3510-22-P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648-XD870

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Shallow Geohazard Survey in the Beaufort Sea, Alaska

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; proposed incidental harassment authorization; request for comments.

SUMMARY: NMFS received an application from Hilcorp Alaska, LLC. (Hilcorp) for an Incidental Harassment Authorization (IHA) to take marine mammals, by harassment, incidental to shallow geohazard survey in the Beaufort Sea, Alaska. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an IHA to Hilcorp to take, by Level B harassment only, 6 species of marine mammals during the specified activity.

DATES: Comments and information must be received no later than [*insert date 30 days after date of publication in the FEDERAL REGISTER*].

ADDRESSES: Comments on the application should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910. The mailbox address for providing

email comments is ITP.Guan@noaa.gov. NMFS is not responsible for e-mail comments sent to addresses other than the one provided here. Comments sent via e-mail, including all attachments, must not exceed a 10-megabyte file size.

Instructions: All comments received are a part of the public record and will generally be posted to *http://www.nmfs.noaa.gov/pr/permits/incidental.htm* without change. All Personal Identifying Information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

A copy of the application, which contains several attachments, including Hilcorp's marine mammal mitigation and monitoring plan (4MP), used in this document may be obtained by writing to the address specified above, telephoning the contact listed below (see **FOR FURTHER INFORMATION CONTACT**), or visiting the internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm*. Documents cited in this notice may also be viewed, by appointment, during regular business hours, at the aforementioned address.

FOR FURTHER INFORMATION CONTACT: Shane Guan, Office of Protected Resources, NMFS, (301) 427-8401.

SUPPLEMENTARY INFORMATION:

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq*.) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations

are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

An authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. NMFS has defined "negligible impact" in 50 CFR 216.103 as "an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival."

Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) 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 [Level B harassment].

Summary of Request

On December 1, 2014, NMFS received an application from Hilcorp for the taking of marine mammals incidental to shallow geohazard surveys in the Beaufort Sea. After receiving NMFS comments, Hilcorp submitted a revised IHA application on January 5, 2015. In addition, Hilcorp submitted a 4MP on January 21, 2015. NMFS determined that the application was adequate and complete on February 9, 2015.

The proposed activity would occur between July 1 and September 30, 2015. The actual survey is expected to be complete in 45 days, including weather and equipment downtime. Underwater noises generated from the sonar used for the survey are likely to result Level B harassment of individuals of 6 species of marine mammals.

Description of the Specified Activity

Overview

Hilcorp plans to conduct a shallow geohazard survey and Strudel Scour survey with a transition zone component on state lands, and in federal and state waters of Foggy Island Bay in the Beaufort Sea during the open water season of 2015. The scope of this request is limited to the activities that will be conducted during the 2015 open water evaluation of the proposed Liberty field development.

Dates and Duration

Hilcorp seeks incidental harassment authorization for the period July 1 to September 30, 2015. The survey is expected to take approximately 45 days to complete, including weather and equipment downtime. About 25% of downtime is included in this total, so the actual number of days that equipment are expected to be operating is estimated at 34, based on a continuous 24-hr operation.

Specified Geographic Region

The project area of the proposed Liberty shallow geohazard survey lies within Foggy Island Bay as shown in Figure 1 of Hilcorp's IHA application. The project area is 2.5 mi^2 in water depths ranging from 3 to 20 ft.

Detailed Description of Activities

(1) Survey Designs

The proposed sonar survey vessel (M/V *Sidewinder* or equivalent) is about 40 x 14 feet in size. The sub-bottom profilers and magnetometer will be deployed from the vessel. The echosounder and side scan sonar will be hull-mounted. No equipment will be placed on the sea floor as part of survey activities. Because of the extremely shallow project area, additional small vessel(s) may be utilized to safely extend vessel operations for data collection.

The total planned survey lines are approximately 300 miles, not including turns and cross-lines. Data will be acquired along the subsea pipeline corridor area using the single-beam or multibeam echosounder, side scan sonar, sub-bottom profilers, and the magnetometer. Because of the shallow nature of the project area and small size of the vessel, systems will be towed in optimal groupings that best facilitate safe operations and data quality. As necessary, a small vessel may be used to extend data collection into shallow waters. Planned survey lines will be designed to acquire 150% side scan sonar data coverage or as mandated, with line spacing dependent upon water depth. A 300 m corridor around the centerline of the proposed pipeline area will be covered.

(2) Acoustic Sources

Multibeam echo sounder and side scan sonar

A single-beam or multibeam echosounder and side scan sonar will be used to obtain high accuracy information regarding bathymetry of the seafloor. For accurate object detection, a side scan sonar survey is required to complement a multibeam echosounder survey.

The proposed multibeam echosounder operates at an rms source level of a maximum of 220 dB re 1 µPa @1m. The multibeam echosounder emits high frequency (240 kHz) energy in a

fan-shaped pattern of equidistant or equiangular beam spacing (Table 1). The beam width of the emitted sound energy in the along-track direction is 1.5 degrees, while the across track beam width is 1.8 degrees. The maximum ping rate of the multibeam echosounder is 40 Hz.

The proposed single-beam echosounder operates at an rms source level of approximately 220 dB re 1 µPa @1m (Table 1). The transducer selected uses a frequency of 210 kHz and has a ping rate of up to 20 Hz. The transducer's beam width is approximately 3 degrees.

The proposed side scan sonar system will operate at about 400 kHz and 900 kHz. The rms source level is 215 dB re 1µPa @1m. The sound energy is emitted in a narrow fan-shaped pattern, with a horizontal beam width of 0.45 degrees for 400 kHz and 0.25 degrees at 900 kHz, with a vertical beam width of 50 degrees (Table 1). The maximum ping rate is 75 Hz.

Sub-bottom profiler

The proposed high-resolution sub-bottom profiler operates at an rms source level of 210db re 1 µPa @1m. The proposed system emits energy in the frequency bands of 2 to 24 kHz. The beam width is 15 to 24 degrees (Table 1). Typical pulse rate is between 3 and 10 Hz.

The proposed low-resolution sub-bottom profiler operates at an rms source level of 212db re 1 µPa @1m. This secondary sub-bottom profiler will be utilized as necessary to increase sub-bottom profile penetration. The proposed system emits energy in the frequency bands of 1 to 4 kHz.

Table 1. Source characteristics of the proposed geophysical survey equipment to be used during the Liberty geohazard survey.

Equipment	Sample Equipment Model Type	Operating Frequency	Along track beam width	Across track beam width	Source Level (dB re 1 µPa @ 1m, rms)

Multibeam echosounder	Reson 7101 SV	240 kHz	1.5°	1.8°	220
Single-beam echosounder	Odom	210 kHz	3°	3°	220
Side scan sonar	Edgetech 4125	400 kHz/900 kHz	0.5°	50°	215
High resolution (CHIRP) sub-bottom profiler	Edgetech 3200	2 to 24 kHz	15° to 24°	15° to 24°	210
Low resolution sub-bottom profiler	Applied Acoustics AA251	1 to 4 kHz	n/a	n/a	212
Alternative multibeam echosounder	Norbit IWBMS	400 kHz	1.9^{o}	0.9^{o}	218

Description of Marine Mammals in the Area of the Specified Activity

The Beaufort Sea supports a diverse assemblage of marine mammals. Table 2 lists the 12 marine mammal species under NMFS jurisdiction with confirmed or possible occurrence in the proposed project area.

Table 2. Marine mammal species with confirmed or possible occurrence in the proposed shallow geohazard survey area.

Common Name	Scientific Name	Occurrence	Seasonality	Range	Abundance
Odontocetes Beluga whale (Beaufort Sea stock)	*Delphinapterus leucas*	Common	Mostly spring and fall with some in summer	Mostly Beaufort Sea	39,258
Beluga whale (eastern Chukchi Sea stock)		Common	Mostly spring and fall with some in summer	Mostly Chukchi Sea	3,710
Killer whale	*Orcinus orca*	Extralimital	Mostly summer and early fall	California to Alaska	552
Harbor porpoise	*Phocoena phocoena*	Extralimital	Mostly summer and early fall	California to Alaska	48,215
Narwhal	*Monodon monoceros*	Extralimital	Year round	Arctic Ocean	45,358
Mysticetes Bowhead whale*	*Balaena mysticetus*	Common	Mostly spring and fall with some in summer	Russia to Canada	19,534
Gray whale	*Eschrichtius robustus*	Somewhat common	Mostly summer	Mexico to the U.S. Arctic Ocean	19,126
Minke whale	*Balaenoptera acutorostrata*	Extralimital	Mostly summer	North Pacific Ocean	810-1,003
Humpback whale (Central North Pacific stock)*	*Megaptera novaeangliae*	Extralimital	Mostly summer	North Pacific Ocean	21,063
Pinnipeds Bearded seal (Beringia distinct population segment)	*Erigathus barbatus*	Common	Spring and summer	Bering, Chukchi, and Beaufort Seas	155,000
Ringed seal (Arctic stock)*	*Phoca hispida*	Common	Year round	Arctic Ocean	300,000
Spotted seal	*Phoca largha*	Common	Summer	Japan to U.S. Arctic Ocean	141,479
Ribbon seal	*Histriophoca fasciata*	Occasional	Summer	Arctic Ocean	49,000

*Endangered, threatened, or species of concern under the Endangered Species Act (ESA); Depleted under the MMPA

The highlighted (grayed out) species in Table 2 are so rarely sighted in the proposed project area that take is unlikely. Minke whales are relatively common in the Bering and southern Chukchi Seas and have recently also been sighted in the northeastern Chukchi Sea (Aerts *et al.*, 2013; Clarke *et al.*, 2013). Minke whales are rare in the Beaufort Sea. They have not been reported in the Beaufort Sea during the Bowhead Whale Aerial Survey Project/Aerial Surveys of Arctic Marine Mammals (BWASP/ASAMM) surveys (Clarke *et al.*, 2011, 2012; 2013; Monnet and Treacy, 2005), and there was only one observation in 2007 during vessel-based surveys in the region (Funk *et al.*, 2010). Humpback whales have not generally been found in the Arctic Ocean. However, subsistence hunters have spotted humpback whales in low numbers around Barrow, and there have been several confirmed sightings of humpback whales in the northeastern Chukchi Sea in recent years (Aerts *et al.*, 2013; Clarke *et al.*, 2013). The first confirmed sighting of a humpback whale in the Beaufort Sea was recorded in August 2007 (Hashagen *et al.*, 2009), when a cow and calf were observed 54 mi east of Point Barrow. No additional sightings have been documented in the Beaufort Sea. Narwhal are common in the waters of northern Canada, west Greenland, and in the European Arctic, but rarely occur in the Beaufort Sea (COSEWIC, 2004). Only a handful of sightings have occurred in Alaskan waters (Allen and Angliss, 2013). These three species are not considered further in this proposed IHA notice. Both the walrus and the polar bear could occur in the U.S. Beaufort Sea; however, these species are managed by the U.S. Fish and Wildlife Service (USFWS) and are not considered further in this Notice of Proposed IHA.

The Beaufort Sea is a main corridor of the bowhead whale migration route. The main migration periods occur in spring from April to June and in fall from late August/early

September through October to early November. During the fall migration, several locations in the U.S. Beaufort Sea serve as feeding grounds for bowhead whales. Small numbers of bowhead whales that remain in the U.S. Arctic Ocean during summer also feed in these areas. The U.S. Beaufort Sea is not a main feeding or calving area for any other cetacean species. Ringed seals breed and pup in the Beaufort Sea; however, this does not occur during the summer or early fall. Further information on the biology and local distribution of these species can be found in Hilcorp's application (see **ADDRESSES**) and the NMFS Marine Mammal Stock Assessment Reports, which are available online at: *http://www.nmfs.noaa.gov/pr/species/*.

Potential Effects of the Specified Activity on Marine Mammals

This section includes a summary and discussion of the ways that the types of stressors associated with the specified activity (e.g., sonar sources and vessel movement) have been observed to or are thought to impact marine mammals. This section may include a discussion of known effects that do not rise to the level of an MMPA take (for example, with acoustics, we may include a discussion of studies that showed animals not reacting at all to sound or exhibiting barely measurable avoidance). The discussion may also include reactions that we consider to rise to the level of a take and those that we do not consider to rise to the level of a take. This section is intended as a background of potential effects and does not consider either the specific manner in which this activity will be carried out or the mitigation that will be implemented or how either of those will shape the anticipated impacts from this specific activity. The "**Estimated Take by Incidental Harassment**" section later in this document will include a quantitative analysis of the number of individuals that are expected to be taken by this activity. The "**Negligible Impact Analysis**" section will include the analysis of how this specific activity will impact marine

mammals and will consider the content of this section, the "**Estimated Take by Incidental Harassment**" section, the "**Proposed Mitigation**" section, and the "**Anticipated Effects on Marine Mammal Habitat**" section to draw conclusions regarding the likely impacts of this activity on the reproductive success or survivorship of individuals and from that on the affected marine mammal populations or stocks.

Background on Sound

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water, and is generally characterized by several variables. Frequency describes the sound's pitch and is measured in hertz (Hz) or kilohertz (kHz), while sound level describes the sound's intensity and is measured in decibels (dB). Sound level increases or decreases exponentially with each dB of change. The logarithmic nature of the scale means that each 10-dB increase is a 10-fold increase in acoustic power (and a 20-dB increase is then a 100-fold increase in power). A 10-fold increase in acoustic power does not mean that the sound is perceived as being 10 times louder, however. Sound levels are compared to a reference sound pressure (micro-Pascal) to identify the medium. For air and water, these reference pressures are "re: 20 μPa" and "re: 1 μPa," respectively. Root mean square (RMS) is the quadratic mean sound pressure over the duration of an impulse. RMS is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick, 1975). RMS accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels. This measurement is often used in the context of discussing behavioral effects, in part, because behavioral effects, which often result from auditory cues, may be better expressed through

averaged units rather than by peak pressures.

Acoustic Impacts

When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Based on available behavioral data, audiograms have been derived using auditory evoked potentials, anatomical modeling, and other data, Southall *et al.* (2007) designate "functional hearing groups" for marine mammals and estimate the lower and upper frequencies of functional hearing of the groups. The functional groups and the associated frequencies are indicated below (though animals are less sensitive to sounds at the outer edge of their functional range and most sensitive to sounds of frequencies within a smaller range somewhere in the middle of their functional hearing range):

• Low frequency cetaceans (13 species of mysticetes): functional hearing is estimated to occur between approximately 7 Hz and 30 kHz;

• Mid-frequency cetaceans (32 species of dolphins, six species of larger toothed whales, and 19 species of beaked and bottlenose whales): functional hearing is estimated to occur between approximately 150 Hz and 160 kHz;

• High frequency cetaceans (eight species of true porpoises, six species of river dolphins, Kogia, the franciscana, and four species of cephalorhynchids): functional hearing is estimated to occur between approximately 200 Hz and 180 kHz;

• Phocid pinnipeds in Water: functional hearing is estimated to occur between approximately 75 Hz and 100 kHz; and

• Otariid pinnipeds in Water: functional hearing is estimated to occur between

approximately 100 Hz and 40 kHz.

