	1,760 cui
190, Level A pinniped exclusion zone[2]	1	10	50	880
180, Level A cetacean exclusion zone[3]	3	10	182	1840
160, Level B marine mammal disturbance zone[4]	25	280	3050	6830

[1]Pinger exclusion zones assume a simple spreading loss of 20 log R (where R is radius) with a source level of 188 dB

[2]Each listed pinniped observed at less than the indicated distance during operational volumes of the indicated sound source must be considered to have been subjected to Level A take under the MMPA and must count as one take each time the individual enters the area so ensonified.

[3]Each listed cetacean observed at less than the indicated distance during operational volumes of the indicated sound source must be considered to have been subjected to Level A take under the MMPA and must count as one take each time the individual enters the area so ensonified.

[4]Each listed marine mammal observed at less than the indicated distance during operational volumes of the indicated sound source must be considered to have been subjected to level B take under the MMPA and must count as one take each time the individual enters the area so ensonified.

We adopt NMFS PR1's estimate of MMPA take for Cook Inlet beluga whales (30 per year) as a reasonable estimate for the anticipated level of exposures to NMFS's sound thresholds rising to the level of take under the ESA. We find this approach conservative for evaluating jeopardy under the ESA because the mitigation measures typically result in a lower number of exposures actually occurring.

Humpback Whale Take

AKR determined that a take of five humpback whales during 2015 operations is appropriate for SAE, based on the action area. Lomac-MacNair et al. (2014) reported two humpback whales were taken by seismic operations by Apache in 2014. However, we have no previous records of humpback whales in the upper Cook Inlet area, suggesting that the presence of humpback whales in upper Cook Inlet is rare. No more than two humpback whales have been recorded by NMFS observers or Apache PSOs in the entire action area for this proposed project in any given year (two humpbacks are known to have occurred in the action area in 2004 and in 2014). The probability that SAE project vessels would encounter and take five humpback whales in the action area is low. Further, the humpback whale take event in upper Cook Inlet during 2014 was a highly unusual event that is unlikely to be repeated during the SAE 2015 seismic survey due to the rarity of this species in the action area and the effectiveness of project mitigation measures.

Western DPS Steller Sea Lion Take

During aerial surveys in June 2012, contracted observers documented approximately 75 pinnipeds hauled out on the banks of the Beluga River (north of the operational area). Because the observers were unable to clearly identify the species from air, the sighting was noted as "unidentified pinnipeds", but there was some speculation that they could be Steller sea lions given they appeared larger and lighter in color than harbor seals observed in the area at the same time (Lomac-MacNair et al. 2013). Lacking evidence beyond speculation on the identity of the

unidentified pinnipeds, NMFS considers it unlikely that these animals were Steller sea lions. Our estimate for take of western DPS Steller sea lions does not incorporate that speculative observation because the observation of that many Steller sea lions so far north in Cook Inlet is, as far as we are aware, unprecedented. Previously, we have recorded no more than two Steller sea lions in upper Cook Inlet in a single year, and these animals were not hauled out (NMFS unpublished data).

The exposure estimate of 25 western DPS Steller sea lions assumes annual take comparable to the maximum number of western DPS Steller sea lions observed in the action area in a given year from 2004-2014:

- In 2012, four Steller sea lions were observed (Lomac-MacNair et al. 2013)
- On June 10, 2006, 20 Steller sea lions were observed at the southern end of the action area (NMFS unpublished data).

NMFS AKR's estimate of Steller sea lion take includes the anomalous sighting with 20 animals along the southern edge of the action area (Shelden et al. 2013), far from any known haulouts or rookeries (such a Steller sea lion congregation far from haulouts or rookeries is unusual), but does not include animals observed outside of the action area. NMFS AKR is typically made aware of one or two Steller sea lions within the action area per year. Two individuals were observed by Apache PSOs in 2014 and three groups totaling about four sea lions were observed in 2012. We have determined that an aerial observation of unidentified pinnipeds hauled-out in the far northern section of Cook Inlet was not of Steller sea lions because prior to that report, sea lions have not been observed hauled out anywhere in upper Cook Inlet, and the greatest number of individuals reported in a single year was two Steller sea lions. Therefore, we do not take that sighting into account in our density estimates or take calculation. Our estimate of exposures to sound source levels above 160 dB adequately accounts for the number of animals one may reasonably expect seismic vessels implementing mitigation measures to encounter in a year and allows for the possibility that the survey vessels may encounter an anomalously large group such as was observed by NMFS aerial observers near the southern portion of the action area in 2006 (Shelden et al. 2013). Given the 3,934 km^2 [1,519 mi^2]) action area, we determined that analyzing and authorizing take of 25 Steller sea lions is most appropriate and uses the best available scientific data.

10.2 Reasonable and Prudent Measures

The following Reasonable and Prudent Measures are necessary and appropriate to minimize the impact of incidental take of the endangered Cook Inlet beluga whale, humpback whale, and western DPS Steller sea lion.

1. All seismic-related activity must comply with all applicable regulations, permit conditions, and requirements.

2. The taking of Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions must be by incidental harassment only (MMPA Level B take as defined in Term and Condition 2.1). The taking by serious injury or death (MMPA Level A take as defined in Term and Condition 2.1), or the taking by harassment greater numbers of animals than is authorized in this ITS, is prohibited and may result in a modification, suspension, or

revocation of the ITS. Level A take must be reported within 24 hours of occurrence to NMFS contacts (as listed under Term and Condition 6). SAE's accounting of take must be consistent with the guidelines for determining occurrence of take, as set forth in this biological opinion and the associated ITS.

3. A comprehensive mitigation, monitoring, and reporting program must be implemented to ensure that listed marine mammals are not taken in numbers or in a manner not anticipated by the biological opinion.

4. Waters within the action area that are known to be perennially used by Cook Inlet beluga whales for feeding, breeding or nursing (see Term and Condition 4.1) must not be ensonified to levels ≥160 dB when Cook Inlet beluga whales are present.

5. Records, including metadata, on all marine mammal observations made by PSOs associated with this project, regardless of the observed marine mammal(s) distance from the source vessel, must be made available to NMFS and the public in machine-readable format.[18]

10.3 Terms and Conditions

For any incidental takes that result from the actions of NMFS PR1, BOEM, or their applicant SAE and other authorized entities, to be exempt from the prohibitions of section 9 of the ESA, the action which causes the take must comply with the following terms and conditions. These Terms and Conditions implement the Reasonable and Prudent Measures described above and are non-discretionary.

1. **Terms and conditions associated with Reasonable and Prudent Measure 1**:
   All seismic-related activity must comply with all applicable regulations, permit conditions, and requirements.
   1.1. All seismic-related activity must comply with all applicable regulations, permit conditions, and requirements listed in each valid, current Incidental Harassment Authorization (IHA), or incidental take authorization, issued to the operator for this project under the authority of MMPA section 101(a)(5) and 50 CFR 216.107.
   1.2. Airgun arrays must be used for purposes of exploration and seismic data acquisition only. The use of any airgun array must not continue for more than 30 minutes when it is not being used to actively survey a transect on a node-equipped patch.

2. **Terms and Conditions associated with Reasonable and Prudent Measure 2**:
   The taking of Cook Inlet beluga whales, humpback whales, and western DPS Steller sea lions must be by incidental harassment only (MMPA Level B take as defined in Term and Condition 2.1). The taking by serious injury or death (MMPA Level A take as defined in Term and Condition 2.1), or the taking by harassment of a greater numbers of animals than is authorized in this ITS, is prohibited and may result in a modification, suspension, or revocation of the ITS. Level A take must be reported within 24 hours of occurrence to NMFS contacts (as listed under Term and Condition 6). SAE's accounting of take must be consistent

[18] See (un-numbered) Executive Order of May 9, 2013: Making open and machine readable the new default for government information.

with the guidelines for determining occurrence of take, as set forth in this biological opinion and the associated ITS.

2.1. Determination and reporting the take of listed[19] marine mammals must be as follows: If a listed cetacean enters the area ensonified at more than 180 dB re 1 μPa_{rms}, or a listed pinniped enters the area ensonified at more than 190 dB re 1 μPa_{rms}, then Level A take has occurred even if there are subsequent modifications to seismic survey activity (e.g. power-down, shut-down). Level A take is not authorized. If Level A take occurs, the equipment that produced the sound that resulted in Level A take must be immediately shut-down. Level A take must be reported within 24 hours of occurrence to the specified contacts (Term and Condition 5.7). All takes must be recorded in weekly reports to NMFS (Term and Condition 5.2, 5.3, and 5.4).

