Endangered Species Act Section 7(a)(2) Biological Opinion and Section 7(a)(4) Conference Opinion

Proposed Issuance of an Incidental Harassment Authorization to Hilcorp Alaska, LLC for Shallow Geohazard and Strudel Scour Surveys in Foggy Island Bay, Beaufort Sea, Alaska

NMFS Consultation Number: AKR-2015-9454

Action Agency: Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, NOAA

Consultation Conducted by: Alaska Region, National Marine Fisheries Service, NOAA

Approved by: _____

James W. Balsiger, Ph.D.
Administrator, Alaska Region

Date: 6/26/15

Table of Contents **Page**

Tables

Figures

Abbreviations and Acronyms

AMAR	autonomous multichannel acoustic recorder
CWA	Clean Water Act
dB	decibel
DPS	distinct population segment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
GPS	global positioning system
IHA	incidental harassment authorization
IWC	International Whaling Commission
kHz	kilohertz
kts	knots
MMPA	Marine Mammal Protection Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
Opinion	this biological opinion
Permits Division	NMFS Office of Protected Resources, Permits and Conservation Division
p-p	peak-to-peak
PSO	protected species observer
RMS	root mean square
SDI	satellite drilling island
ZOI	zone of influence
µPa	micropascal
0-p	peak

1 INTRODUCTION

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1536(a)(2)), requires federal agencies to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat. When a federal agency's action may affect ESA-listed species or critical habitat, consultation with National Marine Fisheries Service (NMFS) and/or the U.S. Fish and Wildlife Service is required (50 CFR 402.14(a)).

The NMFS Office of Protected Resources, Permits and Conservation Division (hereafter referred to as "the Permits Division"), proposes to issue an incidental harassment authorization (IHA) pursuant to section 101(a)(5)(D) of the Marine Mammal Protection Act of 1972, as amended (MMPA) (16 U.S.C. 1361 et seq.), to Hilcorp Alaska, LLC (Hilcorp) for harassment of marine mammals incidental to open-water shallow geohazard surveys in the Beaufort Sea (80 FR 27901).

The NMFS Alaska Region (hereafter referred to as "we") consulted with the Permits Division on the proposed action. This document represents our biological opinion (Opinion) on the action and its effects on ESA-listed species: endangered bowhead whales (*Balaena mysticetus*), threatened Arctic ringed seals (*Erignathus barbatus nauticus*), and Beringia Distinct Population Segment (DPS) bearded seals[1] (*Phoca hispida hispida*). The Opinion also considers effects on proposed critical habitat for Arctic ringed seals. We based our Opinion on the items included in the Permits Division's consultation initiation package and the best scientific and commercial data available, as found in: ESA listing documents, recovery plans, scientific publications, past biological opinions, and other sources of information. We prepared our Opinion in accordance with section 7(a)(2) of the ESA (16 U.S.C. 1536(a)(2)), associated implementing regulations (50 CFR 402), and agency policy and guidance (USFWS and NMFS 1998).

1.1 Consultation History

Our communication with the Permits Division regarding this consultation is summarized as follows:

- **January 12, 2015:** received IHA application and monitoring plan from the Permits Division for early review
- **January 14 to 20, 2015:** discussed IHA application and monitoring plan with the Permits Division and requested the Permits Division obtain additional information from the applicant
- **January 21 and 26, 2015:** received the applicant's clarifications on the permit application from the Permits Division
- **February 25, 2015:** received a section 7 consultation initiation request from the Permits Division
- **February 27, 2015:** received revised effects determinations from the Permits Division
- **April 29, 2015:** initiated formal consultation with the Permits Division

[1] On July 25, 2014, the U.S. District Court for Alaska issued a memorandum decision in a lawsuit challenging the listing of bearded seals under the ESA (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RPB). The decision vacated NMFS's listing of the Beringia distinct population segment of bearded seals as a threatened species. NMFS has appealed that decision. While the appeal is pending, our biological opinions will continue to address effects to bearded seals so that action agencies have the benefit of NMFS's analysis of the consequences of the proposed action on the species, even though the listing is not in effect.

2 DESCRIPTION OF THE ACTIONS

The proposed action for this consultation consists of three related components:

1. Hilcorp's proposed shallow geohazard and strudel scour surveys;
2. the associated proposed passive acoustic monitoring; and
3. the Permits Division's proposed issuance of an IHA.

2.1 Hilcorp's Shallow Geohazard and Strudel Scour Surveys

Hilcorp proposes to conduct vessel-based shallow geohazard and strudel scour surveys over a proposed subsea pipeline corridor in Foggy Island Bay, Beaufort Sea, Alaska. The purpose of the shallow geohazard survey is to identify and locate archaeological resources and potential geologic hazards on the seafloor and in the shallow subsurface. The strudel scour survey will investigate strudel scours[2] and ice gouges on the seafloor.

2.1.1 Dates and Duration

The surveys are expected to take approximately 45 days to complete, including weather and equipment downtime, between July 1 and September 30, 2015. To limit potential impacts to bowhead whale migration and subsistence hunting, all sonar activities will cease by August 25, 2015. Vessel transit, magnetometry, and demobilization of equipment will be the only project activities that will occur between August 26 and September 30, 2015.

2.1.2 Vessel

The proposed main geohazard survey vessel (M/V *Sidewinder* or equivalent) is approximately 12.2 m (40 ft) long and 4.3 m (14 ft) wide. The *Sidewinder* is currently stationed on the Alaska North Slope and will be prepared and launched at the West Dock Causeway. Vessel preparation will include the assembly and installation of navigation, acoustic, and safety equipment. Once assembled, the navigation and acoustic systems will be tested and calibrated at West Dock or at the project site.