As mentioned previously in this document, six marine mammal species (three cetaceans and three phocid pinnipeds) may occur in the proposed shallow hazard survey area. Of the three cetacean species likely to occur in the proposed project area and for which take is requested, two are classified as low-frequency cetaceans (i.e., bowhead and gray whales), the beluga whale is classified as mid-frequency cetacean (Southall *et al.*, 2007). A species functional hearing group is a consideration when we analyze the effects of exposure to sound on marine mammals.

Although the analysis of impacts of underwater sound on marine mammals described below heavily based on studies from seismic airgun noises, Hilcorp's proposed shallow geohazard survey does not plan to use airguns. Therefore, the potential impacts to marine mammals are expected to be much lower. The reason that the analysis includes airgun impact research is because there are few studies on impacts of marine mammals from marine surveys conducted by sonar equipment.

1. Tolerance

Numerous studies have shown that underwater sounds from industry activities are often readily detectable by marine mammals in the water at distances of many kilometers. Numerous studies have also shown that marine mammals at distances more than a few kilometers away often show no apparent response to industry activities of various types (Miller *et al.*, 2005; Bain and Williams, 2006). This is often true even in cases when the sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to underwater sound such as airgun pulses or vessels under some

conditions, at other times mammals of all three types have shown no overt reactions (e.g., Malme *et al.*, 1986; Richardson *et al.*, 1995). Weir (2008) observed marine mammal responses to seismic pulses from a 24 airgun array firing a total volume of either 5,085 in^3 or 3,147 in^3 in Angolan waters between August 2004 and May 2005. Weir recorded a total of 207 sightings of humpback whales (n = 66), sperm whales (n = 124), and Atlantic spotted dolphins (n = 17) and reported that there were no significant differences in encounter rates (sightings/hr) for humpback and sperm whales according to the airgun array's operational status (i.e., active versus silent). However, the current geohazard survey will not use airguns. In general, pinnipeds and small odontocetes seem to be more tolerant of exposure to some types of underwater sound than are baleen whales. Richardson *et al.* (1995) found that vessel noise does not seem to strongly affect pinnipeds that are already in the water. Richardson *et al.* (1995) went on to explain that seals on haul-outs sometimes respond strongly to the presence of vessels and at other times appear to show considerable tolerance of vessels.

2. Masking

Masking is the obscuring of sounds of interest by other sounds, often at similar frequencies. Marine mammals use acoustic signals for a variety of purposes, which differ among species, but include communication between individuals, navigation, foraging, reproduction, avoiding predators, and learning about their environment (Erbe and Farmer, 2000). Masking, or auditory interference, generally occurs when sounds in the environment are louder than, and of a similar frequency as, auditory signals an animal is trying to receive. Masking is a phenomenon that affects animals that are trying to receive acoustic information about their environment, including sounds from other members of their species, predators, prey, and sounds that allow

them to orient in their environment. Masking these acoustic signals can disturb the behavior of individual animals, groups of animals, or entire populations.

Masking occurs when anthropogenic sounds and signals (that the animal utilizes) overlap at both spectral and temporal scales. For the sonar sound generated from the proposed shallow geohazard survey, sound will consist of broadband (2 - 24 kHz) pulses with extremely short durations (less than one second). There is little concern regarding masking near the sound source due to the brief duration of these pulses and relatively longer silence between the pulses. However, at long distances (over tens of kilometers away), due to multipath propagation and reverberation, the durations of airgun pulses can be "stretched" to seconds with long decays (Madsen *et al.*, 2006), although the intensity of the sound is greatly reduced.

3. Behavioral Disturbance

Marine mammals may behaviorally react when exposed to anthropogenic sound. These behavioral reactions are often shown as: changing durations of surfacing and dives, number of blows per surfacing, or moving direction and/or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where sound sources are located; and/or flight responses (e.g., pinnipeds flushing into water from haulouts or rookeries).

The biological significance of many of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. However, the consequences of behavioral modification have the potential to be biologically significant if the change affects growth, survival, or reproduction. Examples of significant behavioral modifications include:

- Drastic change in diving/surfacing patterns (such as those thought to be causing beaked whale stranding due to exposure to military mid-frequency tactical sonar);
- Habitat abandonment due to loss of desirable acoustic environment; and
- Cessation of feeding or social interaction.

The onset of behavioral disturbance from anthropogenic noise depends on both external factors (characteristics of noise sources and their paths) and the receiving animals (hearing, motivation, experience, demography, current activity, reproductive state) and is also difficult to predict (Gordon *et al.*, 2004; Southall *et al.*, 2007; Ellison *et al.*, 2011).

Mysticetes: Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much greater distances (Miller *et al.*, 2005). However, baleen whales exposed to strong noise pulses often react by deviating from their normal migration route (Richardson *et al.*, 1999). Migrating gray and bowhead whales were observed avoiding the sound source by displacing their migration route to varying degrees but within the natural boundaries of the migration corridors (Schick and Urban, 2000; Richardson *et al.*, 1999). Baleen whale responses to pulsed sound however may depend on the type of activity in which the whales are engaged. Some evidence suggests that feeding bowhead whales may be more tolerant of underwater sound than migrating bowheads (Miller *et al.*, 2005; Lyons *et al.*, 2009; Christie *et al.*, 2010).

Results of studies of gray, bowhead, and humpback whales have determined that received levels of pulses in the 160–170 dB re 1 µPa rms range seem to cause obvious avoidance behavior

in a substantial fraction of the animals exposed. In many areas, seismic pulses from large arrays of airguns diminish to those levels at distances ranging from 2.8-9 mi (4.5-14.5 km) from the source. Baleen whales within those distances may show avoidance or other strong disturbance reactions to the airgun array. Subtle behavioral changes sometimes become evident at somewhat lower received levels, and recent studies have shown that some species of baleen whales, notably bowhead and humpback whales, at times show strong avoidance at received levels lower than 160–170 dB re 1 µPa rms. Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with avoidance occurring out to distances of 12.4-18.6 mi (20-30 km) from a medium-sized airgun source (Miller *et al.*, 1999; Richardson *et al.*, 1999). However, more recent research on bowhead whales (Miller *et al.*, 2005) corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources. In summer, bowheads typically begin to show avoidance reactions at a received level of about 160–170 dB re 1 µPa rms (Richardson *et al.*, 1986; Ljungblad *et al.*, 1988; Miller *et al.*, 2005).

Malme *et al.* (1986) studied the responses of feeding eastern gray whales to pulses from a single 100 in^3 airgun off St. Lawrence Island in the northern Bering Sea. They estimated, based on small sample sizes, that 50% of feeding gray whales ceased feeding at an average received pressure level of 173 dB re 1 µPa on an (approximate) rms basis, and that 10% of feeding whales interrupted feeding at received levels of 163 dB. Those findings were generally consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast and on observations of the distribution of feeding Western Pacific gray whales off Sakhalin Island, Russia, during a seismic survey (Yazvenko *et al.*, 2007).

Data on short-term reactions (or lack of reactions) of cetaceans to impulsive noises do not necessarily provide information about long-term effects. While it is not certain whether impulsive noises affect reproductive rate or distribution and habitat use in subsequent days or years, certain species have continued to use areas ensonified by airguns and have continued to increase in number despite successive years of anthropogenic activity in the area. Gray whales continued to migrate annually along the west coast of North America despite intermittent seismic exploration and much ship traffic in that area for decades (Appendix A in Malme *et al.*, 1984). Bowhead whales continued to travel to the eastern Beaufort Sea each summer despite seismic exploration in their summer and autumn range for many years (Richardson *et al.*, 1987). Populations of both gray whales and bowhead whales grew substantially during this time. In any event, the proposed survey will occur in summer (July through late August) when most bowhead whales are commonly feeding in the Mackenzie River Delta, Canada.

Odontocetes: Few systematic data are available describing reactions of toothed whales to noise pulses. However, systematic work on sperm whales is underway, and there is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (e.g., Stone, 2003). Miller *et al.* (2009) conducted at-sea experiments where reactions of sperm whales were monitored through the use of controlled sound exposure experiments from large airgun arrays consisting of 20-guns and 31-guns. Of 8 sperm whales observed, none changed their behavior when exposed to either a ramp-up at 4-8 mi (7-13 km) or full array exposures at 0.6-8 mi (1-13 km).

Seismic operators and marine mammal observers sometimes see dolphins and other small toothed whales near operating airgun arrays, but, in general, there seems to be a tendency for

most delphinids to show some limited avoidance of seismic vessels operating large airgun systems. However, some dolphins seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large arrays of airguns are firing. Nonetheless, there have been indications that small toothed whales sometimes move away or maintain a somewhat greater distance from the vessel when a large array of airguns is operating than when it is silent (e.g., 1998; Stone, 2003). The beluga may be a species that (at least in certain geographic areas) shows long-distance avoidance of seismic vessels. Aerial surveys during seismic operations in the southeastern Beaufort Sea recorded much lower sighting rates of beluga whales within 10–20 km (6.2-12.4 mi) of an active seismic vessel. These results were consistent with the low number of beluga sightings reported by observers aboard the seismic vessel, suggesting that some belugas might have been avoiding the seismic operations at distances of 10–20 km (6.2-12.4 mi) (Miller *et al.*, 2005).

Captive bottlenose dolphins and (of more relevance in this project) 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.*, 2002, 2005). However, the animals tolerated high received levels of sound (pk–pk level >200 dB re 1 μPa) before exhibiting aversive behaviors.

Observers stationed on seismic vessels operating off the United Kingdom from 1997 - 2000 have provided data on the occurrence and behavior of various toothed whales exposed to seismic pulses (Stone, 2003; Gordon *et al.*, 2004). Killer whales 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 approximately 0.5 km (0.3 mi) or more. Killer whales also appear to be more tolerant of seismic shooting in deeper water.

Reactions of toothed whales to large arrays of airguns are variable and, at least for delphinids, seem to be confined to a smaller radius than has been observed for mysticetes. However, based on the limited existing evidence, belugas should not be grouped with delphinids in the "less responsive" category.

Pinnipeds: Pinnipeds are not likely to show a strong avoidance reaction to the airgun sources proposed for use. Visual monitoring from seismic vessels has shown only slight (if any) avoidance of airguns by pinnipeds and only slight (if any) changes in behavior. Monitoring work in the Alaskan Beaufort Sea during 1996–2001 provided considerable information regarding the behavior of Arctic ice seals exposed to seismic pulses (Harris *et al.*, 2001; Moulton and Lawson, 2002). These seismic projects usually involved arrays of 6 to 16 airguns with total volumes of 560 to 1,500 in^3. 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 a few hundreds of meters, and many seals remained within 100–200 m (328–656 ft) of the trackline as the operating airgun array passed by. Seal sighting rates at the water surface were lower during airgun array operations than during no-airgun periods in each survey year except 1997. Similarly, seals are often very tolerant of pulsed sounds from seal-scaring devices (Richardson *et al.*, 1995). However, initial telemetry work suggests that avoidance and other behavioral reactions by two other species of seals to small airgun sources may at times be stronger than evident to date from visual studies of pinniped reactions to airguns (Thompson *et al.*, 1998). Even if reactions of the species occurring in the present study area are as strong as

those evident in the telemetry study, reactions are expected to be confined to relatively small distances and durations, with no long-term effects on pinniped individuals or populations.

4. Threshold Shift (Noise-induced Loss of Hearing)

When animals exhibit reduced hearing sensitivity (i.e., sounds must be louder for an animal to detect them) following exposure to an intense sound or sound for long duration, it is referred to as a noise-induced threshold shift (TS). An animal can experience temporary threshold shift (TTS) or permanent threshold shift (PTS). TTS can last from minutes or hours to days (i.e., there is complete recovery), can occur in specific frequency ranges (i.e., an animal might only have a temporary loss of hearing sensitivity between the frequencies of 1 and 10 kHz), and can be of varying amounts (for example, an animal's hearing sensitivity might be reduced initially by only 6 dB or reduced by 30 dB). PTS is permanent, but some recovery is possible. PTS can also occur in a specific frequency range and amount as mentioned above for TTS.

The following physiological mechanisms are thought to play a role in inducing auditory TS: effects to sensory hair cells in the inner ear that reduce their sensitivity, modification of the chemical environment within the sensory cells, residual muscular activity in the middle ear, displacement of certain inner ear membranes, increased blood flow, and post-stimulatory reduction in both efferent and sensory neural output (Southall *et al.*, 2007). The amplitude, duration, frequency, temporal pattern, and energy distribution of sound exposure all can affect the amount of associated TS and the frequency range in which it occurs. As amplitude and duration of sound exposure increase, so, generally, does the amount of TS, along with the recovery time. For intermittent sounds, less TS could occur than compared to a continuous

exposure with the same energy (some recovery could occur between intermittent exposures depending on the duty cycle between sounds) (Ward, 1997). For example, one short but loud (higher SPL) sound exposure may induce the same impairment as one longer but softer sound, which in turn may cause more impairment than a series of several intermittent softer sounds with the same total energy (Ward, 1997). Additionally, though TTS is temporary, prolonged exposure to sounds strong enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals.

PTS is considered auditory injury (Southall *et al.*, 2007). Irreparable damage to the inner or outer cochlear hair cells may cause PTS; however, other mechanisms are also involved, such as exceeding the elastic limits of certain tissues and membranes in the middle and inner ears and resultant changes in the chemical composition of the inner ear fluids (Southall *et al.*, 2007).

Although the published body of scientific literature contains numerous theoretical studies and discussion papers on hearing impairments that can occur with exposure to a loud sound, only a few studies provide empirical information on the levels at which noise-induced loss in hearing sensitivity occurs in nonhuman animals. For marine mammals, published data are limited to the captive bottlenose dolphin, beluga, harbor porpoise, and Yangtze finless porpoise (Finneran *et al.*, 2000, 2002, 2003, 2005, 2007; Finneran and Schlundt, 2010; Lucke *et al.*, 2009; Mooney *et al.*, 2009; Popov *et al.*, 2011a, 2011b; Kastelein *et al.*, 2012a; Schlundt *et al.*, 2006; Nachtigall *et al.*, 2003, 2004). For pinnipeds in water, data are limited to measurements of TTS in harbor seals, an elephant seal, and California sea lions (Kastak *et al.*, 2005; Kastelein *et al.*, 2012b).

Marine mammal hearing plays a critical role in communication with conspecifics, and interpretation of environmental cues for purposes such as predator avoidance and prey capture.

Depending on the degree (elevation of threshold in dB), duration (i.e., recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious (similar to those discussed in auditory masking, below). For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that occurs during a time where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during time when communication is critical for successful mother/calf interactions could have more serious impacts. Also, depending on the degree and frequency range, the effects of PTS on an animal could range in severity, although it is considered generally more serious because it is a permanent condition. Of note, reduced hearing sensitivity as a simple function of aging has been observed in marine mammals, as well as humans and other taxa (Southall *et al.*, 2007), so we can infer that strategies exist for coping with this condition to some degree, though likely not without cost.

5. Non-auditory Physical Effects

Non-auditory physical effects might occur in marine mammals exposed to strong underwater sound. Possible types of non-auditory physiological effects or injuries that theoretically might occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. Some marine mammal species (i.e., beaked whales) may be especially susceptible to injury and/or stranding when exposed to strong pulsed sounds.