2.2. If any listed marine mammal enters the area ensonified to more than 160 dB re 1 μPa_{rms}, then Level B take has occurred, even if there are subsequent modifications to seismic survey activity (e.g. power down, shut-down). Having already exposed an animal to Level B take does not negate the obligation to immediately implement mitigation measures; the sound sources that caused take must still be powered down or shutdown immediately after observing listed marine mammals within the 160 dB disturbance zone for that sound source (Table ITS 1). Level B take must be recorded in weekly reports to NMFS AKR (see Term and Condition 5.10). Contents of weekly reports must include information specified in Terms and Conditions 5.6, 5.7 and 5.8.

2.3. In determining the number of Level A and level B takes that have occurred, each individual animal must be considered a discrete take if it approaches any sound source more closely than the designated Level A and Level B threshold distance for that sound source (Table ITS 1).

3. **Terms and Conditions associated with Reasonable and Prudent Measure 3***: A comprehensive mitigation, monitoring, and reporting program must be implemented to ensure that listed marine mammals are not taken in numbers or in a manner not anticipated by the biological opinion.*

3.1. All mitigation measures in this biological opinion must be implemented, and these mitigation measures must be implemented for beluga whales, humpback whales, and Steller sea lions. Vessel crews must assist in implementing these mitigation measures.

3.2. After power-downs and shutdowns, the entire 160 dB disturbance zone must be visible for 15 minutes (pinniped) or 30 minutes (cetacean) for a pre-ramp-up observation period. During this pre-ramp-up 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 pre-ramp-up scan, ramp-up operations may be implemented. If a listed marine mammal is observed within the 160 dB disturbance zone, then the pre-ramp-up scan must start over.

3.3. The operator must possess on board each seismic sound source vessel:

3.3.1. A copy of this ITS issued under the authority of section 7 of the Endangered Species Act.

[19] A listed marine mammal is one that is designated as threatened or endangered under the Endangered Species Act

3.3.2. A current and valid IHA issued by NMFS PR1 to SAE under the authority of the MMPA. Any take must be authorized by: 1) this IHA issued by NMFS to SAE and 2) a valid ITS. Take of listed species must occur in compliance with all terms, conditions, and requirements that are included in such authorizations.

3.4. Following a power-down or shutdown due to the proximity of listed marine mammals, daylight ramp up must not be initiated until the listed marine mammal has cleared the 160 dB disturbance zone. The disturbance zone will be considered void of listed marine mammals if:

3.4.1. The animals that were observed within the zone were all observed to have left the zone: or

3.4.2. no listed pinnipeds have been observed within the zone for 15 minutes; or

3.4.3. no listed cetaceans have been observed within the zone for 30 minutes.

3.5. During daylight ramp-up operations for each airgun array, the 160 dB disturbance zone for that array must be monitored for listed marine mammals, and a power-down or shut-down must be implemented if listed marine mammals appear likely to enter the zone prior to or during operational seismic survey work using that array.

3.6. To allow sufficient time for SAE to obtain and mobilize passive acoustic monitoring equipment, Term and Condition 3.6 will take effect 30 days following the initiation of SAE's seismic exploration activities in Cook Inlet. Following a power-down period that concludes between local sunset and sunrise, ramp up of airgun arrays must not be initiated until a properly trained PSO, using appropriate over-the-side passive acoustic detection equipment, has failed to detect beluga whales, humpback whales, or Steller sea lions for 30 minutes prior to ramp-up and throughout seismic operations that occur between local sunset and sunrise. The passive acoustic equipment should cover a frequency range of 0.1-160 kHz to allow detecting both social and echolocation signals, with a system sensitivity in the range -165 to -185 dB re1 V/µPa, and floor noise spectra similar to Beaufort Sea State 0. When bathymetry allows, the hydrophone depth must be at least twice the vessel draft, ideally at half the area's depth. The hydrophone must be suspended using a surface isolation buoy. As bathymetric and weather conditions allow, the support vessel deploying the passive acoustic equipment should focus its efforts on waters shoreward of seismic source vessels that are headed towards shore, and seaward of seismic source vessels that are headed away from shore. The support vessel must remain sufficiently distant from the seismic source vessel to ensure that beluga whales, if present and vocalizing, can be detected. Passive acoustic monitoring must continue throughout seismic operations occurring between local sunset and sunrise.

3.7. If a live marine mammal stranding is reported within 20 nm of seismic operations, seismic operations must cease and must not be initiated until NMFS AKR has determined that the stranding is not likely to have been caused by seismic operations; or until all surviving marine mammals involved in the live stranding event are swimming and clear of the 160 dB Level B disturbance zone.

4. **Terms and Conditions associated with Reasonable and Prudent Measure 4**: *Waters within the action area that are known to be perennially used by Cook Inlet beluga whales for feeding, breeding or nursing must not be ensonified to levels >160 dB when Cook Inlet beluga whales are present.*

4.1.

4.2. River mouths at or near which listed species are observed to be feeding shall be avoided to an extent that they remain outside of the 160 dB disturbance zone until such time that listed species are no longer present.

5. **Terms and Conditions associated with Reasonable and Prudent Measure 5:** *Records, including metadata, on all marine mammal observations made by PSOs associated with this project, regardless of the observed marine mammal(s) distance from the source vessel, must be made available to NMFS and the public in machine-readable format.*
   5.1. The period of reporting for weekly reports will be for the week ending Tuesday prior to the Thursday reporting deadline (e.g., the weekly report for the period June 30-July 7, 2015 will be submitted to NMFS PR1 and NMFS AKR by close of business, Alaska time, July 9th, 2015).
   5.2. The reporting period for each monthly report will be the entire calendar month, and will be submitted by close of business of the 5th day of the month following the end of the reporting period (e.g., The monthly report covering July 1-31, 2015, will be submitted to NMFS PR1 and NMFS AKR by close of business on August 5th, 2015).
   5.3. A final technical report will be submitted to NMFS PR1 and NMFS AKR within 90 days after the final seismic shot has been fired for the season, or at least 60 days before the request for another Incidental Take Authorization for the next open water season, which would enable NMFS PR1 to incorporate observation data into the next IHA and Biological Opinion. The report will summarize all seismic activities and marine mammal monitoring results (i.e., vessel and shore-based visual monitoring) conducted during in-water seismic surveys. The Final Technical Report will include information required by terms and conditions 5.6.1-5.7.8, as well as:
      5.3.1. Summaries that include monitoring effort (e.g., total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors that affect visibility and detectability of marine mammals)
      5.3.2. Analyses on the effects from various factors that influences detectability of marine mammals (e.g., sea state, number of observers, fog, glare, etc.)
      5.3.3. 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
      5.3.4. Analyses on the effects of survey operations on listed marine mammals
      5.3.5. Number of marine mammals observed (by species) during periods with and without seismic survey activities (and other variables that could affect detectability), such as:
         5.3.5.1. Initial sighting distances versus survey activity state
         5.3.5.2. Closest point of approach versus survey activity state
         5.3.5.3. Observed behaviors and movement types versus survey activity state
         5.3.5.4. Numbers of sightings/individuals seen versus survey activity state
         5.3.5.5. Distribution around the source vessels versus survey activity state
   5.4. In an effort to maximize use of marine mammal observation data that can be used to minimize future take of these animals, SAE must, within 90 days of the final seismic transect surveyed by them, provide NMFS AKR with both a raw and a quality controlled digital database.

5.5. A standardized data recording format is under development. Upon delivery of this data recording format from NMFS AKR to SAE, that format must be adopted by all PSOs to report listed marine mammal observations and interactions by SAE and its contractors. Prior to that time, data must be recorded by all PSOs and reported using an industry-standard spreadsheet or relational database format (Term and Condition 5.3).

5.6. PSO data must include the following for each listed marine mammal observation (or "sighting event" if repeated sightings are made of the same animal or animals):

5.6.1. species, date, and time for each sighting event;

5.6.2. number of animals per sighting event; and number of adults/juveniles/calves per sighting event;

5.6.3. primary, and, if observed, secondary behaviors of the marine mammals in each sighting event;

5.6.4. geographic coordinates for the observed animals and the nearest seismic vessel, with the position recorded by using the most precise coordinates practicable (coordinates must be recorded in decimal degrees, or similar standard, and defined coordinate system);

5.6.5. time of most recent seismic shot (the most proximal actively operating seismic vessel) prior to marine mammal observation;

5.6.6. environmental conditions as they existed during each sighting event, including Beaufort Sea State, weather conditions, visibility (km/mi), lighting conditions, and percentage of ice cover.