During data acquisition, the *Sidewinder* will travel at approximately 5.6 km/hr (3 knots [kts]). Average cruising speed during transit to, from, or between areas of data acquisition will range from approximately 41 to 44 km/hr (22 to 24 kts).

Due to the extremely shallow waters in portions of the geohazard and strudel scour surveys areas, one or two additional small vessel(s) may be used to conduct surveys in very shallow waters. The additional small vessel(s) will likely be a skiff or inflatable craft with limited crew and range. Small vessel operations will be supported by the larger vessel.

Each survey vessel will be equipped with a global positioning system (GPS) receiving differential corrections from a variety of possible sources, including a shore-based kinematic base station.

Tidal corrections will be determined through GPS computation, comparison with any local tide gauges, or, if available, with tide gauges operated by other projects.

Support activities, such as crew transfers and vessel re-supply will occur primarily at West Dock, but could also occur at the Endicott satellite drilling island (SDI) or the Endicott SDI causeway. For

[2] Strudel scours are depressions in the seafloor caused by drainage of fresh water through holes and cracks (strudel) in sea ice.

protection from weather, the vessel may anchor near the West Dock causeway, near the barrier islands, or other safe harbor, near-shore locations.

The *Sidewinder* will also serve as the platform from which protected species observers (PSOs) will watch for marine mammals during project activities. Passive acoustic monitoring equipment will also be deployed from and retrieved with the *Sidewinder*.

2.1.3 Equipment

Table 1 shows the type and acoustic characteristics of the sonar equipment proposed for use during the surveys.

Table 1. Type and acoustic characteristics of sonar equipment proposed for use during Hilcorp's shallow geohazard and strudel scour surveys, Foggy Island Bay, Beaufort Sea, Alaska.

Equipment	Manufacturer and Model	Operating Frequency (kHz)	Horizontal Beamwidth (degrees)	Vertical Beamwidth (degrees)	Source Level (dB re 1 μPa_{rms} at 1m)	Maximum Pulse Rate (Hz)	Survey Type[1]
Single-beam echosounder	Odom	210	3	3	220	20	SG SS
Multibeam echosounder	Reson 7101 SV	240	1.5	1.8	220	40	SG SS
Side scan sonar	Edgetech 4125	400 900	0.45 0.25	50	215	75	SG SS
High-resolution (CHIRP) sub-bottom profiler	Edgetech 3200	2 to 24	15 to 24	15 to 24	210	3 to 10	SG
Low-resolution sub-bottom profiler	Applied Acoustics AA251	1 to 4	N/A	N/A	212	Not Provided[2]	SG

[1] Survey type: SG = shallow geohazard
SS = strudel scour

[2] Pulse rate not provided by the manufacturer. Depending on the setting, the pulse duration is 120, 150, or 180 microseconds.

A marine magnetometer will be used during both the shallow geohazard and strudel scour surveys to passively measure changes in magnetic fields over the seabed. Magnetometers do not produce sounds.

Due to the shallow waters in the project area and small size of the *Sidewinder*, systems will be towed in optimal groupings that best facilitate safe operations and data quality. The magnetometer will be towed approximately 37 m (121 ft) behind the vessel using a dual-conductor data cable protected by a polyurethane jacket. If the magnetometer requires additional support in shallow water, a small buoy (approximately 0.3 m [1 ft]) will be attached to it with polypropylene rope. The sidescan sonar will use a "tow-fish" towed behind the boat with a marine-armored coaxial tow cable. The tow distance will vary with water depth and vessel speed, but it will typically be towed at a distance roughly equivalent to the average water depth. In very shallow water, the sidescan sonar may be hard-mounted to a vessel pole arm. The echosounders will be hull-mounted.

2.1.4 Monitoring and Mitigation

Monitoring and mitigation measures for the surveys include:

- Employing PSOs during all project-related activities
- Vessel-related mitigation relating to movement and operation

- Establishing a zone of influence (ZOI)[3]
- Ramp-ups, power-downs, and shut-downs

These measures are discussed in more detail in Section 2.3 of this document.

2.2 Passive Acoustic Monitoring

JASCO Applied Sciences (Alaska), Inc. (JASCO) developed a passive acoustic monitoring plan for the shallow geohazard survey designed to:

- Document ambient noise conditions
- Examine the spatial and temporal distribution of marine mammals based on acoustic detections of their vocalizations
- Characterize the long-range propagation of sounds produced during the geohazard survey

Passive acoustic monitoring data will be collected with JASCO's specialized autonomous multichannel acoustic recorder systems (AMARs). The AMARs will be deployed on the seabed from the *Sidewinder* at the beginning of the shallow geohazard survey and will remain in place until after the shallow geohazard survey is completed. They will remain on the seabed for approximately three months.

2.2.1 Methods and Equipment

The AMARs will be manually lowered to, and retrieved from the seafloor from the *Sidewinder* using approximately 18 m (60 ft) of sinking groundline and a terminal anchor of approximately 4.5 kg (10 lbs.), marked with floats for retrieval. AMARs and groundlines will be retrieved upon completion of the surveys.