Classic stress responses begin when an animal's central nervous system perceives a potential threat to its homeostasis. That perception triggers stress responses regardless of

whether a stimulus actually threatens the animal; the mere perception of a threat is sufficient to trigger a stress response (Moberg, 2000; Sapolsky *et al.*, 2005; Seyle, 1950). Once an animal's central nervous system perceives a threat, it mounts a biological response or defense that consists of a combination of the four general biological defense responses: behavioral responses; autonomic nervous system responses; neuroendocrine responses; or immune responses.

In the case of many stressors, an animal's first and most economical (in terms of biotic costs) response is behavioral avoidance of the potential stressor or avoidance of continued exposure to a stressor. An animal's second line of defense to stressors involves the sympathetic part of the autonomic nervous system and the classical "fight or flight" response, which includes the cardiovascular system, the gastrointestinal system, the exocrine glands, and the adrenal medulla to produce changes in heart rate, blood pressure, and gastrointestinal activity that humans commonly associate with "stress." These responses have a relatively short duration and may or may not have significant long-term effects on an animal's welfare.

An animal's third line of defense to stressors involves its neuroendocrine or sympathetic nervous systems; the system that has received the most study has been the hypothalmus-pituitary-adrenal system (also known as the HPA axis in mammals or the hypothalamus-pituitary-interrenal axis in fish and some reptiles). Unlike stress responses associated with the autonomic nervous system, virtually all neuroendocrine functions that are affected by stress – including immune competence, reproduction, metabolism, and behavior – are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg, 1987), altered metabolism (Elasser *et al.*, 2000), reduced immune competence (Blecha, 2000), and behavioral disturbance. Increases in the circulation of

glucocorticosteroids (cortisol, corticosterone, and aldosterone in marine mammals; see Romano *et al.*, 2004) have been equated with stress for many years.

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and distress is the biotic cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose a risk to the animal's welfare. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other biotic functions, which impair those functions that experience the diversion. For example, when mounting a stress response diverts energy away from growth in young animals, those animals may experience stunted growth. When mounting a stress response diverts energy from a fetus, an animal's reproductive success and fitness will suffer. In these cases, the animals will have entered a pre-pathological or pathological state which is called "distress" (sensu Seyle, 1950) or "allostatic loading" (sensu McEwen and Wingfield, 2003). This pathological state will last until the animal replenishes its biotic reserves sufficient to restore normal function. Note that these examples involved a long-term (days or weeks) stress response exposure to stimuli.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiment; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (for examples see, Holberton *et al.*, 1996; Hood *et al.*, 1998; Jessop *et al.*, 2003; Krausman *et al.*, 2004; Lankford *et al.*, 2005; Reneerkens *et al.*, 2002; Thompson and Hamer, 2000). Although no

information has been collected on the physiological responses of marine mammals to anthropogenic sound exposure, studies of other marine animals and terrestrial animals would lead us to expect some marine mammals to experience physiological stress responses and, perhaps, physiological responses that would be classified as "distress" upon exposure to anthropogenic sounds.

For example, Jansen (1998) reported on the relationship between acoustic exposures and physiological responses that are indicative of stress responses in humans (e.g., elevated respiration and increased heart rates). Jones (1998) reported on reductions in human performance when faced with acute, repetitive exposures to acoustic disturbance. Trimper *et al.* (1998) reported on the physiological stress responses of osprey to low-level aircraft noise while Krausman *et al.* (2004) reported on the auditory and physiology stress responses of endangered Sonoran pronghorn to military overflights. Smith *et al.* (2004a, 2004b) identified noise-induced physiological transient stress responses in hearing-specialist fish (i.e., goldfish) that accompanied short- and long-term hearing losses. Welch and Welch (1970) reported physiological and behavioral stress responses that accompanied damage to the inner ears of fish and several mammals.

Hearing is one of the primary senses marine mammals use to gather information about their environment and communicate with conspecifics. Although empirical information on the relationship between sensory impairment (TTS, PTS, and acoustic masking) on marine mammals remains limited, we assume that reducing a marine mammal's ability to gather information about its environment and communicate with other members of its species would induce stress, based on data that terrestrial animals exhibit those responses under similar conditions (NRC, 2003) and

because marine mammals use hearing as their primary sensory mechanism. Therefore, we assume that acoustic exposures sufficient to trigger onset PTS or TTS would be accompanied by physiological stress responses. More importantly, marine mammals might experience stress responses at received levels lower than those necessary to trigger onset TTS. Based on empirical studies of the time required to recover from stress responses (Moberg, 2000), NMFS also assumes that stress responses could persist beyond the time interval required for animals to recover from TTS and might result in pathological and pre-pathological states that would be as significant as behavioral responses to TTS.

Resonance effects (Gentry, 2002) and direct noise-induced bubble formations (Crum *et al.*, 2005) are implausible in the case of exposure to an impulsive broadband source like an airgun array. If seismic surveys disrupt diving patterns of deep-diving species, this might result in bubble formation and a form of the bends, as speculated to occur in beaked whales exposed to sonar. However, there is no specific evidence of this upon exposure to low-intensity civilian sonar pulses. Additionally, no beaked whale species occur in the proposed project area.

In general, very little is known about the potential for strong, anthropogenic underwater sounds to cause non-auditory physical effects in marine mammals. Such effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.*, 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. There is no definitive evidence that any of these effects occur even for marine mammals in close proximity to large arrays of airguns, which are not proposed for use during this program. In

addition, marine mammals that show behavioral avoidance of industry activities, including bowheads, belugas, and some pinnipeds, are especially unlikely to incur non-auditory impairment or other physical effects.

6. Stranding and Mortality

Marine mammals close to underwater detonations of high explosive can be killed or severely injured, and the auditory organs are especially susceptible to injury (Ketten *et al.*, 1993; Ketten, 1995). Airgun pulses are less energetic and their peak amplitudes have slower rise times. To date, there is no evidence that serious injury, death, or stranding by marine mammals can occur from exposure to airgun pulses, even in the case of large airgun arrays. Additionally, Hilcorp's project will use low-intensity sonar equipment in shallow water. NMFS does not expect any marine mammals will incur injury or mortality in the shallow waters off Beaufort Sea or strand as a result of the proposed geohazard survey.

Vessel Impacts

Vessel activity and noise associated with vessel activity will temporarily increase in the action area during Hilcorp's shallow geohazard survey as a result of the operation of 1-2 vessels. To minimize the effects of vessels and noise associated with vessel activity, Hilcorp will alter speed if a marine mammal gets too close to a vessel. In addition, source vessels will be operating at slow speed (4-5 knots) when conducting surveys. Marine mammal monitoring observers will alert vessel captains as animals are detected to ensure safe and effective measures are applied to avoid coming into direct contact with marine mammals. Therefore, NMFS neither anticipates nor authorizes takes of marine mammals from ship strikes.

McCauley *et al.* (1996) reported several cases of humpback whales responding to vessels

in Hervey Bay, Australia. Results indicated clear avoidance at received levels between 118 to 124 dB in three cases for which response and received levels were observed/measured.

Palka and Hammond (2001) analyzed line transect census data in which the orientation and distance off transect line were reported for large numbers of minke whales. The authors developed a method to account for effects of animal movement in response to sighting platforms. Minor changes in locomotion speed, direction, and/or diving profile were reported at ranges from 1,847 to 2,352 ft (563 to 717 m) at received levels of 110 to 120 dB.

Odontocetes, such as beluga whales, killer whales, and harbor porpoises, 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 response to vessel noise varies greatly from tolerance to extreme sensitivity depending on the activity of the whale and previous experience with vessels (Richardson *et al.*, 1995). Reactions to vessels depends on whale activities and experience, habitat, boat type, and boat behavior (Richardson *et al.*, 1995) and 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.

There are few data published on pinniped responses to vessel activity, and most of the 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 (Richardson *et al.*, 1995).

The addition of the vessels and noise due to vessel operations associated with the shallow geohazard survey is not expected to have effects that could cause significant or long-term consequences for individual marine mammals or their populations.

Anticipated Effects on Marine Mammal Habitat

The primary potential impacts to marine mammal habitat and other marine species are associated with elevated sound levels produced by airguns and other active acoustic sources. However, other potential impacts to the surrounding habitat from physical disturbance are also possible. This section describes the potential impacts to marine mammal habitat from the specified activity. Because the marine mammals in the area feed on fish and/or invertebrates there is also information on the species typically preyed upon by the marine mammals in the area.

With regard to fish as a prey source for odontocetes and seals, fish are known to hear and react to sounds and to use sound to communicate (Tavolga *et al.*, 1981) and possibly avoid predators (Wilson and Dill, 2002). Experiments have shown that fish can sense both the strength and direction of sound (Hawkins, 1981). Primary factors determining whether a fish can sense a sound signal, and potentially react to it, are the frequency of the signal and the strength of the signal in relation to the natural background noise level.

Fishes produce sounds that are associated with behaviors that include territoriality, mate search, courtship, and aggression. It has also been speculated that sound production may provide the means for long distance communication and communication under poor underwater visibility conditions (Zelick *et al.*, 1999), although the fact that fish communicate at low-frequency sound levels where the masking effects of ambient noise are naturally highest suggests that very long distance communication would rarely be possible. Fishes have evolved a diversity of sound

generating organs and acoustic signals of various temporal and spectral contents. Fish sounds vary in structure, depending on the mechanism used to produce them (Hawkins, 1993). Generally, fish sounds are predominantly composed of low frequencies (less than 3 kHz).

Since objects in the water scatter sound, fish are able to detect these objects through monitoring the ambient noise. Therefore, fish are probably able to detect prey, predators, conspecifics, and physical features by listening to environmental sounds (Hawkins, 1981). There are two sensory systems that enable fish to monitor the vibration-based information of their surroundings. The two sensory systems, the inner ear and the lateral line, constitute the acoustico-lateralis system.

Although the hearing sensitivities of very few fish species have been studied to date, it is becoming obvious that the intra- and inter-specific variability is considerable (Coombs, 1981). Nedwell *et al.* (2004) compiled and published available fish audiogram information. A noninvasive electrophysiological recording method known as auditory brainstem response is now commonly used in the production of fish audiograms (Yan, 2004). Generally, most fish have their best hearing in the low-frequency range (i.e., less than 1 kHz). Even though some fish are able to detect sounds in the ultrasonic frequency range, the thresholds at these higher frequencies tend to be considerably higher than those at the lower end of the auditory frequency range.

Literature relating to the impacts of sound on marine fish species can be divided into the following categories: (1) pathological effects; (2) physiological effects; and (3) behavioral effects. Pathological effects include lethal and sub-lethal physical damage to fish; physiological effects include primary and secondary stress responses; and behavioral effects include changes in exhibited behaviors of fish. Behavioral changes might be a direct reaction to a detected sound or

a result of the anthropogenic sound masking natural sounds that the fish normally detect and to which they respond. The three types of effects are often interrelated in complex ways. For example, some physiological and behavioral effects could potentially lead to the ultimate pathological effect of mortality. Hastings and Popper (2005) reviewed what is known about the effects of sound on fishes and identified studies needed to address areas of uncertainty relative to measurement of sound and the responses of fishes. Popper *et al.* (2003/2004) also published a paper that reviews the effects of anthropogenic sound on the behavior and physiology of fishes.

Potential effects of exposure to sound on marine fish include TTS, physical damage to the ear region, physiological stress responses, and behavioral responses such as startle response, alarm response, avoidance, and perhaps lack of response due to masking of acoustic cues. Most of these effects appear to be either temporary or intermittent and therefore probably do not significantly impact the fish at a population level. The studies that resulted in physical damage to the fish ears used noise exposure levels and durations that were far more extreme than would be encountered under conditions similar to those expected during Hilcorp's proposed survey.

The level of sound at which a fish will react or alter its behavior is usually well above the detection level. Fish have been found to react to sounds when the sound level increased to about 20 dB above the detection level of 120 dB (Ona, 1988); however, the response threshold can depend on the time of year and the fish's physiological condition (Engas *et al.*, 1993). In general, fish react more strongly to pulses of sound rather than a continuous signal (Blaxter *et al.*, 1981), such as the type of sound that will be produced by the drillship, and a quicker alarm response is elicited when the sound signal intensity rises rapidly compared to sound rising more slowly to the same level.

Investigations of fish behavior in relation to vessel noise (Olsen *et al.*, 1983; Ona, 1988; Ona and Godo, 1990) have shown that fish react when the sound from the engines and propeller exceeds a certain level. Avoidance reactions have been observed in fish such as cod and herring when vessels approached close enough that received sound levels are 110 dB to 130 dB (Nakken, 1992; Olsen, 1979; Ona and Godo, 1990; Ona and Toresen, 1988). However, other researchers have found that fish such as polar cod, herring, and capeline are often attracted to vessels (apparently by the noise) and swim toward the vessel (Rostad *et al.*, 2006). Typical sound source levels of vessel noise in the audible range for fish are 150 dB to 170 dB (Richardson *et al.*, 1995a). In calm weather, ambient noise levels in audible parts of the spectrum lie between 60 dB to 100 dB.

Short, sharp sounds can cause overt or subtle changes in fish behavior. Chapman and Hawkins (1969) tested the reactions of whiting (hake) in the field to an airgun. When the airgun was fired, the fish dove from 82 to 180 ft (25 to 55 m) depth and formed a compact layer. The whiting dove when received sound levels were higher than 178 dB re 1 µPa (Pearson *et al.*, 1992).

Pearson *et al.* (1992) conducted a controlled experiment to determine effects of strong noise pulses on several species of rockfish off the California coast. They used an airgun with a source level of 223 dB re 1 µPa. They noted:

- Startle responses at received levels of 200–205 dB re 1 µPa and above for two sensitive species, but not for two other species exposed to levels up to 207 dB;
- Alarm responses at 177–180 dB for the two sensitive species, and at 186 to 199 dB for other species;

- An overall threshold for the above behavioral response at about 180 dB;
- An extrapolated threshold of about 161 dB for subtle changes in the behavior of rockfish; and
- A return to pre-exposure behaviors within the 20-60 minute exposure period.

In summary, fish often react to sounds, especially strong and/or intermittent sounds of low frequency. Sound pulses at received levels of 160 dB re 1 µPa may cause subtle changes in behavior. Pulses at levels of 180 dB may cause noticeable changes in behavior (Chapman and Hawkins, 1969; Pearson *et al.*, 1992; Skalski *et al.*, 1992). It also appears that fish often habituate to repeated strong sounds rather rapidly, on time scales of minutes to an hour. However, the habituation does not endure, and resumption of the strong sound source may again elicit disturbance responses from the same fish.

Some of the fish species found in the Arctic are prey sources for odontocetes and pinnipeds. A reaction by fish to sounds produced by Hilcorp's proposed survey would only be relevant to marine mammals if it caused concentrations of fish to vacate the area. Pressure changes of sufficient magnitude to cause that type of reaction would probably occur only very close to the sound source, if any would occur at all. Impacts on fish behavior are predicted to be inconsequential. Thus, feeding odontocetes and pinnipeds would not be adversely affected by this minimal loss or scattering, if any, of reduced prey abundance.