5.7. If a listed marine mammal enters the 160 dB disturbance zone or 180/190 dB exclusion zone (Table ITS 1), it must be reported in the weekly reports and included in the comprehensive observation database. Recall that any Level A take of listed species must be reported within 24 hours (Term and Condition 2.1), where a level A take exposures a pinnipeds to more than 190 dB and exposures cetaceans to more than 180 dB. Observation records for listed marine mammals that enter the 160 dB disturbance zone or 180/190 dB exclusion zone must include:

5.7.1. all the information required by all portions of Term and Condition 5.3

5.7.2. number of listed animals subjected to MMPA Level A take (more than 180 dB for listed whales; and more than190 dB for listed pinnipeds);

5.7.3. number of listed animals subjected to MMPA Level B take (more than 160 dB);

5.7.4. the date and time of each take;

5.7.5. the cause of the take (e.g., 1760 cui airgun array operating at full volume);

5.7.6. the time the animal(s) entered the 160 dB disturbance zone or 180/190 dB exclusion zone, and, if known, the time it exited the zone (whether due to animal movement, ship movement, or mitigation measures);

5.7.7. mitigation measures implemented prior to and after the animal entered the 160 dB disturbance zone.

5.7.8. mitigation measures implemented prior to and after the animal entered the 180/190 dB exclusion zone.

5.8. Although Level A take is not authorized, any Level A take must be reported within 24 hours of occurrence to all NMFS contacts (Term and Condition 5.10).

5.9. These reporting requirements are in addition to those required by the MMPA IHA.

5.10. NMFS Contacts:

In the event that seismic activity causes the take of a marine mammal in a manner other than that authorized by this ITS, SAE must immediately cease the specified activities pending reinitiation of formal consultation with NMFS AKR; and must report the incident to:

AKR Protected Resources Division at: 907-271-5006
NMFS stranding hotline at: 877-925-7773
and by email to:
barbara.mahoney@noaa.gov and Mandy.Migura@noaa.gov

LITERATURE CITED

Abgrall, P., V.D. Moulton, and W.J. Richardson. 2008. Updated review of scientific information on impacts of seismic survey sound on marine mammals, 2004-present. LGL Limited, St. John's, Newfoundland and Labrador, and King City, Ontario, Canada. LGL Report SA973-1.

Aerts, L.A.M., M. Blees, S. Blackwell, C. Greene, K. Kim, D. Hannay, and M. Austin. 2008. Marine mammal monitoring and mitigation during BP Liberty OBC seismic survey in Foggy Island Bay, Beaufort Sea, July-August 2008: 90- day report. LGL Alaska Research Associates, Inc. Report P1011-1.

Alaska Communication Systems [ACS]. 2008. Alaska Communications Systems Fiber Optic Cable Project. Letter to Brad Smith (NMFS) from Stephen E. Gebert (ACS). February 1, 2008.

Alaska Department of Environmental Conservation [ADEC]. 2010. Alaska's Final 2010 Integrated Water Quality Monitoring and Assessment Report. July 15, 2010. http://www.dec.state.ak.us/water/wqsar/Docs/2010_Integrated_Report_Final_20100715_correct ed_july_19.pdf.

ADEC. 2014. Kenai Wastewater Treatment Plant Upgrades. FY2014 Request, Reference No. 57013. http://omb.alaska.gov/ombfiles/14_budget/DEC/Proposed/2014proj57013.pdf

Alaska Department of Fish and Game [ADFG]. 2004. Fish Distribution Database – Interactive Mapping. www.sf.adfg.state.ak.us/sarr/FishDistrib/FDD_ims.cfm.

ADFG. 2011a. Subsistence and Personal Use. www.adfg.alaska.gov/index.cfm?adfg=residentfishing.main.

ADFG. 2011b. Anadromous Waters Catalog. Interactive Mapping (NAD 83). Land and Waters. http://www.adfg.alaska.gov/sf/SARR/AWC/index.cfm?ADFG=maps.interactive.

ADFG. 2011c. Commercial Fisheries. Information by Area. Upper Cook Inlet Management Area. http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareauci.main.

ADFG. 2011d. Commercial Fisheries. Information by Area. Lower Cook Inlet Management Area. http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyarealci.main.

ADFG. 2011e. Final Report: Acoustic Monitoring of beluga whales and noise in Cook Inlet, Alaska. Grant Number: NA07NMF4390364. http://www.alaskafisheries.noaa.gov/protectedresources/whales/beluga/acoustics/cib acoustics-1007-0910.pdf

Alaska Department of Natural Resources [ADNR]. 2009. Cook Inlet Areawide Oil and Gas Lease Sale Final Finding of the Director January 20, 2009. Division of Oil and Gas. Anchorage, AK.

ADNR. 2014. Active oil and gas lease inventory. Division of Oil and Gas. http://dog.dnr.alaska.gov/Publications/OGInventory.htm.

Allen, B.M. and R.P. Angliss 2013. Alaska marine mammal stock assessments, 2012. NOAA Technical Memorandum NMFS-AFSC-245.

American Petroleum Institute [API]. 1986. Underwater drilling - measurement of sound levels and their effect on belukha whales. Prepared by Polar Research Laboratory, Inc. and Hubbs Marine Research Institute.

Anchorage Water and Wastewater Utility [AWWU]. 2014. Wastewater Treatment. John M. Asplund Wastewater Treatment Facility. https://www.awwu.biz/website/about_us/about_us_frame.htm.

Anderson, T.S., R. Adler, P.M. Scheifele, S. Tremblay, J.H. Miller, and G.R. Potty. 2007. Preliminary environmental impact report: Observable seismic, acoustic and hydroacoustic energy attributed to C4 plastique explosive simulating 155mm ordnance at Fort Richardson Alaska, Eagle River flats. U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory.

Angliss, R.P. and R.B. Outlaw. 2008. Alaska marine mammal stock assessments, 2007. U.S. Department of Commerce, NOAA Technical Memo, NMFS-AFSC-180.

Arctic Slope Region Regional Corporation [ASRC]. 2014. Biological Assessment Cook Inlet, Alaska, August 2014.

Au, W.W.L. 1993. The sonar of dolphins. Springer Verlag, New York.

Au, W.W.L. 2000. Hearing in whales and dolphins, an overview. *In*: Hearing by whales and dolphins. W.W.L. Au, A.N. Popper, and R.R. Fay (*eds*). Springer Verlag, New York.

Au, W.W.L., D.A. Carder, and B. L. Scronce. 1985. Demonstration of adaptation in beluga whale (*Delphinapterus leucas*) echolocation signals. Journal of the Acoustical Society of America 77(2):726-730.

Au, W.W.L., A.A. Pack, M.O. Lammers, L.M. Herman, M.H. Deakos and K. Andrews. 2006. Acoustic properties of humpback whale songs. Journal of the Acoustical Society of America 120:1103-1110.

Austin, M.A., and G. Warner. 2012. Sound source acoustic measurements for Apache's 2012 Cook Inlet seismic survey: Version 1.0. Technical Report.

Awbrey, F.T. and B.S. Stewart. 1983. Bbe3ckerehavioral responses of wild beluga whales (*Delphinapterus leucas*) to noise from oil drilling. Journal of the Acoustical Society of America 74, S54.

Baba, N. H. Nitto, and A. Nitta. 2000. Satellite tracking of young Steller sea lion off the coast of northern Hokkaido. Fisheries Science 66:180–181.

Baker, C.S. and L.M. Herman. 1989. Behavioural responses of summering humpback whales to vessel traffic. Experimental and opportunistic observations. NPS-NR-TRS-89-01.

Barlow J., J. Calambokidis, E.A. Falcone, C.S. Baker, A.M. Burdin, P.J. Clapham, J.K.B. Ford, C.M. Gabriele, R. LeDuc, D.K. Mattila, T.J. Quinn, L. Rojas-Bracho, J.M. Straley, B.L. Taylor, R.J. Urbán, P. Wade, D. Weller, B.H. Witteveen, and M. Yamaguchi. 2011. Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Marine Mammal Science 27:793-818.

Batten, S.D. and D.L. Mackas. 2007. A continuous plankton recorder survey of the North Pacific and southern Bering Sea. North Pacific Research Board. Final Report 601.

Becker, P.R., M.M. Krahn, E.A. Mackey, R. Demiralp, M.M. Schantz, M.S. Epstein, M.K. Donais, B.J. Porter, D.C.G. Muir, and S.A. Wise. 2000. Concentrations of polychlorinated biphenyls (PCBs), chlorinated pesticides, and heavy metals and other elements in tissues of belugas, *Delphinapterus leucas*, from Cook Inlet, Alaska. Marine Fisheries Review 62(3).

Becker, P.R., J. Kucklick, J. Houget, J. Keller, J. Reiner, R. Day, and E. Mackey. 2010. Current-Use and legacy persistent pollutants in the Cook Inlet beluga whales: results for the analysis of banked tissues from the Alaska Marine Mammal Tissue Archival Project (AMMTAP). Presentation at the Cook Inlet Beluga Whale Science Conference, October 2010, Anchorage, Alaska.