An AMAR with a sampling rate of 64 kilohertz (kHz) will be deployed 500 m (1,640 ft) from the offshore end of the survey line (see

Figure 2) and will record continuously. A high-frequency AMAR with a sampling rate of 380 kHz will be deployed 5,000 m (16,404 ft) from the offshore end of the survey line (see

Figure 2). The high-frequency AMAR will operate at a sampling rate of 380 kHz for 2 minutes and at 64 kHz for 58 minutes each hour. The AMARs will be calibrated using pistonphone calibrators immediately before and after each deployment. The sampling frequency will capture marine mammal sounds and both ambient and anthropogenic noise. The recordings will be processed at the end of the season using JASCO`s marine mammal detection and classification software. The AMARs do not produce sounds.

2.3 Incidental Harassment Authorization

The Permits Division proposes to issue an IHA for non-lethal "takes"[4] of marine mammals by Level B harassment (as defined by the MMPA) incidental to Hilcorp's proposed action (80 FR 27901). When issued, the IHA will be valid from July 1 to September 30, 2015 and will authorize the incidental harassment of one ESA-listed whale and two ESA-listed seal species, as well as three non-ESA-listed

[3] The area within which received sound levels from sonar sources are greater than or equal to 160 dB re 1 μPa_{rms}.

[4] The MMPA defines "harassment" as "any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild" (referred to as Level A harassment) or "has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering" (referred to as Level B harassment). 16 U.S.C. 1362(18)(A) and (B). For the purposes of this consultation, NMFS considers that a take by "harassment" occurs when an animal is exposed to certain sound levels described below in Section 7..

whale and seal species. Table 2 shows the amount of proposed take for the three ESA-listed species in the proposed IHA.[5] Section 7.2 of this Opinion contains more information about the methods used to calculate these take numbers.

Table 2. Amount of proposed incidental harassment (takes) of ESA-listed species in the proposed IHA.

Common Name	Scientific Name	MMPA-authorized Takes
Bowhead whale	*Balaena mysticetus*	9
Bearded seal*	*Erignathus barbatus nauticus*	87
Ringed seal	*Phoca hispida hispida*	324

* As discussed at the beginning of this document, the U.S. District Court for the District of Alaska issued a decision that vacated the listing on July 25, 2014 (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RPB). NMFS has appealed that decision.

2.3.1 Mitigation, Monitoring, and Reporting Requirements

The proposed IHA includes the following mitigation, monitoring, and reporting requirements applicable to ESA-listed species[6]

1. Mitigation
    a. Establishing a ZOI
        i. Establish and monitor with trained PSOs a ZOI surrounding the sub-bottom profiler on the source vessel where the received level will be 160 dB_{rms} re 1 µPa for all marine mammals.
        ii. The size of the ZOI is a 50-m radius from the source vessel.[7]
    b. Vessel movement
        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:
            1. reducing vessel speed to less than 9.3 km/hr (5 kts) within 274 m (900 ft) of the whale(s)
            2. steering around the whale(s) if possible
            3. operating the vessel(s) in such a way as to avoid separating members of a group of whales from other members of the group
            4. operating the vessel(s) to avoid causing a whale to make multiple changes in direction
            5. checking the waters immediately adjacent to the vessel(s) to ensure that no whales will be injured when the propellers are engaged

[5] Please see proposed IHA for MMPA-authorized takes of marine mammal species not listed under the ESA (80 FR 27901).

[6] Please refer to the proposed IHA (80 FR 27901) for mitigation, monitoring, and reporting requirements for all species and circumstances included in the IHA.

[7] Please refer to Section 7.2 of this Opinion for the discussion about how the ZOI was established.

iii. When weather conditions require, such as when visibility drops, adjust vessel speed accordingly, but not to exceed 9.3 km/hr (5 kts), to avoid the likelihood of injury to whales.
iv. In general, transects will start in shallow water and work deeper to mitigate the potential "herding" effect (i.e., prevent the creation of a situation where marine mammals are "herded" closer to the shore if they are making efforts to avoid project activities).

c. Mitigation measures for sonar sources
   i. Ramp-up
      1. A ramp up may begin when 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 may not begin.
      2. 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 and small odontocetes) or 30 minutes (for mysticetes and large odontocetes, including beluga whales).
      3. If, for any reason, use of 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 the use of the sub-bottom profiler for less than 10 minutes does not require a ramp-up.
      4. 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
      1. The sub-bottom profiler shall be immediately powered down (i.e., the sub-bottom profiler shall be switched to its lowest setting) whenever a marine mammal is sighted approaching close to or within the ZOI for the sub-bottom profiler.
      2. If a marine mammal is already within or is about to enter the ZOI when first detected, the sub-bottom profiler shall be shut down immediately.
      3. After shutdown for more than 10 minutes, ramp-up shall not start until after the marine mammal is visually seen leaving the ZOI; or 15 minutes (for pinnipeds and small odontocetes) or 30 minutes (for mysticetes and large odontocetes, including beluga whales) have passed.
   iii. Poor visibility conditions
      1. If, during foggy conditions, heavy snow or rain, or darkness, the full extent of the ZOI is not visible, the sub-bottom profiler cannot commence a ramp-up procedure from a full shutdown.
      2. 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.
   iv. Firing sub-bottom profiler during turns and transits

1. 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.

2. 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 throughout the duration of the surveys.
        iii. A sufficient number of PSOs shall be onboard the survey vessel to meet the following criteria:
            1. 100% monitoring coverage during all periods of survey operations in daylight
            2. maximum of 4 consecutive hours on watch per PSO
            3. 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 above.
        v. Results of the vessel-based marine mammal monitoring shall be used to calculate the estimated 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 hazard monitoring projects in Alaska, the Canadian Beaufort, or other offshore areas in recent years.
        iv. Resumes for PSO candidates shall be provided to the Permits Division 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 approaches or enters the ZOI.