Some mysticetes, including bowhead whales, feed on concentrations of zooplankton. Some feeding bowhead whales may occur in the Alaskan Beaufort Sea in July and August, but feeding bowheads are more likely to occur in the area after the cessation of survey operations. Reactions of zooplankton to sound are, for the most part, not known. Their ability to move

significant distances is limited or nil, depending on the type of zooplankton. Behavior of zooplankters is not expected to be affected by the survey. These animals have exoskeletons and no air bladders. Many crustaceans can make sounds, and some crustacea and other invertebrates have some type of sound receptor. A reaction by zooplankton to sounds produced by the seismic survey would only be relevant to whales if it caused concentrations of zooplankton to scatter. Pressure changes of sufficient magnitude to cause that type of reaction would probably occur only very close to the sound source, if any would occur at all. Impacts on zooplankton behavior are predicted to be inconsequential. Thus, feeding mysticetes would not be adversely affected by this minimal loss or scattering, if any, of reduced zooplankton abundance.

Based on the preceding discussion, the proposed activity is not expected to have any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or their populations.

Proposed Mitigation

In order to issue an incidental take authorization (ITA) under sections 101(a)(5)(A) and (D) of the MMPA, NMFS must, where applicable, set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses (where relevant). This section summarizes the contents of Hilcorp's Marine Mammal Monitoring and Mitigation Plan (4MP). Later in this document in the "**Proposed Incidental Harassment Authorization**" section, NMFS lays out the proposed conditions for review, as they would appear in the final IHA (if issued).

Hilcorp submitted a 4MP as part of its application (see **ADDRESSES**). Hilcorp's planned shallow geohazard survey incorporates both design features and operational procedures for minimizing potential impacts on marine mammals and on subsistence hunts. The 4MP is a combination of active monitoring in the area of operations and the implementation of mitigation measures designed to minimize project impacts to marine resources. Monitoring will provide information on marine mammals potentially affected by exploration activities, in addition to facilitating real time mitigation to prevent injury of marine mammals by industrial sounds or activities.

Vessel Related Mitigation Measures

The general mitigation measures apply to all vessels that are part of the Foggy Island Bay sonar survey. The source vessel will operate under an additional set of specific mitigation measures during operations.

- To minimize collision risk with marine mammals, vessels shall not be operated at speeds that would make collisions likely. When weather conditions require, such as when visibility drops, vessels shall adjust speed accordingly to avoid the likelihood of marine mammal collisions.
- Vessel operators shall check the waters immediately adjacent to a vessel to ensure that no marine mammals will be injured when the vessel's propellers (or screws) are engaged.
- Vessel operators shall avoid concentrations or groups of whales and vessels shall not be operated in a way that separates members of a group. In proximity of feeding whales or aggregations, vessel speed shall be less than 10 knots.

- When within 900 ft. (300 m) of whales vessel operators shall take every effort and precaution to avoid harassment of these animals by:
    - Reducing speed and steering around (groups of) whales if circumstances allow, but never cutting off a whale's travel path;
    - Avoiding multiple changes in direction and speed.
- In general, the survey design will start in shallow water and work deeper to mitigate the potential "herding" effect.

Establishing Exclusion and Disturbance Zones

Under current NMFS guidelines, the "exclusion zone" for marine mammal exposure to impulse sources is customarily defined as the area within which received sound levels are ≥180 dB (rms) re 1 µPa for cetaceans and ≥190 dB (rms) re 1 µPa for pinnipeds. These safety criteria are based on an assumption that SPL received at levels lower than these will not injure these animals or impair their hearing abilities, but at higher levels might have some such effects. Disturbance or behavioral effects to marine mammals from underwater sound may occur after exposure to sound at distances greater than the exclusion zones (Richardson *et al.* 1995). Currently, NMFS uses 160 dB (rms) re 1 µPa as the threshold for Level B behavioral harassment from impulse noise.

The sounds generated by the multibeam echosounder and sidescan sonar are outside the hearing range of marine mammals. Sounds generated by the sub-bottom profiler are within the hearing range of all marine mammal species occurring in the area. The distance to 160 dB re 1 µPa (rms) zone of influence (ZOI) is estimated at 30 m (Warner & McCrodan 2011). However, Hilcorp will establish a ZOI of 50 m around all sonar sources for more protective measures. The

exclusion zones of all sonar equipment are less than 30 m from the sources.

Mitigation Measures for Sonar Equipment

(1) Ramp Up Procedure

A ramp up of the sub-bottom profiler provides a gradual increase in sound levels, and involves a step-wise increase in the number and incremental levels of the sub-bottom profiler firing until the maximum level is achieved. The purpose of a ramp up (or "soft start") is to "warn" cetaceans and pinnipeds in the vicinity of the survey and to provide time for them to leave the area and thus reducing startling responses from marine mammals.

(2) Shutdown Measures

Although there is no exclusion zone expected from the sonar source operated by Hilcorp during its proposed shallow geohazard survey, Hilcorp proposes to implement shutdown measures when a marine mammals is sighted within the 50 m ZOI during the operation of the sub-bottom profiler.

After showdown for more than 10 minutes, ramp-up shall not start until after the marine mammal is visually seen left the ZOI; or 15 minutes have passed after the last detection of the marine mammal with shorter dive durations (pinnipeds and small odontocetes); or 30 minutes have passed after the last detection of the marine mammal with longer diver durations (mysticetes and large odontocetes, including beluga whales).

(3) Poor Visibility Conditions:

If during foggy conditions, heavy snow or rain, or darkness, the full 160 dB ZOI is not visible, sonar equipment cannot commence a ramp-up procedure from a full shut-down. If the sub-bottom profiler has been operational before nightfall or before the onset of poor visibility

conditions, it can remain operational throughout the night or poor visibility conditions.

Mitigation Conclusions

NMFS has carefully evaluated Hilcorp's proposed mitigation measures and considered a range of other measures in the context of ensuring that NMFS prescribes the means of effecting the least practicable impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another:

● The manner in which, and the degree to which, the successful implementation of the measures are expected to minimize adverse impacts to marine mammals;

● The proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and

● The practicability of the measure for applicant implementation.

Any mitigation measure(s) prescribed by NMFS should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to the accomplishment of one or more of the general goals listed below:

1. Avoidance or minimization of injury or death of marine mammals wherever possible (goals 2, 3, and 4 may contribute to this goal).

2. A reduction in the numbers of marine mammals (total number or number at biologically important time or location) exposed to received levels of sub-bottom profiler, or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing harassment takes only).

3. A reduction in the number of times (total number or number at biologically important

time or location) individuals would be exposed to received levels of sub-bottom profiler or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing harassment takes only).

4. A reduction in the intensity of exposures (either total number or number at biologically important time or location) to received levels of sub-bottom profiler or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing the severity of harassment takes only).

5. Avoidance or minimization of adverse effects to marine mammal habitat, paying special attention to the food base, activities that block or limit passage to or from biologically important areas, permanent destruction of habitat, or temporary destruction/disturbance of habitat during a biologically important time.

6. For monitoring directly related to mitigation – an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation.

Based on our evaluation of the applicant's proposed measures, as well as other measures considered by NMFS, NMFS has preliminarily determined that the proposed mitigation measures provide the means of effecting the least practicable impact on marine mammals species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance. Proposed measures to ensure availability of such species or stock for taking for certain subsistence uses are discussed later in this document (see "**Impact on Availability of Affected Species or Stock for Taking for Subsistence Uses**" section).

Proposed Monitoring and Reporting

In order to issue an ITA for an activity, section 101(a)(5)(D) of the MMPA states that

NMFS must set forth, "requirements pertaining to the monitoring and reporting of such taking." The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for ITAs must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area. Hilcorp submitted a marine mammal monitoring plan as part of the IHA application. The plan may be modified or supplemented based on comments or new information received from the public during the public comment period or from the peer review panel (see the "**Monitoring Plan Peer Review**" section later in this document).

Monitoring measures prescribed by NMFS should accomplish one or more of the following general goals:

1. An increase in our understanding of the likely occurrence of marine mammal species in the vicinity of the action, i.e., presence, abundance, distribution, and/or density of species.

2. An increase in our understanding of the nature, scope, or context of the likely exposure of marine mammal species to any of the potential stressor(s) associated with the action (e.g. sound or visual stimuli), through better understanding of one or more of the following: the action itself and its environment (e.g. sound source characterization, propagation, and ambient noise levels); the affected species (e.g. life history or dive pattern); the likely co-occurrence of marine mammal species with the action (in whole or part) associated with specific adverse effects; and/or the likely biological or behavioral context of exposure to the stressor for the marine mammal (e.g. age class of exposed animals or known pupping, calving or feeding areas).

3. An increase in our understanding of how individual marine mammals respond

(behaviorally or physiologically) to the specific stressors associated with the action (in specific contexts, where possible, e.g., at what distance or received level).

4. An increase in our understanding of how anticipated individual responses, to individual stressors or anticipated combinations of stressors, may impact either: the long-term fitness and survival of an individual; or the population, species, or stock (e.g. through effects on annual rates of recruitment or survival).

5. An increase in our understanding of how the activity affects marine mammal habitat, such as through effects on prey sources or acoustic habitat (e.g., through characterization of longer-term contributions of multiple sound sources to rising ambient noise levels and assessment of the potential chronic effects on marine mammals).

6. An increase in understanding of the impacts of the activity on marine mammals in combination with the impacts of other anthropogenic activities or natural factors occurring in the region.

7. An increase in our understanding of the effectiveness of mitigation and monitoring measures.

8. An increase in the probability of detecting marine mammals (through improved technology or methodology), both specifically within the safety zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals.

Proposed Monitoring Measures

Monitoring will provide information on the numbers of marine mammals potentially affected by the exploration operations and facilitate real-time mitigation to prevent injury of marine mammals by industrial sounds or activities. These goals will be accomplished in the

Beaufort Sea during 2015 by conducting vessel-based monitoring and passive acoustic monitoring to document marine mammal presence and distribution in the vicinity of the survey area.

Visual monitoring by Protected Species Observers (PSOs) during shallow geohazard survey operations, and periods when these surveys are not occurring, will provide information on the numbers of marine mammals potentially affected by these activities and facilitate real-time mitigation to prevent impacts to marine mammals by industrial sounds or operations. Vessel-based PSOs onboard the survey vessels will record the numbers and species of marine mammals observed in the area and any observable reaction of marine mammals to the survey activities in the Beaufort Sea.

(1) Vessel-based Monitoring

(A) Protected Species Observers (PSOs)

Vessel-based monitoring for marine mammals will be done by trained PSOs throughout the period of survey activities. The observers will monitor the occurrence of marine mammals near the survey vessel during all daylight periods during operation, and during most daylight periods when operations are not occurring. PSO duties will include watching for and identifying marine mammals; recording their numbers, distances, and reactions to the survey operations; and documenting "take by harassment."

Two PSOs will be present on the main sonar vessel. The smaller skiff may only accommodate one at a time. Of these two PSOs, one will be on watch at all times, except during darkness.

PSO teams will consist of Inupiat observers and experienced field biologists. Each vessel

will have an experienced field crew leader to supervise the PSO team.

Visual monitoring by the PSOs will be required to meet the following criteria:

- 100% monitoring coverage during all periods of survey operations in daylight;
- Maximum of 4 consecutive hours on watch per PSO; and
- Maximum of 12 hours of watch time per day per PSO.

(B) PSO Qualifications and Training

Lead PSOs will be individuals with experience as observers during recent seismic, site clearance and shallow hazards, and other monitoring projects in Alaska or other offshore areas in recent years. New or inexperienced PSOs will be paired with an experienced PSO or experienced field biologist so that the quality of marine mammal observations and data recording is kept consistent.

Resumes for candidate PSOs will be provided to NMFS for review and acceptance of their qualifications. Inupiat observers will be experienced in the region and familiar with the marine mammals of the area. All observers will complete a training course designed to familiarize individuals with monitoring and data collection procedures.

(C) Marine Mammal Observer Protocol

The PSOs will watch for marine mammals during all periods of source operations and for a minimum of 30 minutes prior to the planned start of sonar operations after an extended shutdown. Marine mammal monitoring shall continue throughout sonar operations and last for 30 minutes after the finish of sonar operations during daylight hours. Hilcorp vessel crew and operations personnel will also watch for marine mammals, as practical, to assist and alert the PSOs for the sub-bottom profiler to be shut down if marine mammals are observed in or about to

enter the 50-m ZOI.

PSOs will also perform vessel-based marine mammal monitoring during vessel transit when the shallow geohazard survey is not being conducted. Marine mammal sighting data collected during the non-survey period will be compared with those during the survey to analyze the effects of the activities.

The PSOs will watch for marine mammals from the best available vantage point on the vessels. The PSOs will scan the area around the vessel systematically with reticle binoculars (e.g., 7 × 50 and 16-40 × 80) and with the naked eye. GPS unit and laptop computer(s) will also be available for PSOs onboard survey vessels.

The observers will give particular attention to the areas within the marine mammal exclusion zones around the source vessels.

When a marine mammal is seen approaching or within the 50-m ZOI, the survey crew will be notified immediately so that mitigation measures called for in the applicable authorization(s) can be implemented.

Information to be recorded by PSOs will include:

- Species, group size, age/size/sex categories (if determinable), physical description of features that were observed or determined not to be present in the case of unknown or unidentified animals;
- Behavior when first sighted and after initial sighting;
- Heading (if consistent), bearing and distance from observer;
- Apparent reaction to activities (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and behavioral pace;

- Time, location, speed, and activity of the vessel, sea state, ice cover, visibility, and sun glare; and
- Positions of other vessel(s) (if present) in the vicinity of the observer location.

The vessel's position, speed, water depth, sea state, ice cover, visibility, and sun glare will also be recorded at the start and end of each observation watch, every 30 minutes during a watch, and whenever there is a change in any of those variables.

(2) Acoustic Monitoring

Passive acoustic monitoring (PAM) will be conducted to document ambient noise conditions, to examine the spatial and temporal distribution of marine mammals based on acoustic detections of their vocalizations, and to characterize the long-range propagation of sounds produced during the geohazard survey. The goal of the program is to address knowledge gaps about ambient sound levels and the distributions and migration paths of several marine mammal species including bowhead whales, beluga whales, and seals.

The acoustic data will be collected with Autonomous Multichannel Acoustic Recorder (AMAR) systems deployed on the seabed for an extended period. Two AMARs with different sampling rates will be deployed on the seabed for 3 months. An AMAR with a sampling rate of 64 kHz (24 bits) will be deployed at 500 m from the offshore end of the survey line and will record continuously. A high-frequency AMAR with a sampling rate of 380 kHz (16 bits) will be deployed at 5,000 m from the offshore end of the survey line. This high-frequency AMAR will be operated at 380 kHz (16 bits) for2 minutes each hour and the rest of the time at 64 kHz (24 bits). The AMARs will be calibrated using pistonphone calibrators immediately before and after each deployment. These calibrations are accurate to less than 0.5 dB absolute.

Monitoring Plan Peer Review

The MMPA requires that monitoring plans be independently peer reviewed "where the proposed activity may affect the availability of a species or stock for taking for subsistence uses" (16 U.S.C. 1371(a)(5)(D)(ii)(III)). Regarding this requirement, NMFS' implementing regulations state, "Upon receipt of a complete monitoring plan, and at its discretion, [NMFS] will either submit the plan to members of a peer review panel for review or within 60 days of receipt of the proposed monitoring plan, schedule a workshop to review the plan" (50 CFR 216.108(d)).