Bel'kovich, V.M. 1960. Some biological observations on the white whale from aircraft. Zool. Zh. 39(9):1414-1422 (Translation NOO-T-403. US Navy Oceanographic Office, Washington, DC. NTIS AD-693538).

Blackwell, S.B. 2005. Underwater measurements of pile-driving sounds during the Port MacKenzie dock modifications, August 13 through 16, 2004. Greeneridge Sciences, Inc. and LGL Alaska Research Associates, Inc.

Blackwell, S.B. and C.R. Greene Jr. 2003. Acoustic measurements in Cook Inlet, Alaska during August 2001. Greeneridge Sciences, Inc. Revised Report 271-2.

Blane, J.M. and R. Jaakson. 1994. The impact of ecotourism boats on the St. Lawrence beluga whales. Environmental Conservation 21(3): 267-269.

Brannian, L. and J. Fox. 1996. Upper Cook Inlet subsistence and personal use fisheries report to the Alaska Board of Fisheries, 1996. ADFG, Division of Commercial Fisheries Management Development. Regional Information Report 2S96-03, Anchorage, Alaska.

Braund, S.R., and H.P. Huntington. 2011. Relationship between the Native Village of Tyonek, Alaska and beluga whales in Cook Inlet, Alaska.

Bureau of Ocean and Energy Management [BOEM]. 2014. Cook Inlet oil and gas lease sale 244. Proposed OCS oil and gas leasing program for 2012-2017. Available at http://www.boem.gov/About-BOEM/BOEM-Regions/Alaska- Region/Leasing-and-Plans/Leasing/Lease-Sales/Sale-244---Cook-Inlet/Index.aspx.

Burek, K. 1999. Biopsy report of beluga whale: Case Number 99V0269.

Burns, J.J. and G.A. Seaman. 1986. Investigations of belukha whales in coastal waters of western and northern Alaska. II. Biology and ecology. U.S. DOC/NOAA/OCSEAP Final Report 56(1988): 221-357.

Calkins, D.G. 1979. Marine mammals of lower Cook Inlet and the potential for impact from outer continental shelf oil and gas exploration, development, and transport. Environmental Assessment. U.S. DOC/NOAA/OCSEAP Final Report 20:171-263. NTIS PB85-201226.

Calkins, D.G. 1984. Susitna hydroelectric project final report: big game studies. Volume IX, belukha whale. ADFG. Final Report No. 2328.

Calkins, D.G., 1986. Marine mammals. *In*: The Gulf of Alaska: physical environment and biological resources. D.W. Hood and S.T. Zimmerman (*eds*). DOC/NOAA Ocean Assessment Division.

Calkins, D.G. 1989. Status of belukha whales in Cook Inlet. *In*: Gulf of Alaska, Cook Inlet, and North Aleutian Basin information update meeting. L.E. Jarvela and L.K. Thorsteinson (*eds*). Anchorage, Alaska, 7-8 February 1989. USDOC/NOAA/OCSEAP.

Calkins, D.G., and K.W. Pitcher 1982. Population assessment, ecology, and trophic relationships of Steller sea lions in the Gulf of Alaska. Pages 447-546 *In*: Environmental assessment of the Alaska continental shelf. U.S. DOC and U.S. DOI. Final Reports of Principal Investigators, Volume 19.

Cohen, D.M., T. Inada, T. Iwamoto, and N. Scialabba. 1990. FAO species catalogue. Volume 10. Gadiform fishes of the world (Order Gadiformes). An annotated and illustrated catalogue of cods, hakes, grenadiers, and other gadiform fishes known to date. FAO Fisheries Synopsis 10 (125):1-442.

Cook Inlet Marine Mammal Council [CIMMC]. 1996. Native harvest and use of beluga in the upper Cook Inlet from July 1 through November 15, 1995. USDOC/NOAA/NMFS Alaska.

CIMMC. 1997. Native harvest and use of beluga in Cook Inlet from April throughout November 1996. USDOC/NOAA/NMFS Alaska.

Cornick, L.A. and L.S. Kendall. 2008. Distribution, habitat use, and behavior of Cook Inlet beluga whales in Knik Arm at the Port of Anchorage Marine Terminal Redevelopment Project. Final Annual Report for 2007. Alaska Pacific University, Anchorage, Alaska.

Cornick, L.A. and L.S. Saxon-Kendall. 2009. End of construction season 2008 marine mammal monitoring report: Construction and scientific marine mammal monitoring associated with the Port of Anchorage Marine Terminal Redevelopment Project. Final Annual Report for 2008. Alaska Pacific University, Anchorage, Alaska.

Cornick, L.A., L.S. Saxon-Kendall, and L. Pinney. 2010. Distribution, habitat use, and behavior of Cook Inlet beluga whales and other marine mammals at the Port of Anchorage Marine Terminal Redevelopment Project May - November 2009. Alaska Pacific University, Anchorage, Alaska.

Cox, T.M, A.J. Read, A. Solow, and N. Tregenza. 2001. Will harbour porpoises *(Phocoena phocoena)* habituate to pingers? Journal of Cetacean Research and Management: 81-86.

Daniel, R. G. 2003. The timing of moulting in wild and captive Steller sea lions (*Eumetopias jubatus*). MSc thesis. University of British Columbia, British Columbia, Canada.

Department of Fisheries and Oceans, Canada [DFO] and World Wildlife Fund [WWF], Canada. 1995. Saint Lawrence beluga whale recovery plan. Saint Lawrence beluga whale recovery team.

Engel, M.H., M.C.C. Marcondes, C.C.A. Martins, F.O. Luna, R.P Lima, and A. Campos. 2004. Are seismic surveys responsible for cetacean strandings? An unusual mortality of adult humpback whales in Abrolhos Bank, northeastern coast of Brazil. Paper SC/56/E28, IWC Annual Meeting.

Environmental Protection Agency [EPA]. 2007a. Chuitna Coal Project - Supplemental Environmental Impact Statement Project Website. At www.chuitnaseis.com/default.htm.

EPA. 2007b. Permit No: AKG-31-5000 Authorization to discharge under the NPDES for oil and gas extraction facilities in federal and state waters in Cook Inlet. Effective July 2007 through July 2012.

Erbe, C. 2000. Underwater noise of whale watching boats and its effects on marine mammals. Institute of Ocean Sciences. Sidney, British Columbia, Canada.

Erbe, C. 2002. Underwater noise of whale watching boats and potential effects on killer whales (*Orcinus orca*), based on an acoustic impact model. Marine Mammal Science 18-394-418.

Erbe, C. and D.M. Farmer. 2000. Zones of impact around icebreakers affecting beluga whales in the Beaufort Sea. Journal of the Acoustical Society of America 108:1332-1340.

Erbe, C. and A.R. King. 2009. Modeling cumulative sound exposure around marine seismic surveys. Journal of the Acoustical Society of America 125(4):2443-2451.

Fay, R.R. 1988. Hearing in vertebrates: a psychophysics databook. Winnetka, Illinois: Hill-Fay Associates.

Fernández, A., M. Arbelo, R. Deaville, I.A.P Patterson, P. Castro, and J.R. Baker. 2004. Pathology: Whales, sonar and decompression sickness (reply). [Brief Communications]. Nature 428 (6984), U1-2.

Fernández, A., J.F. Edwards, F. Rodríguez, A. Espinosa de los Monteros, P. Herráez, and P. Castro. 2005. Gas and fat embolic syndrome involving a mass stranding of beaked whales (Family Ziphiidae) exposed to anthropogenic sonar signals. Veterinary Pathology 42:446-457.

Finneran, J.J., D.A. Carder, C.E. Schlundt, and S.H. Ridgway. 2005. Temporary threshold shift (TTS) in bottlenose dolphins (*Tursiops truncatus*) exposed to mid-frequency tones. Journal of the Acoustical Society of America 118:2696-2705.

Finneran, J.J., C.E. Schlundt, D.A. Carder, J.A. Clark, J.A. Young, J.B. Gaspin, and S.H. Ridgway. 2000. Auditory and behavioral responses of bottlenose dolphins (*Tursiops truncatus*) and a beluga whale (*Delphinapterus leucas*) to impulsive sounds resembling distant signatures of underwater explosions. Journal of the Acoustical Society of America 108:417 431.

Finneran, J.J., C.E. Schlundt, D.A. Carder, and S.H. Ridgway. 2002. Auditory filter shapes for the bottlenose dolphin (*Tursiops truncatus*) and the white whale (*Delphinapterus leucas*) derived with notched noise. The Journal of the Acoustical Society of America 112:7.

Fiscus, C.H. 1961. Growth in Steller sea lion. Journal of Mammalogy 42(2):218-223.