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 stops 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 ZOI. 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 ZOI.

vii. Monitoring shall consist of recording of the following information:

1. 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.)
2. 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:

a. any time a marine mammal is sighted (including pinnipeds hauled out on barrier islands)
b. at the start and end of each watch
c. during a watch (whenever there is a change in one or more variable)

3. identification of all vessels that are visible within 5 km (3.1 mi) of the survey vessel whenever a marine mammal is sighted and the time observed
4. 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)
5. any adjustments made to operating procedures
6. visibility during observation periods so that total estimates of take can be corrected accordingly

viii. 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.

ix. 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.

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

xi. When a marine mammal is seen approaching or within the ZOI, the marine survey crew shall be notified immediately so that mitigation measures can be promptly implemented.

d. Field data-recording and verification

i. PSOs aboard the vessels shall maintain a digital log of shallow geohazard survey activities, 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:

1. vessel speed, position, and activity
2. date, time, and location of each marine mammal sighting
3. number of marine mammals observed, and group size, sex, and age categories
4. observer's name and contact information
5. weather, visibility, and ice conditions at the time of observation
6. estimated distance of marine mammals at closest approach

7. activity at the time of observation, including possible attractants present
8. animal behavior
9. description of the encounter
10. duration of encounter
11. 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:

1. document ambient noise conditions
2. examine the spatial and temporal distribution of marine mammals based on acoustic detections of their vocalizations
3. characterize the long-range propagation of sounds produced during the geohazard survey

ii. Bottom-mounted acoustic sensors

1. Recorders shall be capable of recording marine mammal sounds and making both ambient and anthropogenic noise measurements.
2. Two recorders will be deployed near the Liberty prospect and be aligned with the geohazard survey line, at distances of 500 m (1,640 ft) [AMAR with sampling rate of 64 kHz]) and 5,000 m (16,404 ft [AMAR with sampling rate of 380 kHz]) from the offshore end of the survey line.
3. Recorders shall be located inside of the barrier islands.

3. Reporting

a. Technical report

i. 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 include detailed:

1. 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)
2. 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
3. summaries of all mitigation measures (e.g., operational shutdowns if they occur) and an assessment of the efficacy of the monitoring methods
4. analyses of the effects of various factors influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare)

5. 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
6. data analysis separated into periods when the sub-bottom profiler is operating and when it is not, to better assess impacts to marine mammals
7. 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
    f. estimates of take by harassment
8. a clear comparison of authorized takes and the level of actual estimated takes
9. cumulative sound exposure level over 24 hours, in particular during the use of the two sub-bottom profilers
10. 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
11. 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 dB, sound exposure level, dB peak-to-peak and 1/3 octave bands

ii. 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.

iii. 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.

b. Prohibited take

i. 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).

1. The report must include the following information:
    a. time, date, and location (latitude/longitude) of the incident
    b. the name and type of vessel involved
    c. the vessel's speed during and leading up to the incident
    d. description of the incident
    e. status of all sound source use in the 24 hours preceding the incident
    f. water depth
    g. environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility)
    h. description of marine mammal observations in the 24 hours preceding the incident
    i. species identification or description of the animal(s) involved
    j. the fate of the animal(s)
    k. photographs or video footage of the animal (if equipment is available)
2. 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.

ii. 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 same personnel described in 3(b)(i) above.
    1. The report must include the same information described above.
    2. Activities may continue while NMFS reviews the circumstances of the incident.
    3. NMFS will work with Hilcorp to determine whether modifications in the activities are appropriate.

iii. 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 authorized activities (e.g., previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), Hilcorp shall report the incident to the same personnel identified above within 24 hours of the discovery.
    1. 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.

3 ACTION AREA

"Action area" means all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). For this reason, the action area is typically larger than the project area and extends out to a point where no measurable effects from the proposed action occur. The action area includes the shallow geohazard and strudel scour survey areas, the passive acoustic monitoring equipment locations, and the transit area to and from the passive acoustic monitoring equipment sites in Foggy Island Bay, Beaufort Sea, Alaska (Figure 1 and Figure 2).

The shallow geohazard survey will occur in an area about 6.5 km^2 (2.5 mi^2). The strudel scour survey area is approximately 54 km^2 (21 mi^2). Water depths in both survey areas range from 0.9 to 6.1 m (3 to 20 ft).

The passive acoustic monitoring equipment (AMARs) will be deployed in two locations, one 500 m (1,640 ft) and one 5,000 m (16,404 ft) beyond the north end of the shallow geohazard survey area. Both AMARs will be placed in water depths of approximately 6.7 m (22 ft). The seafloor at the AMAR sites is composed of fine sand and silt surficial sediments overlying silt and clay.

Figure 1. Project location overview for Hilcorp's shallow geohazard and studel scour surveys and passive acoustic monitoring, Foggy Island Bay, Beaufort Sea, Alaska.