NMFS has established an independent peer review panel to review Hilcorp's 4MP for the proposed shallow geohazard survey in the Beaufort Sea. The panel has met in early March 2015, and provided comments and recommendations to NMFS in April 2015. The full panel report can be viewed on the Internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm*.

NMFS provided the panel with Hilcorp's IHA application and monitoring plan and asked the panel to answer the following questions:

1. Will the applicant's stated objectives effectively further the understanding of the impacts of their activities on marine mammals and otherwise accomplish the goals stated above? If not, how should the objectives be modified to better accomplish the goals above?

2. Can the applicant achieve the stated objectives based on the methods described in the plan?

3. Are there technical modifications to the proposed monitoring techniques and methodologies proposed by the applicant that should be considered to better accomplish their stated objectives?

4. Are there techniques not proposed by the applicant (i.e., additional monitoring

techniques or methodologies) that should be considered for inclusion in the applicant's monitoring program to better accomplish their stated objectives?

5. What is the best way for an applicant to present their data and results (formatting, metrics, graphics, etc.) in the required reports that are to be submitted to NMFS (i.e., 90-day report and comprehensive report)?

The peer-review panel report contains recommendations that the panel members felt were applicable to the Hilcorp' monitoring plans. The panel believes that the objectives for both vessel-based and passive acoustic monitoring are appropriate, and agrees that the objective of real-time mitigation of potential disturbance of marine mammals would be met through visual monitoring. Nevertheless, the panel is concerned that there may also be behavioral effects resulting from the use of single and multi-beam echosounders and side-scan sonar that may warrant real-time mitigation to avoid disturbance, and provide a series of recommendations to improve efficiencies and effectiveness of monitoring and mitigation measures.

Specific recommendations provided by the peer review panel to enhance marine mammal monitoring and reporting measures are:

(1) Deploying an additional observer on the source vessel such that at least two observers are on watch during all daylight hours;

(2) Monitoring for marine mammals also be conducted during non-survey activities to assist in the collection of baseline information from which to analyze the effects of the activities;

(3) Deploying a third autonomous multichannel acoustic recorder (AMAR) and arrange the AMARs in a triangular array, as depicted in Figure 1 of the panel report, with the 500 m AMAR be a high-frequency AMAR, for marine mammal monitoring;

(4) Using AMAR to collect data on cumulative sound exposure level over 24 hours ($cSEL_{24}$), in particular during the use of the two sub-bottom profilers;

(5) Ground-truthing data collected by AMARs in consultation with biologists experienced in Arctic species vocalizations and to include error rates for automatic detection to ensure the accurate classification of vocalizations by species;

(6) Collaborating with other entities collecting data on marine mammal vocalizations in the Beaufort Sea to improve auto-detection and manual capabilities for identifying species in which acoustic data are limited or lacking (e.g., spotted seals); and

(7) Including information from high frequency acoustic recordings in reports to provide a better understanding of source levels and other acoustic characteristics of the active acoustics survey equipment, such as spectral content, and received levels in root-mean-squared (RMS) dB, sound exposure level (SEL), dB peak to peak and 1/3 octave bands.

In addition, although not requested by NMFS under the MMPA, the panel also provided several mitigation measures. These recommendations are:

(1) Hilcorp limit operations at night or during periods of low visibility so that marine mammals do not enter the safety zone undetected;

(2) Hilcorp specify that the delay for ramp-up and after a shut-down should be 15 minutes for species with short dive durations (small odontocetes and pinnipeds) and 30 minutes for species with longer diver durations (mysticetes and large odontocetes, including beluga whales);

(3) Additional sound source information from the various active acoustic equipment proposed for the survey be obtained by maneuvering the source vessels over the high frequency AMARs; and

(4) Hilcorp conduct the survey starting closest to shore and proceeding offshore to avoid any potential "herding" effect of marine mammals into shallow waters, as was implicated in a mass stranding of melon headed whales off Madagascar during a multi-beam echosounder survey (Southall et al. 2013).

NMFS discussed these recommendations with Hilcorp to improve its monitoring and reporting measures, and to some extent, as well as mitigation measures. As a result, Hilcorp agrees to implement the following recommendations:

(1) Hilcorp will perform vessel-based marine mammal monitoring by protected species observers (PSOs) during vessel transit when the shallow geohazard survey is not being conducted. Marine mammal sighting data collected during the non-survey period will be compared with those during the survey to analyze the effects of the activities.

(2) Hilcorp and its contractor JASCO will deploy a high-frequency AMAR at the 5000 m site for detecting beluga clicks. The high-frequency AMAR would be operated at 380 kHz (16 bits) for about 2 minutes each hour and the rest of the time at 64 kHz (24 bits) for the 3 months deployment. The reason for deploying the high-frequency AMAR at 5000 m location, which NMFS concurs, is that there is a higher likelihood of detecting marine mammal acoustics in the deeper water father from the island.

(3) Hilcorp will work with JASCO to use AMAR to collect data on cumulative sound exposure level over 24 hours ($cSEL_{24}$), in particular during the use of the two sub-bottom profilers.

(4) Hilcorp with work with JASCO to ground-truth data collected by AMARs in consultation with biologists experienced in Arctic species vocalizations and to include error rates

for automatic detection to ensure the accurate classification of vocalizations by species.

(5) Hilcorp is open to sharing data and work with its contractor JASCO to collaborate with other researchers. In addition, Hilcorp and JASCO will make the passive acoustic recording data, including data on marine mammal vocalizations, publically available for researchers. These data sharing/collaboration efforts will enable scientists to purse a variety of studies concerning the acoustic environment, marine mammal bioacoustics, and potential activity effects on marine mammals in the survey area.

(6) Hilcorp will including information from high frequency acoustic recordings in reports to provide a better understanding of source levels and other acoustic characteristics of the active acoustics survey equipment, such as spectral content, and received levels in root-mean-squared (RMS) dB, sound exposure level (SEL), dB peak to peak and 1/3 octave bands.

Furthermore, Hilcorp agrees to implement the following mitigation recommendation and provided additional information in regard to the peer-review panel report:

(1) Hilcorp will specify that the delay for ramp-up and after a shut-down should be 15 minutes for species with short dive durations (small odontocetes and pinnipeds) and 30 minutes for species with longer diver durations (mysticetes and large odontocetes, including beluga whales).

(2) Regarding sound source information from the various active acoustic equipment proposed for Hilcorp's shallow geohazard survey, acoustic characteristics of these equipment or its equivalents were previously measured by JASCO. The measurement results in the following reports that are posted on NMFS website:

- Statoil 2011 Shallow Hazards Survey 90-day Report (Chapter 3)

(http://www.nmfs.noaa.gov/pr/pdfs/permits/statoil_90day_report2011.pdf).

- Shell 2013 Shallow Hazards Survey 90-day Report (Chapter 2) (http://www.nmfs.noaa.gov/pr/permits/incidental/oilgas/2013_shell_monitoringreport.pdf).

(3) Regarding the panel's recommendation on Hilcorp's survey transect design, Hilcorp states that it can start in shallow water and work deeper to mitigate the potential "herding" effect. Hilcorp's plan is to divide the corridor into multiple sub-sections based on depth and work each section independently. This method is necessary for side scan sonar operations as each subsection will have a different range setting and line spacing that is related to depth.

All these aforementioned recommendations from the peer-review panel are included in the proposed mitigation and monitoring measures for Hilcorp's 2015 open-water shallow geohazard survey in the Beaufort Sea.

However, Hilcorp will not able to increase the number of vessel-based PSOs onboard the survey vessel. The number of PSOs onboard the vessel is limited by the available berth space. The survey vessels used for the proposed shallow geohazard survey can only accommodate maximum of 2 PSOs. Nevertheless, NMFS considers that due to the exceptionally small ensonified zones (no exclusion zone, with the radius of ZOI at 30 m from the source), one PSO on watch onboard the survey vessel is adequate.

In regard to an additional AMAR to be deployed in the vicinity of the survey area, NMFS worked with Hilcorp and determined that deployment of three AMARs would be cost prohibitive to Hilcorp, given the small project budget of the shallow geohazard survey. In addition, due to the short duration and minimal impact of the proposed shallow geohazard survey, the currently

passive acoustic monitoring, improved with a high-frequency AMAR, is adequate to provide needed information to assess potential environmental effects from the proposed project.

Finally, NMFS does not agree with one of the panel's recommendations that Hilcorp limit operations at night or during periods of low visibility so that marine mammals do not enter the safety zone undetected. As mentioned previously, there is not no safety zone (exclusion zone) because of the low intensity high-frequency sonar equipment being employed in the proposed shallow geohazard survey. In addition, limiting survey at night or during periods of low visibility would increase the survey duration, thus extend the noise output from survey vessels in the area. NMFS believes that as long as the 50-m ZOI is cleared of marine mammals before the ramp-up of sonar equipment during daylight hours with good visibility, shallow hazard survey can be carried out with minimum adverse effects to marine mammals.

Reporting Measures

(1) Technical Report

The results of Hilcorp's 2015 vessel-based monitoring, including estimates of "take" by harassment, will be presented in a "90-day" draft Technical Report, to be submitted to NMFS within 90 days after the end of the shallow geohazard survey, and then in a final Technical Report, which will address any comments NMFS had on the draft. The Technical Report will include:

(a) Summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals);

(b) Analyses of the effects of various factors influencing detectability of marine mammals

(e.g., sea state, number of observers, and fog/glare);

(c) 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;

(d) Data analysis separated into periods when a sonar source is operating and when it is not, to better assess impacts to marine mammals – the final and comprehensive report to NMFS should summarize and plot:

- Data for periods when a sonar source is active and when it is not; and
- The respective predicted received sound conditions over fairly large areas (tens of km) around operations;

(e) Sighting rates of marine mammals during periods with and without sonar activities (and other variables that could affect detectability), such as:

- Initial sighting distances versus sonar activity state;
- Closest point of approach versus sonar activity state;
- Observed behaviors and types of movements versus sonar activity state;
- Numbers of sightings/individuals seen versus sonar activity state;
- Distribution around the survey vessel versus sonar activity state; and
- Estimates of take by harassment;

(f) Results from all hypothesis tests, including estimates of the associated statistical power, when practicable;

(g) Estimates of uncertainty in all take estimates, with uncertainty expressed by the presentation of confidence limits, a minimum-maximum, posterior probability distribution, or

another applicable method, with the exact approach to be selected based on the sampling method and data available; and

(h) A clear comparison of authorized takes and the level of actual estimated takes.

In addition, the technical report will include analysis on acoustic monitoring such as:

(a) Cumulative sound exposure level over 24 hours ($cSEL_{24}$), in particular during the use of the two sub-bottom profilers;

(b) Ground-truth of data collected by AMARs in consultation with biologists experienced in Arctic species vocalizations with error rates for automatic detection to ensure the accurate classification of vocalizations by species; and

(c) Information of source levels and other acoustic characteristics of the active acoustics survey equipment, such as spectral content, and received levels in root-mean-squared (RMS) dB, sound exposure level (SEL), dB peak to peak and 1/3 octave bands.

Finally, Hilcorp will share data and work with its contractor JASCO to collaborate with other researchers. The passive acoustic recording data, including data on marine mammal vocalizations, will be made publically available for researchers. These data sharing/collaboration efforts will enable scientists to purse a variety of studies concerning the acoustic environment, marine mammal bioacoustics, and potential activity effects on marine mammals in the survey area.

(5) Notification of Injured or Dead Marine Mammals

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by the IHA, such as a serious injury, or mortality (e.g., ship-strike, gear interaction, and/or entanglement), Hilcorp would immediately cease the specified

activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the Alaska Regional Stranding Coordinators. The report would include the following information:

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

Activities would not resume until NMFS is able to review the circumstances of the prohibited take. NMFS would work with Hilcorp to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. Hilcorp would not be able to resume its activities until notified by NMFS via letter, email, or telephone.

In the event that Hilcorp discovers a dead marine mammal, and the lead PSO determines that the cause of the death is unknown and the death is relatively recent (i.e., in less than a

moderate state of decomposition as described in the next paragraph), Hilcorp would immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinators. The report would include the same information identified in the paragraph above. Activities would be able to continue while NMFS reviews the circumstances of the incident. NMFS would work with Hilcorp to determine whether modifications in the activities are appropriate.

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

Estimated Take by Incidental Harassment

Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) 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 [Level B harassment]. Only take by Level B behavioral harassment is anticipated as a result of the proposed shallow geohazard survey. Noise propagation from subbottom profilers is expected to harass, through behavioral disturbance, affected marine mammal species or stocks.

The full suite of potential impacts to marine mammals from various industrial activities was described in detail in the "**Potential Effects of the Specified Activity on Marine Mammals**" section found earlier in this document. The potential effects of sound from the proposed shallow geohazard survey without any mitigation might include one or more of the following: tolerance; masking of natural sounds; behavioral disturbance; non-auditory physical effects; and, at least in theory, temporary or permanent hearing impairment (Richardson *et al.*, 1995a). As discussed in the following sections in this document, NMFS estimates that Hilcorp's activities will most likely result in behavioral disturbance, including avoidance of the ensonified area or changes in speed, direction, and/or diving profile of one or more marine mammals. For reasons discussed previously in this document, hearing impairment (TTS and PTS) is highly unlikely to occur based on the fact that most of the equipment to be used during Hilcorp's proposed shallow geohazard survey does not have source levels high enough to elicit even mild TTS and/or the fact that certain species are expected to avoid the ensonified areas close to the operations. Additionally, non-auditory physiological effects are anticipated to be minor, if any would occur at all.

For impulsive sounds, such as the signals produced by the subbottom profiler sources during the shallow geohazard survey, NMFS uses a received level of 160-dB (rms) to indicate the onset of Level B harassment. Hilcorp provided calculations of the 160-dB isopleth produced by

the subbottom profiler and then used that isopleth to estimate takes by harassment. Hilcorp provides a full description of the methodology used to estimate takes by harassment in its IHA application (see **ADDRESSES**), which is also provided in the following sections.

Hilcorp has requested authorization to take bowhead, gray, humpback, minke, killer, and beluga whales, harbor porpoise, and ringed, spotted, bearded, and ribbon seals incidental to shallow geohazard survey in the Beaufort Sea. However, as stated previously in this document, humpback, minke, and killer whales, harbor porpoise, and ribbon seal are considered extralimital in the proposed shallow geohazard survey area. Therefore, NMFS is not proposing to authorize take of these species.

Basis for Estimating "Take by Harassment"

"Take by Harassment" is described in this section and was calculated in Hilcorp's application by multiplying the expected densities of marine mammals that may occur near the shallow geohazard survey areas where received noise levels are higher than 160 dB re 1 µPa (rms) created by the subbottom profiler during the survey.

Marine Mammal Density Estimates

Whale species are migratory and therefore show a seasonal distribution, with different densities for the summer period (covering July and August) and the fall period (covering September and October). Seal species in the Beaufort Sea do not show a distinct seasonal distribution during the open water period between July and October. Data acquisition of the proposed sonar survey will only take place in summer (before start of Nuiqsut whaling), therefore only estimates of marine mammal densities for the summer are included in the take calculation. Whale and seal densities in the Beaufort Sea will further depend on the presence of sea ice.