Fraker, M.A. 1977. The 1977 white whale monitoring program, MacKenzie Estuary, N.W.T. Canada.

Frazer, L.N. and E. Mercado. 2000. A sonar model for humpback whale song. Institute of Electrical and Electronics Engineers Journal of Oceanic Engineering 25:160-182.

Frid, A. and L. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology 6(1):11.

Fried, S.M., J.J. Laner, and S.C. Weston. 1979. Investigation of white whale (*Delphinapterus leucas*) predation upon sockeye salmon (*Oncorhynchus nerka*) smolts in Nushagak Bay and associated rivers: 1979 aerial reconnaissance surveys. Project 11-41-6-340. ADFG, Dillingham, Alaska.

Frost, K.J., L.F. Lowry, and R.R. Nelson. 1983. Investigations of belukha whales in coastal waters of western and northern Alaska, 1982-1983: marking and tracking of whales in Bristol Bay. U.S. DOC/NOAA/OCSEAP. Final Report 43(1986):461-585.

Funk, D.W., T.M. Markowitz, and R. Rodrigues (*eds*). 2005. Baseline studies of beluga whale habitat use in Knik Arm, upper Cook Inlet, Alaska, July 2004-July 2005. LGL Alaska Research Associates, Inc.

Geraci, J.R. 1990. Physiological and toxic effects on cetaceans. *In*: Sea mammals and oil: confronting the risks. J.R. Geraci and D.J. St. Aubin (*eds*). Academic Press, Inc. San Diego, California.

Gisiner, R.C. 1985. Male territorial and reproductive behavior in the Steller sea lion, *Eumetopias jubatus*. PhD thesis. University of California, Santa Cruz, California

Goetz, K.T., P.W. Robinson, R.C. Hobbs, K.L. Laidre, L.A. Huckstadt, and K.E.W. Shelden. 2012. Movement and dive behavior of beluga whales in Cook Inlet, Alaska. U.S. DOC/NOAA/AFSC Processed Report 2012-03.

Goetz, K.T., D.J. Rugh, A.J. Read, and R.C. Hobbs. 2007. Habitat use in a marine ecosystem: Beluga whales *Delphinapterus leucas* in Cook Inlet, Alaska. Marine Ecology Progress Series 330:247–256.

Goold, J.C. and P.J. Fish. 1998. Broadband spectra of seismic survey air-gun emissions with reference to dolphin auditory thresholds. Journal of the Acoustical Society of America 103:2177-2184.

Gordon, J., D. Gillespie, J. Potter, A. Frantzis, M.P. Simmonds, R. Swift, and D. Thompson. 2004. A review of the effects of seismic surveys on marine mammals. Marine Technology Society Journal 37:16-34.

Greene, C.R. Jr., N.S. Altman, and W.J. Richardson. 1999. Bowhead whale calls. *In*: W.J. Richardson (*ed*), marine mammal and acoustical monitoring of Western Geophysical's open water seismic program in the Alaskan Beaufort Sea. LGL Limited, King City, Ontario, Canada and Greeneridge Sciences Inc., Santa Barbara, California. LGL report TA2230-3.

Hansen, D.J. and J.D. Hubbard. 1999. Distribution of Cook Inlet beluga whales (*Delphinapterus leucas*) in winter. Final Report. U.S. DOI/MMS/Alaska OCS Region. MMS 99-0024.

Harris, R.E., T. Elliott, and R.A. Davis. 2007. Results of mitigation and monitoring program, Beaufort Span 2-D marine seismic program, open-water season 2006. LGL Report TA4319-1. LGL Limited, King City, Ontario, Canada.

Harrison, C.S. and J.D. Hall. 1978. Alaskan distribution of the beluga whale, *Delphinapterus leucas*. Canadian Field-Naturalist 92:235-241.

HDR, Inc. [HDR]. 2011. Knik Arm Crossing proof of concept study report. Anchorage, Alaska.

Heath, B., G. Jimenez, and K. Marks. 2014. Sound source verification. Final Report, Cook Inlet seismic survey, SAExploration, Alaska.

Heise, K., L.G. Barrett-Lennard, E. Saulitis, C. Matkin, and D. Bain. 2003. Examining the evidence for killer whale predation on Steller sea lions in British Columbia and Alaska. Aquatic Mammals 29(3): 325-334.

Heide-Jorgensen, M. Peter, R.G. Hansen, K. Westdal, R.R. Reeves, and A. Mosbech. 2013. Narwhals and seismic exploration: Is seismic noise increasing the risk of ice entrapments? Biological Conservation 158 (2013):50-54.

Herman, L. 1980. Cetacean behavior. New York, John Wiley and Sons.

Hildebrand, J.A. 2005. Impacts of anthropogenic sound. *In:* Marine mammal research: conservation beyond crisis. J.E. Reynolds, W.F. Perrin, R.R. Reeves, S. Montgomery, and T. Ragen (*eds*). Johns Hopkins University Press, Baltimore, Maryland.

Hobbs, R.C., D.J. Rugh, and D.P. DeMaster. 2000. Abundance of belugas, *Delphinapterus leucas*, in Cook Inlet, Alaska, 1994-2000. Marine Fisheries Review 62(3).

Hobbs, R.C., K.L. Laidre, D.J Vos, B.A. Mahoney, and M. Eagleton. 2005. Movements and area use by belugas, *Delphinapterus leucas*, in a subarctic Alaskan estuary. Arctic 58(4): 331-340.

Hobbs, R.C., and K.E.W. Shelden. 2008. Supplemental status review and extinction assessment of Cook Inlet belugas (*Delphinapterus leucas*). U.S. DOC/NOAA/AFSC Processed Report 2008-08.

Hobbs, R.C., K.E.W. Shelden, D.J. Vos, K.T. Goetz, and D.J. Rugh. 2006. Status review and extinction assessment of Cook Inlet belugas (*Delphinapterus leucas*). U.S. DOC/NOAA/AFSC Processed Report 2006-16.

Hobbs, R.C., K.E.W. Shelden, D.J. Rugh, and S.A. Norman. 2008. 2008 Status review and extinction risk assessment of Cook Inlet belugas (*Delphinapterus leucas*). U.S. DOC/NOAA/AFSC Processed Report 2008-02.

Hobbs, R.C., C.L. Sims, K.E.W. Shelden, and D.J. Rugh. 2009. Estimated abundance of beluga whales in Cook Inlet, Alaska, from aerial surveys conducted in June 2009. U.S. DOC/NOAA/AFSC Unpublished Report.

Houser, D.S., R. Howard, and S. Ridgway. 2001. Can diving induced tissue nitrogen supersaturation increase the chance of acoustically driven bubble growth in marine mammals? Journal of Theoretical Biology 213:183-195.

Huntington, H.P. 2000. Traditional knowledge of the ecology of belugas, *Delphinapterus leucas*, in Cook Inlet, Alaska. Marine Fisheries Review 62(3).

International Association of Geophysical Contractors [IAGC]. 2004. Further analysis of 2002 Abrolhos Bank, Brazil humpback whale strandings coincident with seismic surveys. International Association of Geophysical Contractors, Houston, Texas.

International Panel on Climate Change [IPCC]. 2014: Summary for policymakers. *In*: Climate Change 2014: impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change. Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (*eds*). Cambridge University Press, Cambridge, United Kingdom and New York, New York.

International Whaling Commission [IWC]. 2007. Report of the standing working group on environmental concerns. Annex K to Report of the Scientific Committee. Journal of Cetacean Research and Management 9 (Supplement): 227-260.

Janssen, R. 1980. Future scientific activities in effects of noise on animals. American Speech-Language-Hearing Association, Report Number 10

JASCO Research Limited [JASCO]. 2007. Underwater Sound level measurements of airgun sources from ConocoPhillips' 2007 beluga 3D seismic shoot, Cook Inlet, Alaska. 72 hour Report.

Kastak, D. and R.J. Shusterman. 1999. In-air and underwater hearing sensitivity of a northern elephant seals (*Mirounga angustirostris*). Canadian Journal of Zoology. 77: 1751-1758.

Kastak, D., B.L. Southall, R.D. Schusterman, and C.R. Kastak. 2005. Underwater temporary threshold shifts in pinnipeds: effects of noise level and duration. Journal of the Acoustical Society of America 118: 3154-3163.

Kastelein, R.A., R. van Schie, W. Verboom, and D. Haan. 2005. Underwater hearing sensitivity of a male and a female Steller sea lion (*Eumetopias jubatus*). Journal of the Acoustical Society of America 118:1820-1829.

Katona, S.K., V. Rough, and D.T. Richardson. 1983. A field guide to the whales, porpoises, and seals of the Gulf of Maine and eastern Canada. New York: Charles Scribner's Sons.