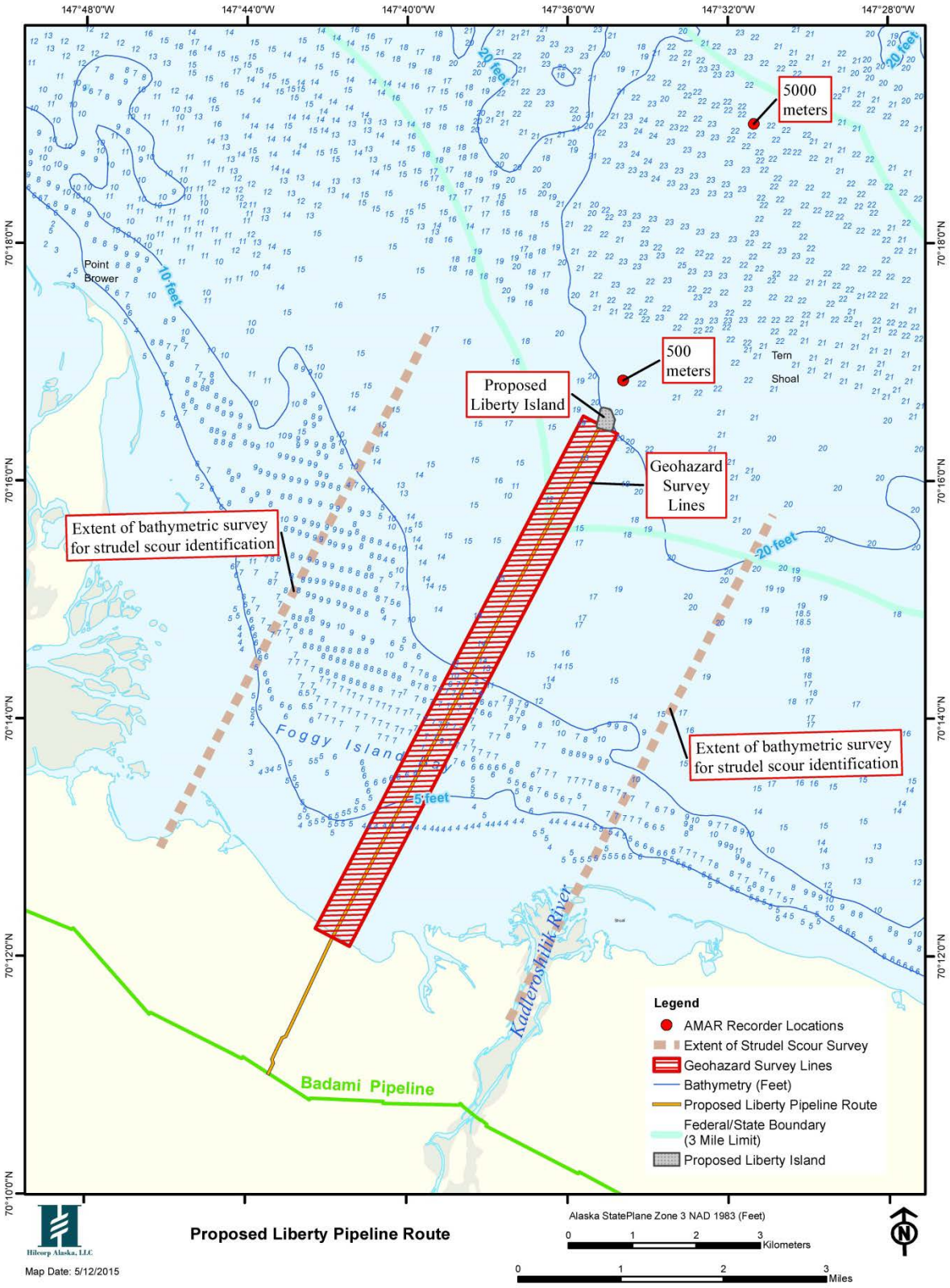

Figure 2. Map of the action area for Hilcorp's shallow geohazard and studel scour surveys and passive acoustic monitoring, Foggy Island Bay, Beaufort Sea, Alaska.

4 APPROACH TO THE ASSESSMENT

Section 7(a)(2) requires every federal agency, in consultation with NMFS, to insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any ESA-listed species or result in the destruction or adverse modification of critical habitat. The jeopardy analysis considers the effects of the action on both the survival and recovery of the species.

During the consultation, first we reviewed information provided by the Permits Division to describe the action. We also described the action area, which includes all areas affected directly and indirectly by the action.

Next, we evaluated the status of ESA-listed species and critical habitat that occur within the action area. We also evaluated the environmental baseline (i.e., past and present anthropogenic impacts within the action area).

Then we evaluated the direct and indirect effects of the action on ESA-listed species and designated critical habitat. Indirect effects are those that could be caused by the proposed action later in time, but still are reasonably certain to occur. We assessed:

1. The exposure to physical, chemical, or biotic stressors produced by the proposed action.
2. Whether such exposure is likely to reduce the survival or reproduction of individuals.
3. Whether fitness reductions will threaten the viability of populations and species.
4. Whether the action is likely to reduce the conservation value of critical habitat.

We did not rely on the regulatory definition of "destruction or adverse modification of critical habitat (50 CFR 402.02), which the Ninth Circuit Court of Appeals held to be invalid in *Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service*, 378 F.3d 1059 (9th Cir. 2004) amended by 387 F.3d 968 (9th Cir. 2004). Instead, we relied upon the statutory provisions of the ESA to complete our critical habitat analysis.[8] We also evaluated the cumulative effects of non-federal activities (i.e., state and private) that are reasonably certain to occur within the action area.

For all analyses, we used the best available scientific and commercial data. For this consultation, we relied on:

- information submitted by the Permits Division
- government reports
- past survey reports for similar activities
- general scientific literature

[8] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

5 STATUS OF THE SPECIES AND CRITICAL HABITAT

Table 3 shows the ESA-listed species and critical habitat that occur in the action area.