However, if ice cover within or close to the sonar survey area is more than approximately 10%, sonar survey activities may not start or be halted for safety reasons. Densities related to ice conditions are therefore not included in the take estimates.

Spatial differentiation is another important factor for marine mammal densities, both in latitudinal and longitudinal gradient. Taking into account the shallow water operations of the proposed sonar survey area and the associated area of influence, data from the nearshore zone of the Beaufort Sea is used for the calculation of densities, if available.

Density estimates are based on best available data. Because available data did not always cover the area of interest, estimates are subject to large temporal and spatial variation. Though correction factors for perception and availability bias have been calculated for certain coastal areas they were not always known for this study area. There is some uncertainty in the 2014 raw data and assumptions were used in the estimated number of exposures. To provide allowance for these uncertainties, maximum density estimates have been provided in addition to average density estimates.

A summary of marine mammal density in the proposed Hilcorp survey area is provided in Table 3.

Table 3. Estimated summer densities of whales and sighting rates of seals (average and maximum) for the proposed North Prudhoe Bay survey. Densities are provided in number of individuals per km^2 (IND/km^2), sighting rates in number of individuals per hour (INDV/hr.).

SPECIES	SUMMER DENSITIES (INDV/km^2) AVERAGE	MAXIMUM
Bowhead whale	0.0088	0.0200
Beluga	0.0008	0.0078
	SUMMER SIGHTING RATES (INDV/hr.) AVERAGE	MAXIMUM
Ringed seal	0.122	0.397
Bearded seal	0.033	0.107

Spotted seal	0.039	0.126

Level B Harassment Zone Distance

As discussed earlier in this document, the operating frequencies of the multibeam, single-beam, and sidescan sonar equipment in Hilcorp's proposed shallow geohazard survey are above the hearing range of all marine mammals and therefore are not expected to have take of marine mammals. Estimated distance to sound pressure levels of 160 dB re 1 µPa, generated by the proposed sub-bottom equipment is 30 m from the source. However, as stated in this document earlier, Hilcorp proposes to implement a 50 m shutdown zone for the Level B behavioral harassment. Therefore, the calculation of marine mammal take is based on the number of animals exposed within the 50 m radius.

Potential Number of "Takes by Harassment"

This section provides estimates of the number of individuals potentially exposed to pulsed sound levels ≥160 dB re 1 µPa rms by shallow geohazard survey using a subbottom profiler. The estimates are based on a consideration of the number of marine mammals that might be affected by operations in the Beaufort Sea during 2015 and the anticipated area exposed to those sound levels.

The potential number of bowhead whales and belugas that might be exposed to the 160 dB re 1 µPa (rms) sound pressure level was calculated by multiplying:

- The expected bowhead and beluga density as provided in Table 3;
- The total 160 dB re 1 µPa (rms) ensonified area in a single hour by the vessel travelling at 3 knots; and
- The estimated number of hours that the source vessels are operating.

The calculated area (0.0079 km^2) expected to be ensonified is determined based on the maximum distance to the 160 dB re 1 μPa (rms) sound pressure level for the Sub-bottom profiler, which is 0.05 km.

The estimated number of 24-hr days of sonar operations was determined by assuming a 25% downtime during the planned 45-day time span of the sonar survey period. Downtime is related to weather, equipment maintenance, mitigation implementation, and other circumstances. The total number of full 24-hr days that data acquisition is expected to occur is ~34 days or 816 hours.

The total 160 dB re 1 μPa (rms) ensonified area in a single hour by the vessel is calculated as 0.556 km^2 / hr.

The average and maximum number of bowhead whales potentially exposed to sonar sound levels of 160 dB re 1μPa (rms) or more is estimated at 4 and 9 respectively. The limited number of exposures is due to the low estimated density of bowheads in Foggy Island Bay during July and August, the short duration of the survey, and the small acoustic footprint. For the requested authorization, the maximum number was increased by three to account for unexpected bowhead occurrences.

The average and maximum number of potential beluga exposures to 160 dB is < 1. Belugas are known to show aggregate behavior and can occur in large numbers in nearshore zones, as evidenced by the sighting from Endicott in August 2013. Although beluga whales are not expected to frequent the vicinity of the Liberty Unit shallow geohazard survey area, their occurrence is still a possibility. To account for the potential average take of 1 beluga whale per day during the 45-day survey period, NMFS proposes a take authorization of 45 beluga whales

for Hilcorp's shallow geohazard survey. Chance encounters with small numbers of other whale species are possible, but exposures to 160 dB or more are very unlikely for these species.

Although gray whale density is not known, this species has been occasionally sited in the Arctic, and Hilcorp is requesting takes of 3 individuals of gray whales by Level B behavioral harassment (Table 4).

The estimated number of seals that might be exposed to pulsed sounds of 160 dB re 1 µPa (rms) is calculated by multiplying:

- The expected species specific sighting rate as provided in Table 3; and
- The total number of hours that each source vessel will be operating during the data acquisition period.

The estimated number of hours that the sonar equipment will operate was determined by assuming a 25% downtime during a 45-day survey period, which is a total of 816 hours (34 days of 24 hour operations).

These estimated exposures do not take into account the mitigation measures that will be implemented, such as marine mammal observers watching for animals, shutdowns or power downs of the equipment when marine mammals are seen within defined ranges. These measures will further reduce the number of exposures and expected short-term reactions, and minimize any effects on hearing sensitivity.

A summary of the request takes and percent take among the population is provided in Table 4.

Table 4. The total number of potential exposures of marine mammals to sound levels ≥160 dB re 1 µPa rms during the Hilcorp's proposed shallow geohazard survey in the Beaufort Sea, Alaska, 2015. Estimates are also shown as a percent of each population

Species	Abundance	Number potential exposure	% Estimated population

Beluga whale (Beaufort Sea stock)	39,258	45	0.11%
Bowhead whale	19,534	12	0.06%
Gray whale	19,126	3	0.02%
Bearded seal	155,000	100	0.06%
Ringed seal	300,000	350	0.17%
Spotted seal	141,479	120	0.08%

Analysis and Preliminary Determinations

Negligible Impact

Negligible impact is "an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival" (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (i.e., population-level effects). An estimate of the number of Level B harassment takes, alone, is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be "taken" through behavioral harassment, NMFS must consider other factors, such as the likely nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), as well as the number and nature of estimated Level A harassment takes, the number of estimated mortalities, effects on habitat, and the status of the species.

No injuries or mortalities are anticipated to occur as a result of Hilcorp's proposed shallow geohazard survey, and none are proposed to be authorized. Additionally, animals in the area are not expected to incur hearing impairment (i.e., TTS or PTS) or non-auditory physiological effects. The takes that are anticipated and authorized are expected to be limited to short-term Level B behavioral harassment. While the sonar sources are expected to be operated

for approximately 45 days, the project timeframe will occur when cetacean species are typically not found in the project area or are found only in low numbers. While pinnipeds are likely to be found in the proposed project area more frequently, their distribution is dispersed enough that they likely will not be in the Level B harassment zone continuously. As mentioned previously in this document, pinnipeds appear to be more tolerant of anthropogenic sound than mysticetes.

Most of the marine mammals encountered will likely show overt disturbance (avoidance) only if they receive sonar sounds with levels ≥ 160 dB re 1 μPa. However, the estimated 160 dB zone is only 30 m from the source, which means that the animals have to be very close to the source vessel to be exposure to noise levels that could cause Level B harassment. In addition, Hilcorp will implement shutdown measures if a marine mammal is sighted within or is moving towards the 160 dB isopleths.

Taking into account the mitigation measures that are planned, effects on marine mammals are generally expected to be restricted to avoidance of a limited area around Hilcorp's proposed open-water activities and short-term changes in behavior, falling within the MMPA definition of "Level B harassment." Mitigation measures, such as controlled vessel speed, dedicated marine mammal observers, non-pursuit, ramp up procedures, and shut downs or power downs when marine mammals are seen within or approaching the ZOI, will further reduce short-term reactions. In all cases, the effects are expected to be short-term, with no lasting biological consequence.

Of the six marine mammal species likely to occur in the proposed marine survey area, bowhead whale and ringed seal are listed as endangered and threatened under the ESA, respectively. These species are also designated as "depleted" under the MMPA. Despite these

designations, the Bering-Chukchi-Beaufort stock of bowheads has been increasing at a rate of 3.4 percent annually for nearly a decade (Allen and Angliss 2010). Additionally, during the 2001 census, 121 calves were counted, which was the highest yet recorded. The calf count provides corroborating evidence for a healthy and increasing population (Allen and Angliss 2010). There is no critical habitat designated in the U.S. Arctic for the bowhead whales. The Arctic stock of ringed seals have been listed by NMFS as threatened under the ESA. None of the other species that may occur in the project area are listed as threatened or endangered under the ESA or designated as depleted under the MMPA.

Potential impacts to marine mammal habitat were discussed previously in this document (see the "**Anticipated Effects on Habitat**" section). Although some disturbance of food sources of marine mammals is possible, any impacts are anticipated to be minor enough as to not affect rates of recruitment or survival of marine mammals in the area. The marine survey activities would occur in a localized area, and given the vast area of the Arctic Ocean where feeding by marine mammals occurs, any missed feeding opportunities in the direct project area could be offset by feeding opportunities in other available feeding areas.

In addition, no important feeding or reproductive areas are known in the vicinity of Hilcorp's proposed shallow geohazard survey. No critical habitat of ESA-listed marine mammal species occurs in the Beaufort Sea.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from Hilcorp's proposed shallow geohazard survey in the Beaufort Sea, Alaska,

will have a negligible impact on the affected marine mammal species or stocks.

Small Numbers

The requested takes proposed to be authorized represent less than 0.2% of all populations or stocks potentially impacted (see Table 4 in this document). These take estimates represent the percentage of each species or stock that could be taken by Level B behavioral harassment if each animal is taken only once. The numbers of marine mammals estimated to be taken are small proportions of the total populations of the affected species or stocks. In addition, the mitigation and monitoring measures (described previously in this document) proposed for inclusion in the IHA (if issued) are expected to reduce even further any potential disturbance to marine mammals.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the mitigation and monitoring measures, NMFS preliminarily finds that small numbers of marine mammals will be taken relative to the populations of the affected species or stocks.

Impact on Availability of Affected Species or Stock for Taking for Subsistence Uses

Relevant Subsistence Uses

Marine mammals are legally hunted in Alaskan waters by coastal Alaska Natives and represent between 60% and 80% of their total subsistence harvest. The species regularly harvested by subsistence hunters in and around the Beaufort Sea are bowhead and beluga whales, and ringed, spotted, and bearded seals. The importance of each of the subsistence species varies among the communities and is mainly based on availability and season.

The communities closest to the project area are, from west to east, the villages of Barrow, Nuiqsut and Kaktovik. Barrow is located >200 mi west from the Hilcorp's proposed survey area.

It is the largest community on the Alaska's Beaufort Sea coast. Important marine subsistence resources for Barrow include bowhead and beluga whales, and ice seals. Nuiqsut is located near the mouth of the Colville River, about 55 mi southwest of the proposed project area. Most important marine subsistence resource for Nuiqsut is the bowhead whale, and to a lesser extent belugas and seals. Nuiqsut hunters use Cross Island, (~20 mi northwest of the project area) as a base to hunt for bowhead whales during the fall migration and have historically hunted bowhead whales as far east as Flaxman Island. Kaktovik is located on Barter Island, about 120 mi east of the project area. Major marine subsistence resources include bowhead and beluga whales, and seals.

(1) Bowhead Whale

The bowhead whale is a critical subsistence and cultural resource for the North Slope communities of Barrow, Nuiqsut, and Kaktovik. The level of allowable harvest is determined under a quota system in compliance with the International Whaling Commission (IWC 1980; Gambell 1982). The quota is based on the nutritional and cultural needs of Alaskan Natives as well as on estimates of the size and growth of the Bering-Chukchi-Beaufort seas stock of bowhead whales (Donovan 1982; Braund 1992). The AEWC allots the number of bowhead whales that each community is permitted to harvest. Contemporary whaling in Kaktovik dates from 1964 and in Nuiqsut from 1973 (EDAW/AECOM 2007; Galginaitis and Koski 2002). The number of boats used or owned in 2011 by the subsistence whaling crew of the villages of Kaktovik, Nuiqsut, and Barrow was 8, 12, and 40, respectively. These numbers presumably change from year to year.

Bowhead harvesting in Barrow occurs both during the spring (April-May) and fall

(September-October) when the whales migrate relatively close to shore (ADNR 2009). During spring bowheads migrate through open ice leads close to shore. The hunt takes place from the ice using umiaks (bearded seal skin boats). During the fall, whaling is shore-based and boats may travel up to 30 mi a day (EDAW/AECOM 2007). In Barrow, most whales were historically taken during spring whaling. More recently, however, the efficiency of the spring harvest appeared to be lower than the autumn harvest due to ice and weather conditions as well as struck whales escaping under the ice (Suydam *et al*. 2010). In the past few years the bowhead fall hunt has become increasingly important.

Nuiqsut and Kaktovik hunters harvest bowhead whales only during the fall. The bowhead spring migration in the Beaufort Sea occurs too far from shore for hunting because ice leads do not open up nearshore (ADNR 2009). In Nuiqsut, whaling takes place from early September through mid-to-late September as the whales migrate west (EDAW/AECOM 2007). Three to five whaling crews base themselves at Cross Island, a barrier island approximately 20 mi northwest of the Liberty Unit shallow geohazard survey area. Nuiqsut whalers harvest an average of 2 bowheads each year. Whaling from Kaktovik also occurs in the fall, primarily from late August through late September or early October (EDAW/AECOM 2007). Kaktovik whalers hunt from the Okpilak and Hulahula rivers east to Tapkaurak Point (ADNR 2009). Whaling activities are staged from the community rather than remote camps; most whaling takes place within 12 mi of the community (ADNR 2009). Kaktovik whalers harvest an average of 2–3 bowhead whales each year.

(2) Beluga

The harvest of belugas is managed cooperatively through an agreement between NMFS

and the Alaska Beluga Whale Committee (ABWC). From 2005-2009, between 5 and 48 belugas were harvested annually from the Beaufort Sea stock (Allen and Angliss 2014); with a mean annual take of 25.8 animals. Both Nuiqsut and Kaktovik harvest few belugas, mostly opportunistically during the fall bowhead hunt.

(3) Seals

Seals represent an important subsistence resource for the North Slope communities. Harvest of bearded seals usually takes place during the spring and summer open water season from Barrow (EDAW/AECOM 2007) with only a few animals taken by hunters from Kaktovik or Nuiqsut. Seals are also taken during the ice-covered season, with peak hunting occurring in February (ADNR 2009). In 2003, Barrow-based hunters harvested 776 bearded seals, 413 ringed seals and 12 spotted seals (ADNR 2009). Nuiqsut hunters harvest seals in an area from Cape Halkett to Foggy Island Bay. For the period 2000-2001, Nuiqsut hunters harvested one bearded seal and 25 ringed seals (ADNR 2009). Kaktovik hunters also hunt seals year-round. In 2002-2003, hunters harvested 8 bearded seals and 17 ringed seals.