Kenyon, K.W. and D.W. Rice. 1961. Abundance and distribution of the Steller sea lion. Journal of Mammalogy 42:223-234.

Ketten, D.R. 1994. Functional analysis of whale ears: adaptations for underwater hearing. Institute of Electrical and Electronics Engineers Proceedings in Underwater Acoustics 1:264-270.

Ketten, D.R. 1995. Estimates of blast injury and acoustic trauma zones for marine mammals from underwater explosions. *In*: Sensory systems of aquatic mammals. R.A. Kastelein, J.A. Thomas and P.E. Nachtigall (*eds*). De Spil Publishers, Woerden, Netherlands.

Ketten, D.R. 1997. Structure and function in whale ears. Bioacoustics 8:103-137.

Ketten, D.R. 1998. Marine mammal auditory systems: a summary of audiometric and anatomical data and its implications for underwater acoustic impacts. NOAA-TM-NMFS-SWFSC-256.

Ketten, D.R., J. Lien, and S. Todd. 1993. Blast injury in humpback whale ears; evidence and implications. Journal of the Acoustical Society of America. 94(3, Pt. 2): 1849-1850.

King, J.E. 1954. The otariid seals of the Pacific coast of America. Bulletin of the British Museum (Natural History) Zoology 2:311-337.

Kingsley M.C.S. 2002. Cancer rates in St Lawrence belugas; comment on Martineau et al. 1999, cancer in beluga whales. Journal of Cetacean Research and Management. Special Issue 1:249-265[Letter]. *In*: Marine Mammal Science 18:572–574.

Kleinenberg, S.E., A.V. Yablov, B.M. Bel'kovich, and M.N. Tarasevich. 1964. Beluga (*Delphinapterus leucas*). Investigations of the species. Izdatelstvo Nauka, Moscow. [Translated from Russian by the Israel Program for Scientific Translation, Jerusalem, 1969].

Knik Arm Bridge and Toll Authority [KABATA]. 2004. Knik Arm Crossing preliminary offshore water quality assessment. Kinnetic Laboratories, Inc.

Kryter, K.D. 1985. The effects of noise on man. Second Edition. Academic Press, Orlando, Florida.

Lesage, V., C. Barrette, M.C.S. Kingsley and B.L. Sjare. 1999. The effect of vessel noise on the vocal behavior of belugas in the St. Lawrence River estuary, Canada. Marine Mammal Science 15: 65-84.

Lammers, M.O., M. Castellote, R.J. Small, S. Atkinson, J. Jenniges, A. Rosinski, J.N. Oswald, and C. Garner. 2013. Passive acoustic monitoring of Cook Inlet beluga whales (*Delphinapterus leucas*). Journal of the Acoustical Society of America 134:2497-25014.

LGL Alaska Research Associates, Inc. [LGL]. 2006. Review of literature of fish species and beluga whales in Cook Inlet, Alaska. Final Report.

Lomac-MacNair, K.S., L.S. Kendall, and S. Wisdom. 2013. Marine mammal monitoring and mitigation 90-day report, May 6-September 30, 2012, Alaska Apache Corporation 3D seismic program, Cook Inlet, Alaska. SAExploration and Fairweather, Anchorage, Alaska

Lomac-MacNair, K., M.A. Smultea, and G. Campbell. 2014. Draft NMFS 90-Day report for marine mammal monitoring and mitigation during Apache's Cook Inlet 2014 seismic survey, 2 April - 27 June 2014. Smultea Environmental Sciences, Preston, Washington.

Loughlin, T.R. 1993. Status and pelagic distribution of otariid pinnipeds in the Bering Sea during winter. U.S. DOI/MMS/Alaska OCS Region. MMS 93-0026.

Loughlin, T.R. 1997. Using the phylogeographic method to identify Steller sea lion stocks. *In*: Molecular genetics of marine mammals. A.E. Dizon, S.J. Chivers, W.F. Perrin (*eds*). Society for Marine Mammalogy Special Publication 3, Society for Marine Mammalogy.

Loughlin, T.R. and R. Nelson. 1986. Incidental catch of northern sea lions in Shelikof Strait, Alaska. Marine Mammal Science 2:14-33.

Loughlin, T.R., A.S. Perlov, and V.A. Vladimirov 1992. Range-wide survey and estimation of total numbers of Steller sea lions in 1989. Marine Mammal Science 8:220-239.

Loughlin, T.R. D.J. Rugh, and C.H. Fiscus. 1984. Northern sea lion distribution and abundance: 1956-80. Journal of Wildlife Management 48:729-740.

Lucke, K., U. Siebert, P.A. Lepper, and M.A. Blanchet. 2009. Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli. Journal of the Acoustical Society of America 125:4060-4070.

Mahoney, B.A. and K.E.W. Shelden. 2000. Harvest history of beluga whale, *Delphinapterus leucas,* in Cook Inlet, Alaska. Marine Fisheries Review 62(3).

Manly, B.F.J. 2006. Incidental catch and interactions of marine mammals and birds in the Cook Inlet salmon driftnet and setnet fisheries, 1999-2000. Draft Report.

Markowitz, T.M., D.W. Funk, D.S. Ireland, R. Rodrigues, and M.R. Link. 2005. Use of Knik Arm by Cook Inlet beluga whales. LGL Alaska Research Associates, Inc., Anchorage, Alaska.

Markowitz, T. and T.L. McGuire. 2007. Temporal-spatial distribution, movements and behavior of beluga whales near the Port of Anchorage, Alaska. LGL Alaska Research Associates, Inc. Anchorage, Alaska. Final Report.

Mate, B.R. and J.T. Harvey (*eds*). 1987. Acoustical deterrents in marine mammal conflicts with fisheries: a workshop held February 17-18, 1986. Oregon State University, Corvallis, Oregon. Publication number ORESU-W-86-001.

McDonald, M.A., J.A. Hildebrand, and S.C. Webb. 1995. Blue and fin whales observed on a seafloor array in the Northeast Pacific. Journal of the Acoustical Society of America 98:712-721.

McGuire, T., M. Blees, and M. Bourdon. 2011a. Photo-identification of beluga whales in upper Cook Inlet, Alaska. Final report of field activities and belugas re-sighted in 2009. LGL Alaska Research Associates, Inc.

McGuire, T.L., M.L. Bourdon and R. Kirchner. 2011b. Pre-deployment visual monitoring for beluga whales in and near the Cook Inlet tidal energy project proposed deployment area, May-November 2010. LGL Alaska Research Associates, Inc.

McGuire, T.L., C.C. Kaplan, and M.K. Blees. 2009. Photo-identification of beluga whales in upper Cook Inlet, Alaska. Final report of belugas re-sighted in 2008. LGL Alaska Research Associates, Inc.

McGuire, T.L., C.C. Kaplan, M.K. Blees, and M.R. Link. 2008. Photo-identification of beluga whales in upper Cook Inlet, Alaska. 2007 Annual report. LGL Alaska Research Associates, Inc.

McGuire, T.L., A. Stevens, and L. Bisson. 2014. Photo-identification of Cook Inlet beluga whales in waters of the Kenai Peninsula Borough. Final report of field activities and belugas identified 2011-2013. LGL Alaska Research Associates, Inc.

Merrick, R.L. 1995. The relationship of the foraging ecology of Steller sea lions (*Eumetopias jubatus*) to their population decline in Alaska. PhD Thesis, University of Washington, Washington.

Merrick, R.L., T.R. Loughlin, and D.C. Calkins. 1987. Decline in abundance of the northern sea lion, *Eumetopias jubatus,* in Alaska, 1956-86. Fishery Bulletin, U.S. 85:351-365.

Miller, G.W., V.D. Moulton, R.A. Davis, M. Holst, P. Millman, A. MacGillivray, and D. Hannay.2005. Monitoring seismic effects on marine mammals - southeastern Beaufort Sea, 2001-2002. *In*: Offshore oil and gas environmental effects monitoring: approaches and technologies. S.L. Armsworthy, P.J. Crandfor, and K. Lee (*eds*). Battelle Press, Columbus, Ohio.

Mizroch, S.A., L.M. Herman, J.M. Straley, D. Glockner-Ferrari, C. Jurasz, J. Darling, S. Cerchio, C. Gabriele, D. Salden, and O. von Ziegesar. 2004. Estimating the adult survival rate of central North Pacific humpback whales. Journal of Mammalogy 85(5):963-972.

Mobley, J.M., S. Spitz, R. Grotefendt, P. Forestell, A. Frankel, and G. Bauer. 2001. Abundance of humpback whales in Hawaiian waters: Results of 1993-2000 aerial surveys.