Table 3. ESA-listed species and critical habitat that occur in the action area.

Common Name	Scientific Name	Population	Status[2]	Critical Habitat FR Notice
Cetaceans				
Bowhead whale	*Balaena mysticetus*	N/A	E	N/A
Pinnipeds				
Bearded seal[3]	*Erignathus barbatus nauticus*	Beringia DPS[1]	T	N/A
Ringed seal	*Phoca hispida hispida*	Arctic subspecies	T	79 FR 73010 (proposed)

[1] DPS = distinct population segment

[2] Status: E = endangered, T = threatened

[3] As discussed at the beginning of this document, the U.S. District Court for the District of Alaska issued a decision that vacated the threatened status listing on July 25, 2014 (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RPB). NMFS has appealed that decision.

5.1 Proposed Critical Habitat not Considered Further in this Opinion.

If an action's effects on ESA-listed species will be insignificant, discountable, or completely beneficial, we conclude that the action is not likely to adversely affect those species and further analysis is not required. Insignificant effects relate to the size of impact and are those that one would not be able to meaningfully measure, detect, or evaluate, and should never reach the scale where take occurs. Discountable effects are those that are extremely unlikely to occur. Similarly, if proposed activities are not likely to destroy or adversely modify critical habitat, further analysis is not required. In this section, we describe proposed critical habitat that is not likely to be destroyed or adversely modified by the proposed action.

5.1.1 Arctic Ringed Seal Proposed Critical Habitat

NMFS proposed to designate critical habitat for the Arctic ringed seal on December 9, 2014 (79 FR 73010). The proposed critical habitat includes marine habitat in Alaska and offshore federal waters of the northern Bering, Chukchi, and Beaufort Seas that have one or more of the following essential features:

- Seasonal landfast (shorefast) ice in waters more than 2 m deep or dense, stable pack ice, that has undergone deformation and contains snowdrifts at least 54 cm deep, suitable for the formation and maintenance of birth lairs used for sheltering pups during whelping and nursing
- Sea ice of 15 percent or more concentration in waters more than 2 m deep, suitable as a platform for basking and molting
- Primary prey resources (i.e., Arctic cod, saffron cod, shrimps, and amphipods)

Project activities will not occur during periods of ice cover; therefore, project activities will not affect essential features related to ice cover for ringed seals.

Fine sand and silt will be disturbed during deployment of AMARs, but sediment is expected to disperse in the water column and re-settle on the seafloor quickly. This activity will have very small or no effects to the primary prey resources of ringed seals and their food sources. No other components of the proposed action will disturb habitat or affect prey resources of ringed seals.

We conclude project-related activities are likely to have no more than insignificant effects to the essential features of proposed ringed seal critical habitat; therefore, proposed ringed seal critical habitat is not discussed further in this Opinion.

5.2 Species Likely to Be Adversely Affected by the Action

This Opinion examines the status of each listed species that may be affected by the proposed action. The Status of the Species (Section 5 of this Opinion) helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02.

5.2.1 Bowhead Whale

We used information available in the most recent stock assessment (Allen and Angliss 2014), NMFS species information (NMFS 2015b), and recent biological opinions (NMFS 2014e, a) to summarize the status of the species, as follows.

5.2.1.1 Distribution

Bowhead whales are found throughout Arctic and near-Arctic waters, between latitudes of 54 to 85° N. They spend much of the year in shallow, relatively heavy ice-covered continental shelf waters. In winter, they generally occur at the southern limit of the pack ice or in polynyas (large, semi-stable open areas of water within the ice), and move northward as sea ice recedes during the spring.

In Alaska, the majority of bowhead whales migrate annually from northern Bering Sea wintering areas (December to March), through the Chukchi Sea in spring (April to May), to Beaufort Sea where they spend much of the summer (June to August) before returning to Bering Sea wintering areas in fall (September through December).

Bowhead whales are found near Foggy Island Bay in the summer and fall, but generally stay outside of the barrier islands and do not come into nearshore waters (Clarke et al. 2013).

5.2.1.2 Life History

Bowhead whales are large baleen whales distinguished by a dark body, white chin, and lack of a dorsal fin. The lifespan of bowhead whales is thought to exceed 100 years. Sexual maturity is reached at approximately 20 years of age. Most mating occurs in the Bering Sea during winter and spring months. The gestation period of bowhead whales is approximately 13 to 14 months. Most birthing occurs in the Bering Sea during spring and summer months. Additional information on bowhead whales can be found at: http://alaskafisheries.noaa.gov/protectedresources/whales/bowhead/.

Bowhead whales produce a variety of vocalizations. NMFS classifies bowhead whales in the low-frequency cetacean (i.e., baleen whale) functional hearing group. As a group, it is estimated that baleen whales can hear frequencies between 0.007 and 30 kHz (NOAA 2013). Direct studies of bowhead whale hearing have not been conducted, but it is assumed that they can hear the same frequencies that they

produce (between 0.05 and 5.0 kHz) (Ljungblad et al. 1980, Ljungblad et al. 1982, Clark and Johnson 1984, Cummings and Holliday 1987) and are likely most sensitive to this frequency range (Richardson et al. 1995, Ketten 1997).

5.2.1.3 Population Dynamics

Five stocks of bowhead whales are recognized in the North Atlantic and Pacific Oceans. The population of all stocks, combined, is estimated to be approximately 12,278 whales (Shelden and Rugh 1995, Heide-Jørgensen et al. 2007, Wiig et al. 2009, Wiig et al. 2011, Allen and Angliss 2014, Meschersky et al. 2014) . The Western Arctic stock, the only stock that occurs in the Action area, is estimated to have a minimum of 10,314 whales. Population trends are not available for all bowhead stocks due to insufficient data, but growth appears to be positive in most areas. The western Arctic stock yearly growth rate is estimated to be 3.2 to 3.4 percent, indicating that it is resilient to current threats.