Potential Impacts to Subsistence Uses

NMFS has defined "unmitigable adverse impact" in 50 CFR 216.103 as: "an impact resulting from the specified activity: (1) That is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (i) Causing the marine mammals to abandon or avoid hunting areas; (ii) Directly displacing subsistence users; or (iii) Placing physical barriers between the marine mammals and the subsistence hunters; and (2) That cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

The proposed shallow geohazard survey will take place between July 1 and September 30, 2015, with data acquisition occurring in July and August. The project area is located >200 mi east from Barrow, approximately 55 mi northeast from Nuiqsut (20 mi southeast of Cross Island), and 120 mi west from Kaktovik. Potential impact on the subsistence hunt from the planned activities is expected mainly from sounds generated by sonar equipment. Due to the timing of the project and the distance from the surrounding communities, there will be no effects on spring harvesting and little or no effects on the occasional summer harvest of beluga and subsistence seal hunts (ringed and spotted seals are primarily harvested in winter while bearded seals are hunted during July-September in the Beaufort Sea). The community of Nuiqsut may begin fall whaling activities in late August to early September from Cross Island (northwest of the survey area).

Plan of Cooperation or Measures to Minimize Impacts to Subsistence Hunts

(1) Plan of Cooperation

Regulations at 50 CFR 216.104(a)(12) require IHA applicants for activities that take place in Arctic waters to provide a Plan of Cooperation (POC) or information that identifies what measures have been taken and/or will be taken to minimize adverse effects on the availability of marine mammals for subsistence purposes.

Hilcorp has prepared a draft POC and is currently establishing a dialogue to coordinate activities with the villages. A POC will include the aforementioned mitigation measures and includes plans for and results of meetings with Alaska Native communities.

Liberty Unit was transferred to Hilcorp ownership along with the Northstar, Milne Point and Endicott facilities. Previously, BP Exploration, Alaska (BPXA) coordinated with

communities and stakeholders regarding the Liberty Unit work during the 2014 season:

- December 13 - 14, 2012: Meeting with the Alaska Eskimo Whaling Commission (AEWC) and Whaling Captains' Associations during the AEWC Quarterly meeting in Anchorage.
- February 7 - 8, 2013: CAA discussions with AEWC and Whaling Captains' Associations during the AEWC Annual Convention in Barrow.

Hilcorp plans to continue attending the above meetings and has engaged stakeholders and Native community members throughout 2014. A list of meetings follows:

- Informal engagement with AEWC - July 2014
- Meeting with Native Village of Barrow leadership – August 2014
- Meeting with North Slope Borough (NSB) Wildlife Management Dept. – August 2014
- Meeting with NSB Assembly – August 2014
- Meeting with NSB Planning Commission – October 2014
- Presentation and discussion with AEWC – October 2014
- Meeting with NSB Jacob Adams and NSB Counsel – October 2014
- Cultural awareness/subsistence presentation and Q&A with Uum's Consulting – October 2014

Additional pre-season meetings maybe planned if needed to address additional requests for coordination. Any subsistence discussions will be documented and forwarded to the NMFS as part of the POC.

(2) Stakeholder Engagement

Hilcorp has begun discussions with the AEWC to develop a Conflict Avoidance Agreement (CAA) intended to minimize potential interference with bowhead subsistence hunting. Hilcorp will attend and participate in the CAA meetings scheduled in 2015. The CAA, when executed, will describe measures to minimize any adverse effects on the availability of bowhead whales for subsistence uses.

The North Slope Borough Department of Wildlife Management (NSB-DWM) was consulted, and the project was also presented to the NSB Planning Commission in January 2015. Hilcorp will hold meetings with key stakeholders in the community of Nuiqsut, Barrow, and Kaktovik to present the proposed project, address questions and concerns, and provide them with contact information of project management to which they can direct concerns during the survey.

The following are measures that Hilcorp will take to reduce impacts to the subsistence community:

- Hilcorp will comply with the CAA terms to address plans to meet with the affected community to resolve conflicts and notify the communities of any changes in the operation.
- Inupiat Marine Mammal Observers on board the vessels are tasked with looking out for whales and other marine mammals in the vicinity of the vessel to assist the vessel captain in avoiding harm to whales and other marine mammals.
- Vessels will be operated in a manner to avoid areas where species that are sensitive to noise or movement are concentrated at times when such species are concentrated.
- Communications and conflict resolution are detailed in the CAA. Hilcorp is

planning to participate in the Communications Center that is operated annually during the bowhead subsistence hunt.

- Communications with the villages of Barrow, Kaktovik, and Nuiqsut – discuss community questions or concerns including all subsistence hunting activities.

(3) Future Plan of Cooperation Consultations

Hilcorp plans to engage with the relevant subsistence communities regarding its future Beaufort Sea activities. With regard to the 2015 Liberty Unit shallow geohazard survey project, Hilcorp will present the data on marine mammal sightings and the results of the marine mammal monitoring and mitigation as part of our 90-day report to the regulatory authorities.

Unmitigable Adverse Impact Analysis and Preliminary Determination

NMFS considers that these mitigation measures including measures to reduce overall impacts to marine mammals in the vicinity of the proposed shallow geohazard survey area and measures to mitigate any potential adverse effects on subsistence use of marine mammals are adequate to ensure subsistence use of marine mammals in the vicinity of Hilcorp's proposed survey in the Beaufort Sea.

Based on the description of the specified activity, the measures described to minimize adverse effects on the availability of marine mammals for subsistence purposes, and the proposed mitigation and monitoring measures, NMFS has preliminarily determined that there will not be an unmitigable adverse impact on subsistence uses from Hilcorp's proposed activities.

Endangered Species Act (ESA)

There are two marine mammal species listed as endangered under the ESA with confirmed or possible occurrence in the proposed project area: the bowhead whale and ringed

seal. NMFS' Permits and Conservation Division has initiated consultation with NMFS' Endangered Species Division under section 7 of the ESA on the issuance of an IHA to Hilcorp under section 101(a)(5)(D) of the MMPA for this activity. Consultation will be concluded prior to a determination on the issuance of an IHA.

National Environmental Policy Act (NEPA)

NMFS is preparing an Environmental Assessment (EA), pursuant to NEPA, to determine whether the issuance of an IHA to Hilcorp for its 2015 shallow geohazard activities may have a significant impact on the human environment. NMFS has released a draft of the EA for public comment along with this proposed IHA.

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to issue an IHA to Hilcorp for conducting shallow geohazard survey in the Beaufort Sea during the 2015 Arctic open-water season, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. The proposed IHA language is provided next.

This section contains a draft of the IHA itself. The wording contained in this section is proposed for inclusion in the IHA (if issued).

(1) This Authorization is valid from July 1, 2015, through September 30, 2015.

(2) This Authorization is valid only for activities associated with Hilcorp's 2015 Beaufort Sea shallow geohazard survey. The specific area where Hilcorp's shallow geohazard survey will be conducted lies within Foggy Island Bay in the U.S. Beaufort Sea, as shown in Figure 1 of Hilcorp's IHA application.

(3)(a) The incidental taking of marine mammals, by Level B harassment only, is limited

to the following species: bowhead whale; gray whale; beluga whale; ringed seal; bearded seal; and spotted seal, as shown in Table 4.

(3)(b) The authorization for taking by harassment is limited to the following acoustic sources and from the following activities:

(i) Sonar sources used for shallow geohazard survey; and

(ii) Vessel activities related to the shallow geohazard survey.

(3)(c) The taking of any marine mammal in a manner prohibited under this Authorization must be reported within 24 hours of the taking to the Alaska Regional Administrator (907-586-7221) or his designee in Anchorage (907-271-3023), National Marine Fisheries Service (NMFS) and the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, at (301) 427-8401, or her designee (301-427-8418).

(4) The holder of this Authorization must notify the Chief of the Permits and Conservation Division, Office of Protected Resources, at least 48 hours prior to the start of shallow geohazard survey (unless constrained by the date of issuance of this Authorization in which case notification shall be made as soon as possible).

(5) Prohibitions

(a) The taking, by incidental harassment only, is limited to the species listed under condition 3(a) above and by the numbers listed in Table 4. The taking by injury or death of these species or the taking by harassment, injury or death of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this Authorization.

(b) The taking of any marine mammal is prohibited whenever the required source vessel protected species observers (PSOs), required by condition 7(a)(i), are not onboard in

conformance with condition 7(a)(i) of this Authorization.

(6) Mitigation

(a) Establishing Zone of Influence (ZOI)

(i) Establish and monitor with trained PSOs a ZOI zone surrounding the sub-bottom profiler on the source vessel where the received level would be 160 dB (rms) re 1 µPa for all marine mammals.

(ii) The sizes of the ZOI is 50 m radius from the source vessel.

(b) Vessel Movement Mitigation:

(i) Avoid concentrations or groups of whales by all vessels under the direction of Hilcorp.

(ii) If any vessel approaches within 1.6 km (1 mi) of observed bowhead whales, except when providing emergency assistance to whalers or in other emergency situations, the vessel operator will take reasonable precautions to avoid potential interaction with the bowhead whales by taking one or more of the following actions, as appropriate:

(A) Reducing vessel speed to less than 5 knots within 300 yards (900 feet or 274 m) of the whale(s);

(B) Steering around the whale(s) if possible;

(C) Operating the vessel(s) in such a way as to avoid separating members of a group of whales from other members of the group;

(D) Operating the vessel(s) to avoid causing a whale to make multiple changes in direction; and

(E) Checking the waters immediately adjacent to the vessel(s) to ensure that no whales will be injured when the propellers are engaged.

(iii) When weather conditions require, such as when visibility drops, adjust vessel speed accordingly, but not to exceed 5 knots, to avoid the likelihood of injury to whales.

(iv) In general, the survey design will start in shallow water and work deeper to mitigate the potential "herding" effect.

(c) Mitigation Measures for Sonar Sources

(i) Ramp-up:

(A) A ramp up, following a cold start, can be applied if the ZOI has been free of marine mammals for a consecutive 30-minute period. The entire ZOI must have been visible during these 30 minutes. If the entire ZOI is not visible, then ramp up from a cold start cannot begin.

(B) If a marine mammal(s) is sighted within the ZOI during the 30-minute watch prior to ramp up, ramp up will be delayed until the marine mammal(s) is sighted outside of the ZOI or the animal(s) is not sighted for at least 15 minutes for pinnipeds, or 30 minutes for cetaceans.

(C) If, for any reason, the sub-bottom profiler has been discontinued for a period of 10 minutes or more, ramp-up procedures shall be implemented. If the PSO watch has been suspended during that time, a 30-minute clearance of the ZOI is required prior to commencing ramp-up. Discontinuation of sonar activity for less than 10 minutes does not require

a ramp-up.

(D) The survey operator and PSOs shall maintain records of the times when ramp-ups start and when the sub-bottom profiler reaches full power.

(ii) Power-down/Shutdown:

(A) The sub-bottom profiler shall be immediately powered down whenever a marine mammal is sighted approaching close to or within the sub-bottom profiler at full power, but is outside the ZOI of the sub-bottom profiler at reduced power.

(B) If a marine mammal is already within or is about to enter the ZOI when first detected, the sub-bottom profiler shall be shutdown immediately.

(C) After showdown for more than 10 minutes, ramp-up shall not start until after the marine mammal is visually seen left the ZOI; or 15 minutes have passed after the last detection of the marine mammal with shorter dive durations (pinnipeds and small odontocetes); or 30 minutes have passed after the last detection of the marine mammal with longer diver durations (mysticetes and large odontocetes, including beluga whales).

(iii) Poor Visibility Conditions:

(A) If during foggy conditions, heavy snow or rain, or darkness, the full 160 dB ZOI is not visible, the sub-bottom profiler cannot commence a ramp-up procedure from a full shut-down.

(B) If the sub-bottom profiler has been operational before nightfall or before the onset of poor visibility conditions, they can remain operational

throughout the night or poor visibility conditions.

(iv) Firing Sub-bottom Profiler During Turns and Transits

(A) Throughout the shallow geohazard survey, during turning movements and short transits, Hilcorp will employ the use of the lowest setting for the sub-bottom profiler to deter marine mammals from being within the immediate area of the survey. The sub-bottom profiler would be operated at approximately one shot per minute and would not be operated for longer than three hours in duration.

(d) Mitigation Measures for Subsistence Activities:

(i) For the purposes of reducing or eliminating conflicts between subsistence whaling activities and Hilcorp's survey program, the holder of this Authorization will participate with other operators in the Communication and Call Centers (Com-Center) Program. Com-Centers will be operated to facilitate communication of information between Hilcorp and subsistence whalers. The Com-Centers will be operated 24 hours/day during the 2015 fall subsistence bowhead whale hunt.

(ii) All vessels shall report to the appropriate Com-Center at least once every six hours, commencing each day with a call at approximately 06:00 hours.

(iii) The appropriate Com-Center shall be notified if there is any significant change in plans. The appropriate Com-Center also shall be called regarding any unsafe or unanticipated ice conditions.

(iv) Upon notification by a Com-Center operator of an at-sea emergency, the holder of this Authorization shall provide such assistance as necessary to prevent the loss of

life, if conditions allow the holder of this Authorization to safely do so.

(v) Hilcorp shall monitor the positions of all of its vessels and exercise due care in avoiding any areas where subsistence activity is active.

(vi) Routing barge and transit vessels:

(A) Vessels transiting in the Beaufort Sea east of Bullen Point to the Canadian border shall remain at least 5 miles offshore during transit along the coast, provided ice and sea conditions allow.

(B) From August 31 to October 31, vessels in the Chukchi Sea or Beaufort Sea shall remain at least 20 miles offshore of the coast of Alaska from Icy Cape in the Chukchi Sea to Pitt Point on the east side of Smith Bay in the Beaufort Sea, unless ice conditions or an emergency that threatens the safety of the vessel or crew prevents compliance with this requirement. This condition shall not apply to vessels actively engaged in transit to or from a coastal community to conduct crew changes or logistical support operations.

(C) Vessels shall be operated at speeds necessary to ensure no physical contact with whales occurs, and to make any other potential conflicts with bowheads or whalers unlikely. Vessel speeds shall be less than 10 knots in the proximity of feeding whales or whale aggregations.

(D) If any vessel inadvertently approaches within 1.6 kilometers (1 mile) of observed bowhead whales, except when providing emergency assistance to whalers or in other emergency situations, the vessel operator will take

reasonable precautions to avoid potential interaction with the bowhead whales by taking one or more of the following actions, as appropriate:

- Reducing vessel speed to less than 5 knots within 900 feet of the whale(s);
- Steering around the whale(s) if possible;
- Operating the vessel(s) in such a way as to avoid separating members of a group of whales from other members of the group;
- Operating the vessel(s) to avoid causing a whale to make multiple changes in direction; and
- Checking the waters immediately adjacent to the vessel(s) to ensure that no whales will be injured when the propellers are engaged.

(vii) Hilcorp shall complete operations in time to allow such vessels to complete transit through the Bering Strait to a point south of 59 degrees North latitude no later than November 15, 2015. Any vessel that encounters weather or ice that will prevent compliance with this date shall coordinate its transit through the Bering Strait to a point south of 59 degrees North latitude with the appropriate Com-Centers. Hilcorp vessels shall, weather and ice permitting, transit east of St. Lawrence Island and no closer than 10 miles from the shore of St. Lawrence Island.