Mooney, T.A. P.E. Nachtigall, M. Castellote, K.A. Taylor, A.F. Pacini, and J.A Esteban. 2008. Hearing pathways and directional sensitivity of the beluga whale, *Delphinapterus leucas*. Journal of Experimental Biology and Ecology 362:108-116.

Moore, S.E., K.E.W. Shelden, L.K. Litzky, B.A. Mahoney, and D.J. Rugh. 2000. Beluga, *Delphinapterus leucas*, habitat associations in Cook Inlet, Alaska. Marine Fisheries Review 62(3).

Morrow, J.E. 1980. The freshwater fishes of Alaska. Animal Resources Ecology Library, University of British Columbia, British Columbia, Canada.

Morton, A.B. and H.K. Symonds. 2002. Displacement of *Orcinus orca* (L.) by high amplitude sound in British Columbia, Canada. International Council for the Exploration of the Sea, Journal of Marine Science 59:71-80.

Moulton, V.D. and J.W. Lawson. 2002. Seals, 2001. *In*: marine mammal monitoring of Western Geco's open-water seismic program in the Alaskan Beaufort Sea, 2001. W.J. Richardson and J.W. Lawson (*eds*). Report TA2564-4. LGL Limited, King City, Ontario, Canada.

Murray, N.K. and F.H. Fay. 1979. The white whales or belukhas, *Delphinapterus leucas*, of Cook Inlet, Alaska. Paper SC/31/SM12, IWC Annual Meeting.

Muslow, J. and C. Reichmuth. 2010. Psychophysical and electrophysiological aerial audiograms of a Steller sea lion (*Eumetopias jubatus*). Journal of the Acoustical Society of America 127:2692-2701.

Nachtigall, P.E., J.L. Pawloski, and W.W.L. Au. 2003. Temporary threshold shifts and recovery following noise exposure in the Atlantic bottlenose dolphin (*Tursiops truncatus*) measured using auditory evoked potentials. Marine Mammal Science. 20: 673-687.

National Marine Fisheries Service [NMFS]. 1991. Final recovery plan for the humpback whale *Megaptera novaeangliae*. U.S. DOC/NOAA/NMFS Silver Spring, Maryland.

NMFS. 2008a. Final conservation plan for the Cook Inlet beluga whale (*Delphinapterus leucas*). U.S. DOC/NOAA/NMFS, Juneau, Alaska.

NMFS. 2008b. Cook Inlet beluga whale subsistence harvest Final Supplemental Environmental Impact Statement. U.S. DOC/NOAA/NMFS, Juneau, Alaska.

NMFS. 2008c. Recovery plan for the Steller sea lion (*Eumetopias jubatus*). Revision. U.S. DOC/NOAA/NMFS, Silver Spring, Maryland.

NMFS. 2008d. Marine mammal viewing guidelines and regulations. U.S. DOC/NOAA/NMFS Juneau, Alaska. http://alaskafisheries.noaa.gov/protectedresources/mmv/guide.htm.

National Research Council [NRC]. 2005. Marine mammal population and ocean noise: Determining when noise causes biologically significant effects. The National Academies Press.

Neilson, J.L., C.M. Gabriele, A.S. Jensen, K. Jackson, and J.M. Straley. 2012. Summary of reported whale-vessel collisions in Alaskan waters. Journal of Marine Biology 2012:1-18.

Nieukirk, S.L., K.M. Stafford, D.K. Mellinger, R.P. Dziak, and C.G. Fox. 2004. Low frequency whale and seismic airgun sounds recorded in the mid-Atlantic ocean. Journal of the Acoustical Society of America 115:1832-1843.

Noad, M.J., and D.H. Cato. 2007. Swimming speeds of singing and non-singing humpback whales during migration. Marine Mammal Science. 23(3):481-495.

Nowak, R.M. 2003. Walker's marine mammals of the world. Johns Hopkins University Press, Baltimore, Maryland.

Ogura, M. and Ishida, Y. 2011. Homing behavior and vertical movements of four species of Pacific salmon (Oncorhynchus spp.) in the central Bering Sea. Canadian Journal of Fisheries and Aquatic Sciences. 52:532-540.

Parente, C.L., J.P. Araújo, and M.E. Araújo. 2007. Diversity of cetaceans as tool in monitoring environmental impacts of seismic surveys. Biota Neotropica 7(1): 49-55. http://www.biotaneotropica.org.br/v7n1/pt/abstract?article+bn01307012007.

Patenaude, N., W.J. Richardson, M.A. Smultea, W.R. Koski, G.W. Miller and B. Würsig. 2002. Aircraft sound and disturbance to bowhead and beluga whales during spring migration in the Alaskan Beaufort Sea. Marine Mammal Science 18: 309-335.

Payne, K. and R. Payne. 1985. Large scale changes over 19 years in songs of humpback whales in Bermuda. Z. Tierpsychol 68:89-114.

Perrin, W.F. 1999. Selected examples of small cetaceans at risk. *In* conservation and management of marine mammals. J.R. Twiss and R.R. Reeves (*eds*). Smithsonian, Washington, DC.

Piatt, J.F., G. Drew, T. VanPelt, A. Abookire, A. Nielsen, M. Shultz, and A. Kitaysky. 1999. Biological effects of the 1997/98 El Nino-Southern Oscillation in Cook Inlet, Alaska.

Pitcher, K.W., and D.G. Calkins. 1981. Reproductive biology of Steller sea lions in the Gulf of Alaska. Journal of Mammalogy 62:599-605

Port of Anchorage [POA]. 2003. Environmental baseline survey for the Port of Anchorage road and rail extension right of way.

POA, U.S. Department of Transportation Maritime Administration, and U.S. Army Corps of Engineers Alaska District. 2009. Biological assessment of the beluga whale *Delphinapterus leucas* in Cook Inlet for the Port of Anchorage expansion project and associated dredging at the Port of Anchorage, Alaska.

Raum-Suryan, K.L., K.W. Pitcher, D.G. Calkins, J.L. Sease, and T.R. Loughlin. 2002. Dispersal, rookery fidelity, and metapopulation structure of Steller sea lions (*Eumetopias jubatus*) in an increasing and a decreasing population in Alaska. Marine Mammal Science 18:746-764.

Reeves, R.R., B.S. Stewart, P.J. Clapham, and J.A. Powell. 2002. National Audubon Society guide to marine mammals of the world. A.A. Knopf, Random House, New York.

Reynolds, J. 2010. Presentation at NMFS workshop on Cook Inlet beluga whale research, October 11-12, 2010, Anchorage, Alaska. Mote Marine Laboratory, Sarasota, Florida.

Richardson, W.J., C.R. Greene, C.I. Malme, and D.H. Thomson. 1995. Marine mammals and noise. Academic Press, Inc., San Diego, California.

Richardson, W.J. and B. Würsig. 1997. Influences of man-made noise and other human actions on cetacean behavior. Marine and Freshwater Behavior and Physiology 29:183-209.

Ridgway, S. and Sir R. Harrison. 1981. Handbook of marine mammals. Volume 4. Academic Press. London.

Romano, T.A., M.J. Keogh, C. Kelly, P. Feng, L. Berk, C.E. Schlundt, D.A. Carder, and J.J. Finneran. 2004. Anthropogenic sound and marine mammal health: measures of the nervous and immune systems before and after intense sound exposure. Canadian Journal of Fisheries and Aquatic Sciences 61: 1124-1134.

Ruesch, P.H. and J. Fox. 1999. Upper Cook Inlet commercial fisheries annual management report, 1998. ADFG, Division of Commercial Fisheries Management Development. Regional Information Report 2A99-21, Anchorage, Alaska.

Rugh, D.J., B.A. Mahoney, and B.K. Smith. 2004. Aerial surveys of beluga whales in Cook Inlet, Alaska, between June 2001 and June 2002. U.S. DOC/NOAA/NMFS. Technical Memorandum NMFS-AFSC-145.

Rugh, D.J., K.E.W. Shelden, and R.C. Hobbs. 2010. Range contraction in a beluga whale population. Endangered Species Research 12:69-75.

Rugh, D.J., K.E.W. Shelden, and B.A. Mahoney. 2000. Distribution of belugas, *Delphinapterus leucas*, in Cook Inlet, Alaska during June/July 1993-2000. Marine Fisheries Review 62(3).

Rugh, D.J., K.E.W. Shelden, C.L. Sims, B.A. Mahoney, B.K. Smith, L.K. Litzky, and R.C. Hobbs. 2005. Aerial surveys of belugas in Cook Inlet, Alaska, June 2001, 2002, 2003, and 2004. U.S. DOC/NOAA/NMFS. Technical Memorandum NMFS-AFSC-149.

SAExploration, Inc. [SAE]. 2015. Revised biological assessment for SAExploration, Inc. Cook Inlet 3D seismic program Cook Inlet, Alaska.