5.2.1.4 Status

The species was listed as endangered under the Endangered Species Preservation Act of 1969 on December 2, 1970 (35 FR 18319), and they remain endangered under the ESA. The bowhead whale became endangered because of past commercial whaling. Whaling for subsistence purposes still occurs for bowhead whales, though at a sustainable level. Since 1985, there have been 1,428 bowhead whale takes[9] for subsistence purposes; of those, seven were hunted by Denmark in Greenland, 21 were hunted by Russia near Chukotka, and 1,400 were hunted by the U.S. in Alaska (IWC 2015).

Additional threats to the species include ship strikes, fisheries interactions (including entanglement) and noise. All threats to the species are discussed further in Section 6 of this Opinion.

5.2.1.5 Critical Habitat

There is no critical habitat designated for the bowhead whale.

5.2.2 Bearded Seal (Beringia DPS)

We used information available in the recent stock assessment report (Allen and Angliss 2014), the status review (Cameron et al. 2010), listing documents (75 FR 77496; 77 FR 76739), NMFS species information (NMFS 2015a), and a recent biological opinion (NMFS 2014b) to summarize the status of the species, as follows.

5.2.2.1 Distribution

The bearded seal subspecies *E. b. nauticus* is further separated into two DPSs: the Beringia DPS and Okhotsk DPS. The Beringia DPS of bearded seals is the only DPS in the action area.

The Beringia DPS bearded seal is an ice-associated species that occurs in continental shelf waters of the Bering, Chukchi, Beaufort, and East Siberian Seas. The majority of seals move seasonally, following the extent of the sea ice; however some remain near the coasts of the Bering and Chukchi Seas during the summer and early fall.

Bearded seals have been observed near the action area during marine mammal monitoring associated with previous geophysical surveys in Foggy Island Bay (Aerts et al. 2008, Smultea et al. 2014).

[9] These numbers include both landed and struck and lost whales.

5.2.2.2 Life History

Bearded seals are the largest of the Arctic seals, reaching lengths of 2.0 to 2.5 m and weights of 260 to 360 kg. They are distinguished by their small head; small, square foreflippers; and the thick, long, white whiskers that give them their trademark "beard". The lifespan of bearded seals is 20 to 30 years. Males reach sexual maturity at 6 to 7 years of age; females mature at 5 to 6 years of age and give birth to a single pup annually. Gestation lasts 9 months and pups are weaned at approximately 3 to 4 weeks of age. Birthing and nursing occur on sea ice. Additional information on Beringia DPS bearded seals can be found at: http://alaskafisheries.noaa.gov/protectedresources/seals/ice.htm.

Male bearded seals produce a variety of underwater vocalizations ranging from approximately 0.2 to 4.3 kHz (Jones et al. 2014). NMFS classifies bearded seals in the phocid pinniped functional hearing group. As a group, it is estimated that phocid pinnipeds can hear frequencies between 0.075 and 100 kHz (NOAA 2013). Direct studies of bearded seal hearing have not been conducted, but it is assumed that they can hear the same frequencies that they produce and are likely most sensitive to this frequency range (Richardson et al. 1995).

5.2.2.3 Population Dynamics

Under the MMPA, NMFS recognizes an Alaska stock of bearded seals, which is the same population as the Beringia DPS identified under the ESA.

No precise population estimates for the DPS are available due to lack of surveys in portions of their range and variability among techniques for the surveys that have occurred. In the status review, the population of the DPS was estimated to have 155,000 individuals; however, NMFS considers this a crude estimate.

Due to insufficient data, the population trend for Beringia DPS bearded seals is unknown.

5.2.2.4 Status

The Beringia DPS was listed as threatened under the ESA on December 28, 2012 (77 FR 76739) due to the prjected loss of sea ice and alteration of prey availability from climate change in the foreseeable future. As discussed at the beginning of this document, the U.S. District Court for the District of Alaska issued a decision that vacated the listing on July 25, 2014 (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RPB). NMFS has appealed that decision.

Bearded seals are an important species for Alaska subsistence hunters. The most recent estimate of annual statewide harvest is from 2000 and was 6,788 bearded seals. The current level of subsistence harvest is not known and there are no efforts to quantify statewide harvest numbers. Additional threats to the species include disturbance from vessels, noise from seismic exploration, and oil spills. All threats to the species are discussed further in Section 6 of this Opinion.

Because of their apparently large population size and the long-term nature of the threat of climate change to the DPS, NMFS determined that ESA section 4(d) protective regulations were unnecessary for the conservation of the species at the time of listing.

In summary, the Beringia DPS of bearded seal has an apparently large population, making it resilient to immediate perturbations. However, threatened by climate change in the long-term, the DPS is likely to become endangered in the foreseeable future.

5.2.2.5 Critical Habitat
NMFS has not designated or proposed critical habitat for the Beringia DPS of bearded seal.

5.2.3 Arctic Ringed Seal
We used information available in the recent stock assessment report (Allen and Angliss 2014), the status review (Kelly et al. 2010), listing documents (75 FR 77476, 77 FR 76705), NMFS species information (NMFS 2015f), and a recent biological opinion (NMFS 2014b) to summarize the status of the species, as follows.