(7) Monitoring:

(a) Vessel-based Visual Monitoring:

(i) Vessel-based visual monitoring for marine mammals shall be conducted by NMFS-approved PSOs throughout the period of survey activities.

(ii) PSOs shall be stationed aboard the survey vessels through the duration of the surveys.

(iii) A sufficient number of PSOs shall be onboard the survey vessel to meet the following criteria:

(A) 100% monitoring coverage during all periods of survey operations in daylight;

(B) Maximum of 4 consecutive hours on watch per PSO; and

(C) Maximum of 12 hours of watch time per day per PSO.

(iv) The vessel-based marine mammal monitoring shall provide the basis for real-time mitigation measures as described in (6)(c) above.

(v) Results of the vessel-based marine mammal monitoring shall be used to calculate the estimation of the number of "takes" from the marine surveys and equipment recovery and maintenance program.

(b) Protected Species Observers and Training

(i) PSO teams shall consist of Inupiat observers and NMFS-approved field biologists.

(ii) Experienced field crew leaders shall supervise the PSO teams in the field. New PSOs shall be paired with experienced observers to avoid situations where lack of experience impairs the quality of observations.

(iii) Crew leaders and most other biologists serving as observers in 2015 shall be individuals with experience as observers during recent seismic or shallow hazards

monitoring projects in Alaska, the Canadian Beaufort, or other offshore areas in recent years.

(iv) Resumes for PSO candidates shall be provided to NMFS for review and acceptance of their qualifications. Inupiat observers shall be experienced in the region and familiar with the marine mammals of the area.

(v) All observers shall complete a training course designed to familiarize individuals with monitoring and data collection procedures. The training course shall be completed before the anticipated start of the 2015 open-water season. The training session(s) shall be conducted by qualified marine mammalogists with extensive crew-leader experience during previous vessel-based monitoring programs.

(vi) Crew members should not be used as primary PSOs because they have other duties and generally do not have the same level of expertise, experience, or training as PSOs, but they could be stationed on the fantail of the vessel to observe the near field, especially the area around the survey vessels, and implement a power-down or shutdown if a marine mammal enters the safety zone (or exclusion zone).

(vii) If crew members are to be used as PSOs, they shall go through some basic training consistent with the functions they will be asked to perform. The best approach would be for crew members and PSOs to go through the same training together.

(viii) PSOs shall be trained using visual aids (e.g., videos, photos), to help them identify the species that they are likely to encounter in the conditions under which the

animals will likely be seen.

(ix) Hilcorp shall train its PSOs to follow a scanning schedule that consistently distributes scanning effort according to the purpose and need for observations. All PSOs should follow the same schedule to ensure consistency in their scanning efforts.

(x) PSOs shall be trained in documenting the behaviors of marine mammals. PSOs should record the primary behavioral state (i.e., traveling, socializing, feeding, resting, approaching or moving away from vessels) and relative location of the observed marine mammals.

(c) Marine Mammal Observation Protocol

(i) PSOs shall watch for marine mammals from the best available vantage point on the survey vessels, typically the bridge.

(ii) Observations by the PSOs on marine mammal presence and activity shall begin a minimum of 30 minutes prior to the estimated time that the sub-bottom profiler is to be turned on and/or ramped-up. Monitoring shall continue during the survey operations and last until 30 minutes after the sonar equipment stop firing.

(iii) For comparison purposes, PSOs shall also document marine mammal occurrence, density, and behavior during at least some periods when the sonar equipment used for survey is off.

(iv) PSOs will scan the area around the vessel systematically with reticle binoculars (e.g., 7 × 50 and 16-40 × 80) and with the naked eye. GPS unit and laptop computer(s) will also be available for PSOs onboard survey vessels.

(v) Personnel on the bridge shall assist the marine mammal observer(s) in watching for marine mammals.

(vi) PSOs aboard the marine survey vessel shall give particular attention to the areas within the marine mammal ZOI around the source vessel, as noted in (6)(a)(i) and (ii). They shall avoid the tendency to spend too much time evaluating animal behavior or entering data on forms, both of which detract from their primary purpose of monitoring the exclusion zone.

(vii) Monitoring shall consist of recording of the following information:

(A) The species, group size, age/size/sex categories (if determinable), the general behavioral activity, heading (if consistent), bearing and distance from survey vessel, sighting cue, behavioral pace, and apparent reaction of all marine mammals seen near the survey vessel (e.g., none, avoidance, approach, paralleling, etc);

(B) The time, location, heading, speed, and activity of the vessel (sub-bottom profiler firing or not), along with sea state, visibility, cloud cover and sun glare at (I) any time a marine mammal is sighted (including pinnipeds hauled out on barrier islands), (II) at the start and end of each watch, and (III) during a watch (whenever there is a change in one or more variable);

(C) The identification of all vessels that are visible within 5 km of the survey vessel whenever a marine mammal is sighted and the time observed;

(D) Any identifiable marine mammal behavioral response (sighting data should be collected in a manner that will not detract from the PSO's ability

to detect marine mammals);

(E) Any adjustments made to operating procedures; and

(F) Visibility during observation periods so that total estimates of take can be corrected accordingly.

(vii) Distances to nearby marine mammals will be estimated with binoculars containing a reticle to measure the vertical angle of the line of sight to the animal relative to the horizon. Observers may use a laser rangefinder to test and improve their abilities for visually estimating distances to objects in the water.

(viii) PSOs shall understand the importance of classifying marine mammals as "unknown" or "unidentified" if they cannot identify the animals to species with confidence. In those cases, they shall note any information that might aid in the identification of the marine mammal sighted. For example, for an unidentified mysticete whale, the observers should record whether the animal had a dorsal fin.

(ix) Additional details about unidentified marine mammal sightings, such as "blow only," mysticete with (or without) a dorsal fin, "seal splash," etc., shall be recorded.

(x) When a marine mammal is seen approaching or within the exclusion zone applicable to that species, the marine survey crew shall be notified immediately so that mitigation measures described in (6) can be promptly implemented.

(d) Field Data-Recording and Verification

(i) PSOs aboard the vessels shall maintain a digital log of shallow geohazard survey, noting the date and time of all changes in survey activity (ramp-up, power-down,

shutdowns, etc.) and any corresponding changes in monitoring radii in a software spreadsheet.

(ii) PSOs shall utilize a standardized format to record all marine mammal observations and mitigation actions (sub-bottom profiler power-downs, shut-downs, and ramp-ups).

(iii) Information collected during marine mammal observations shall include the following:

(A) Vessel speed, position, and activity

(B) Date, time, and location of each marine mammal sighting

(C) Number of marine mammals observed, and group size, sex, and age categories

(D) Observer's name and contact information

(E) Weather, visibility, and ice conditions at the time of observation

(F) Estimated distance of marine mammals at closest approach

(G) Activity at the time of observation, including possible attractants present

(H) Animal behavior

(I) Description of the encounter

(J) Duration of encounter

(K) Mitigation action taken

(iv) Data shall be recorded directly into handheld computers or as a back-up, transferred from hard-copy data sheets into an electronic database.

(v) A system for quality control and verification of data shall be facilitated by the pre-

season training, supervision by the lead PSOs, and in-season data checks, and shall be built into the software.

(vi) Computerized data validity checks shall also be conducted, and the data shall be managed in such a way that it is easily summarized during and after the field program and transferred into statistical, graphical, or other programs for further processing.

(e) Passive Acoustic Monitoring

(i) Hilcorp shall conduct passive acoustic monitoring using fixed hydrophone(s) to

(A) Document ambient noise conditions;

(B) Examine the spatial and temporal distribution of marine mammals based on acoustic detections of their vocalizations; and

(C) Characterize the long-range propagation of sounds produced during the geohazard survey; and

(ii) Bottom-Mounted Acoustic Sensors:

(A) Recorders shall be capable of recording marine mammal sounds and making both ambient and anthropogenic noise measurements.

(B) Two recorders be deployed near the Liberty prospect and be aligned with the geohazard survey line, at distances of 500 m (AMAR with sampling rate of 64 kHz) and 5000 m (AMAR with sampling rate of 380 kHz) from the offshore end of the survey line.

(C) Recorders shall be located inside of the barrier islands.

(8) Data Analysis and Presentation in Reports:

(a) Estimation of potential takes or exposures shall be improved for times with low visibility (such as during fog or darkness) through interpolation or possibly using a probability approach. Those data could be used to interpolate possible takes during periods of restricted visibility.

(b) Hilcorp shall provide the information collected, plus a number of summary analyses and graphics to help NMFS assess the potential impacts of Hilcorp's survey. Specific summaries/analyses/graphics would include:

(i) A table or other summary of survey activities (i.e., did the survey proceed as planned);

(ii) A table of sightings by time, location, species, and distance from the survey vessel;

(iii) A geographic depiction of sightings for each species by area and month;

(iv) A table and/or graphic summarizing behaviors observed by species;

(v) A table and/or graphic summarizing observed responses to the survey by species;

(vi) A table of mitigation measures (e.g., power-downs, shutdowns) taken by date, location, and species;

(vii) A graphic of sightings by distance for each species and location;

(viii) A table or graphic illustrating sightings during the survey versus sightings when the sub-bottom profiler was silent; and

(ix) A summary of times when the survey was interrupted because of interactions with marine mammals.

(c) Hilcorp shall collaborate with other industrial operators in the area to integrate and

synthesize monitoring results as much as possible (such as submitting "sightings" from their monitoring projects to an online data archive, such as OBIS-SEAMAP) and archive and make the complete databases available upon request.

(9) Reporting:

(a) Technical report: A draft technical report will be submitted to the Director, Office of Protected Resources, NMFS, within 90 days after the end of HIlcorp's 2015 open-water shallow geohazard survey in the Beaufort Sea. The report will describe in detail:

(i) Summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals);

(ii) Summaries that represent an initial level of interpretation of the efficacy, measurements, and observations, rather than raw data, fully processed analyses, or a summary of operations and important observations;

(iii) Summaries of all mitigation measures (e.g., operational shutdowns if they occur) and an assessment of the efficacy of the monitoring methods;

(iv) Analyses of the effects of various factors influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare);

(v) 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;

(vi) Data analysis separated into periods when the sub-bottom profiler is operating and when it is not, to better assess impacts to marine mammals;

(vii) Sighting rates of marine mammals during periods with and without the sub-bottom profiler (and other variables that could affect detectability), such as:

(A) Initial sighting distances versus survey activity state;

(B) Closest point of approach versus survey activity state;

(C) Observed behaviors and types of movements versus survey activity state;

(D) Numbers of sightings/individuals seen versus survey activity state;

(E) Distribution around the survey vessel versus survey activity state; and

(F) Estimates of take by harassment;

(viii) A clear comparison of authorized takes and the level of actual estimated takes;

(ix) Cumulative sound exposure level over 24 hours ($cSEL_{24}$), in particular during the use of the two sub-bottom profilers;

(x) Ground-truth of data collected by AMARs in consultation with biologists experienced in Arctic species vocalizations with error rates for automatic detection to ensure the accurate classification of vocalizations by species; and

(xi) Information of source levels and other acoustic characteristics of the active acoustics survey equipment, such as spectral content, and received levels in root-mean-squared (RMS) dB, sound exposure level (SEL), dB peak to peak and 1/3 octave bands.

(b) The draft technical report shall be subject to review and comment by NMFS. Any recommendations made by NMFS must be addressed in the final report prior to acceptance by NMFS. The draft report will be considered the final report for this activity under this Authorization if NMFS has not provided comments and recommendations within 90 days of

receipt of the draft report.

(c) Hilcorp will share data and work with its contractor JASCO to collaborate with other researchers. The passive acoustic recording data, including data on marine mammal vocalizations, will be made publically available for researchers.

(10) (a) In the unanticipated event that survey operations clearly cause the take of a marine mammal in a manner prohibited by this Authorization, such as an injury or mortality (e.g., ship-strike, gear interaction, and/or entanglement), Hilcorp shall immediately cease survey operations and immediately report the incident to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to *Jolie.Harrison@noaa.gov* and *Shane.Guan@noaa.gov* and the Alaska Regional Stranding Coordinators (*Aleria.Jensen@noaa.gov* and *Barbara.Mahoney@noaa.gov*). The report must include the following information:

(i) Time, date, and location (latitude/longitude) of the incident;

(ii) The name and type of vessel involved;

(iii) The vessel's speed during and leading up to the incident;

(iv) Description of the incident;

(v) Status of all sound source use in the 24 hours preceding the incident;

(vi) Water depth;

(vii) Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);

(viii) Description of marine mammal observations in the 24 hours preceding the incident;

(ix) Species identification or description of the animal(s) involved;

(x) The fate of the animal(s); and

(xi) Photographs or video footage of the animal (if equipment is available).

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS shall work with Hilcorp to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. Hilcorp may not resume their activities until notified by NMFS via letter, email, or telephone.

(b) In the event that Hilcorp discovers an injured or dead marine mammal, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (i.e., in less than a moderate state of decomposition as described in the next paragraph), Hilcorp will immediately report the incident to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401, and/or by email to *Jolie.Harrison@noaa.gov* and *Shane.Guan@noaa.gov* and the NMFS Alaska Stranding Hotline (1-877-925-7773) and/or by email to the Alaska Regional Stranding Coordinators (*Aleria.Jensen@noaa.gov* and *Barabara.Mahoney@noaa.gov*). The report must include the same information identified in Condition 10(a) above. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with Hilcorp to determine whether modifications in the activities are appropriate.

(c) In the event that Hilcorp discovers an injured or dead marine mammal, and the lead PSO determines that the injury or death is not associated with or related to the activities authorized in Condition 3 of this Authorization (e.g., previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), Hilcorp shall report the incident to

the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401, and/or by email to *Jolie.Harrison@noaa.gov* and *Shane.Guan@noaa.gov* and the NMFS Alaska Stranding Hotline (1-877-925-7773) and/or by email to the Alaska Regional Stranding Coordinators (*Aleria.Jensen@noaa.gov* and *Barbara.Mahoney@noaa.gov*), within 24 hours of the discovery. Hilcorp shall provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network. Hilcorp can continue its operations under such a case.

(11) Activities related to the monitoring described in this Authorization do not require a separate scientific research permit issued under section 104 of the Marine Mammal Protection Act.

(12) The Plan of Cooperation outlining the steps that will be taken to cooperate and communicate with the native communities to ensure the availability of marine mammals for subsistence uses, must be implemented.

(13) This Authorization may be modified, suspended, or withdrawn if the holder fails to abide by the conditions prescribed herein or if the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals, or if there is an unmitigable adverse impact on the availability of such species or stocks for subsistence uses.

(14) A copy of this Authorization and the Incidental Take Statement must be in the possession of each survey vessel operator taking marine mammals under the authority of this Incidental Harassment Authorization.

(15) Hilcorp is required to comply with the Terms and Conditions of the Incidental Take Statement corresponding to NMFS' Biological Opinion.

Request for Public Comments

NMFS requests comment on our analysis, the draft authorization, and any other aspect of the Notice of Proposed IHA for Hilcorp's proposed shallow geohazard survey in the Beaufort Sea. Please include with your comments any supporting data or literature citations to help inform our final decision on Hilcorp's request for an MMPA authorization.

Dated: May 11, 2015.

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Donna S. Wieting,
Director,
Office of Protected Resources,
National Marine Fisheries Service.

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