Scheidat, M., C. Castro, J. Gonzales, and R. Williams. 2004. Behavioural responses of humpback whales (*Megaptera novaeangliae*) to whale watching boats near Isla de la Plata, Machalilla National Park, Ecuador. Journal of Cetacean Research and Management 6 (1):63-68.

Scheifele, P.M., S. Andrew, R.A. Cooper, M. Darre, F.E. Musiek, and L. Max. 2005. Indication of a Lombard vocal response in the St. Lawrence River beluga. Journal of Acoustic Society of America 117: 1486-1492.

Schlundt, C.E., J.J. Finneran, D.A. Carder, and S.H. Ridgway. 2000. Temporary threshold shifts in masked hearing thresholds (MTTS) of bottlenose dolphins and white whales after exposure to intense tones. Journal of the Acoustical Society of America 107:3496-3508.

Scientific Fishery Systems, Inc. [SFS]. 2009. 2008 underwater noise survey during pile driving, Port of Anchorage Marine Terminal Redevelopment Project.

Shallenberger, E.E. 1978. Activities possibly affecting the welfare of humpback whales. *In*: Report on a workshop on problems related to humpback whales (*Megaptera novaeangliae*) in Hawaii. K.S. Norris and R.R. Reeves (*eds*). Sea Life Park Inc., MMC-77/03.

Shelden, K.E.W., D.J. Rugh, K.T. Goetz, C.L .Sims, L. Vate Brattstrom, J.A. Mocklin, B.A. Mahoney, B.K. Smith, and R.C. Hobbs. 2013. Aerial surveys of beluga whales, Delphinapterus leucas, in Cook Inlet, Alaska, June 2005 to 2012. U.S. DOC/NOAA/ NMFS Technical Memorandum NMFS-AFSC-263.

Shelden, K.E.W., D.J. Rugh, B.A. Mahoney, and M.E. Dahlheim. 2003. Killer whale predation on beluga whale in Cook Inlet, Alaska: Implications for a depleted population. Marine Mammal Science: 19(3).

Shelden, K.E.W., C.L .Sims, L. Vate Brattstrom, K.T. Goetz, and R.C. Hobbs. 2015. Aerial surveys of beluga whales (*Delphinapterus leucas*) in Cook Inlet, Alaska, June 2014. U.S. DOC/NOAA/NMFS AFSC Processed Report 2015-03.

Shields, P. 2010. Upper Cook Inlet Commercial Fisheries Annual Management Report, 2010. ADFG Fishery Management Report No. 10-54. Anchorage, Alaska.

Shields, P., and A. Dupuis. 2013. Upper Cook Inlet commercial fisheries annual management report, 2013. ADFG Fishery Management Report No. 13-49. Anchorage, Alaska.

Silber, G.K. 1986. The relationship of social vocalizations to surface behavior and aggression in the Hawaiian humpback whale (*Megaptera novaeangliae*). Canadian Journal of Zoology 64(10):2075-2080.

Širović, A. and L.S. Kendall. 2009. Passive acoustic monitoring of beluga whales. Analysis Report. Alaska Pacific University, Anchorage, Alaska.

Smultea, M.A., J.R. Mobley, D. Fertl, and G.L. Fulling. 2007. An unusual reaction and other observation of sperm whales near fixed-wing aircraft. Gulf and Caribbean Research 20:75-80.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquatic Mammals 33(4).

Speckman, S.G. and J.F. Piatt. 2000. Historic and current use of lower Cook Inlet, Alaska, by belugas, *Delphinapterus leucas*. Marine Fisheries Review 63(3):22-26.

St. Aubin, D.J. 1990. Physiological and toxic effects on pinnipeds. *In:* Sea mammals and oil: confronting the risks. J.R. Geraci and D.J. St. Aubin (*eds*). Academic Press, Inc. San Diego, California.

Stanley, R.G., B.S. Pierce, and D.W. Houseknecht. 2011. U.S. Geological Survey 2011 assessment of undiscovered oil and gas resources of the Cook Inlet region, south-central Alaska: U.S. Geological Survey Open-File Report 2011-1237. http://pubs.usgs.gov/of/2011/1237/.

Stone, C.J. 2003. The effects of seismic activity on marine mammals in the UK waters 1998-2000. Joint Nature Conservation Committee Report 323, Joint Nature Conservancy. Aberdeen, Scotland.

Stone, C.J. and M.L. Tasker. 2006. The effects of seismic airguns on cetaceans in UK waters. Journal of Cetacean Research and Management 8:255-263.

Tyack, P. and H. Whitehead. 1983. Male competition in large groups of wintering humpback whales. Behavior 83:132-154.

Thomas, J.A., R.A. Kastelein, and F.T. Awbrey. 1990. Behavior and blood catecholamines of captive beluga whales during playbacks of noise from an oil drilling platform. Zoo Biology 9:393-402.

Thompson, P.O., W.C. Cummings, and S.J. Ha. 1986. Sounds, source levels, and associated behavior of humpback whales, Southeast Alaska. Journal of Acoustic Society of America 80:735-740.

URS Corporation [URS]. 2007. Port of Anchorage Marine Terminal Development Project underwater noise survey test pile driving program, Anchorage, Alaska.

U.S. Army. 2010. Biological Assessment of the Cook Inlet beluga whale (*Delphinapterus leucas*) for the resumption of year-round firing in Eagle River flats impact area, Fort Richardson, Alaska.

U.S. Army Corps of Engineers [USACE]. 2005. Draft chemical data report - Anchorage Harbor Rapid Optical Screening Technique (ROST) study. Alaska District, Corps of Engineers, Anchorage, Alaska.

USACE. 2008. Environmental assessment and finding of no significant impact: Anchorage Harbor dredging and disposal, Anchorage, Alaska.

U.S. Fish and Wildlife Service and National Marine Fisheries Service [USFWS and NMFS]. 1998. Endangered species consultation handbook: procedures for conducting consultations and conference activities under section 7 of the Endangered Species Act.

Vate-Brattstrom, L., C. Sims, R. Hobbs, and B. Mahoney. 2010. The Cook Inlet beluga whale opportunistic database: A summary of opportunistic sightings during the past 35 years. Poster: Alaska Marine Science Symposium, Anchorage, Alaska.

Viessman, W., Jr. and M.J. Hammer. 1998. Systems for treating wastewater and water. 6th edition. In: water supply and pollution control. Addison Wesley Longman, Inc. Menlo Park, California.

Vos, D.J. and K.E.W. Shelden. 2005. Unusual mortality in the depleted Cook Inlet beluga population. Northwestern Naturalist 86(2):59-65.

Vu, E.T., D. Risch, C.W. Clark, S. Gaylord, and L.T. Hatch. 2012. Humpback whale song occurs extensively on feeding grounds in the western North Atlantic Ocean. Aquatic Biology 14:175-183

Wartzok, D., A.N. Popper, J. Gordon, and J. Merrill. 2004. Factors affecting the responses of marine mammals to acoustic disturbance. Marine Technology Society Journal 37:6-15.

Weilgart, L.S. 2007. A brief review of known effects of noise on marine mammals. International Journal of Comparative Psychology 20:159-168.

Winn, H.E., P.J. Perkins, and T.C. Poulter. 1970. Sound of the humpback whale. In Proceedings of the Seventh Annual Conference on Biological Sonar and Diving Mammals. Stanford Research Institute, Menlo Park, California.

Winship, A.J., A.W. Trites, and D.G. Calkins. 2001. Growth in body size of the Steller sea lion. Journal of Mammalogy 82:500-519.

Withrow, D.E., G.C. Bouchet, and L.L. Jones. 1985. Response of Dall's porpoise (*Phocoenoides dalli*) to survey vessels in both offshore and nearshore waters: results of 1984 research. International North Pacific Fisheries Commission. U.S. DOC/NOAA/AFSC.

Wright, A.J., N. Aguilar Soto, A.L. Baldwin, M. Bateson, C.M. Beale, and C. Clark. 2007. Anthropogenic noise and physiological stress: behavior, context and animal welfare. International Journal of Comparative Psychology 20(2):274-316.

Yoder, J.A. 2002. Declaration of James A. Yoder in opposition to plaintiff's motion for temporary restraining order, 28 October, 2002. Civ. No. 02-05065-JL. U.S. District Court, Northern District of California, San Francisco Division.

Yost, W.A. 2000. Fundamentals of hearing: an introduction. 4th edition. Academic Press, New York, New York.

Zerbini, A.N., J.M. Waite, J.L. Laake, and P.R. Wade. 2006. Abundance, trends and distribution of baleen whales off western Alaska and the central Aleutian Islands. Deep Sea Research Part I:1772-1790.