5.2.3.1 Distribution
The Arctic subspecies of ringed seal has a circumpolar distribution and is found in all seasonally ice-covered waters throughout the Arctic and adjacent waters. The Arctic ringed seal is the most wide-ranging of the five ringed seal subspecies and the only subspecies in the action area. Ringed seals have been observed near the action area during marine mammal monitoring associated with previous geophysical surveys in Foggy Island Bay (Aerts et al. 2008, Smultea et al. 2014).

5.2.3.2 Life History
Ringed seals are the smallest of the Arctic seals, reaching lengths of 1.5 m and weights of 50 to 70 kg. Their coat is dark with silver rings along the back and sides and silver along the underside. They are distinguished by their small head; short, cat-like snout, and plump body. The lifespan of ringed seals is 25 to 30 years. Males reach sexual maturity at 5 to 7 years of age; females mature at 4 to 8 years of age and give birth to a single pup annually. Mating generally occurs in May, though implantation of the fertilized egg is delayed for 3 to 3.5 months. Once implanted, the gestation period lasts about 8 months and pups are weaned between 5 to 9 weeks of age. Birthing and nursing occur in snow caves excavated by the female on sea ice. Additional information on ringed seals can be found at: http://alaskafisheries.noaa.gov/protectedresources/seals/ice.htm.

Ringed seals produce underwater vocalizations ranging from approximately 0.1 to 1.0 kHz (Jones et al. 2014). NMFS classifies ringed seals in the phocid pinniped functional hearing group. As a group, it is estimated that phocid pinnipeds can hear frequencies between 0.075 and 100 kHz (NOAA 2013). Direct studies of ringed seal hearing have not been conducted, but it is assumed that ringed seals can hear the same frequencies that they produce and are likely most sensitive to this frequency range (Richardson et al. 1995).

5.2.3.3 Population Dynamics
Arctic ringed seals have a widespread, circumpolar distribution and their population structure is poorly understood. Under the MMPA, NMFS recognizes one stock, the Alaska stock, in U.S. waters.

No precise population estimates for the entire subspecies are available due to its widespread distribution across political boundaries. In the status review, the population of the subspecies was estimated to have approximately 2 million individuals, however, NMFS considers this a crude estimate.

Similarly, a precise population estimate for the Alaska stock of ringed seals is not available due to inconsistencies in survey methods and assumptions, lack of survey effort in some areas, and because surveys efforts are now more than a decade old. In the status review, the population of ringed seals in Alaskan waters of the Chukchi and Beaufort Seas was estimated to be at least 300,000 individuals,

though it is most likely an underestimate of the true population because surveys in the Beaufort Sea were limited to within 40 km of the shore.

Due to insufficient data, the population trend for the Arctic subspecies and Alaska stock are unknown.

5.2.3.4 Status

The Arctic ringed seal was listed as threatened under the ESA on December 28, 2012 (77 FR 76739). The species is threatened due to climate change, especially from the expected loss of sea ice and snow cover in the foreseeable future.

Ringed seals are an important species for Alaska subsistence hunters. The most recent estimate of annual statewide harvest is from 2000 and was 9,567 ringed seals. The current level of subsistence harvest is not known and there are no efforts to quantify statewide harvest numbers. Additional threats to the species include fisheries interactions (including entanglement), disturbance from vessels, noise from seismic exploration, and oil spills. All threats to the species are discussed further in Section 6 of this Opinion.

Because of their apparently large population size and the long-term nature of the threat of climate change to the DPS, NMFS determined that ESA section 4(d) protective regulations were unnecessary for the conservation of the species at the time of listing.

In summary, the Arctic ringed seal has an apparently large population, making it resilient to immediate perturbations. However, threatened by climate change in the long-term, the species is likely to become endangered in the foreseeable future.

5.2.3.5 Critical Habitat

Critical habitat for the Arctic ringed seal was proposed on December 9, 2014 (79 FR 73010). As discussed in Section **Error! Reference source not found.** of this Opinion, we do not expect project activities to adversely affect proposed Arctic ringed seal critical habitat.

6 ENVIRONMENTAL BASELINE

The environmental baseline includes the past and present impacts of all federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

Focusing on the impacts of activities specifically within the action area allows us to assess the prior experience and condition of the animals that will be exposed to effects from the actions under consultation. This focus is important because individuals of ESA-listed species may commonly exhibit, or be more susceptible to, adverse responses to stressors in some life history states, stages, or areas within their distributions than in others. These localized stress responses or baseline stress conditions may increase the severity of the adverse effects expected from proposed actions.

6.1 Climate Change

The average global surface temperature rose by 0.85º C from 1880 to 2012, and it continues to rise at an accelerating pace (IPCC 2014); the 10 warmest years on record since 1880 have occurred since 1998, with 2014 being the warmest (NCDC 2015). Since 2000, the Arctic (latitudes between 60 and 90º N) has been warming at more than twice the rate of lower latitudes (Jeffries et al. 2014) due to "Arctic amplification", a characteristic of the global climate system influenced by changes in sea ice extent, atmospheric and oceanic heat transports, cloud cover, black carbon, and many other factors (Serreze and Barry 2011).

Direct effects of climate change include increases in atmospheric temperatures, decreases in sea ice, and changes in sea surface temperatures, pH, patterns of precipitation, and sea level. Indirect effects of climate change have, are, and will continue to impact marine species in the following ways (IPCC 2014):

- Shifting abundances
- Changes in distribution
- Changes in timing of migration
- Changes in annual phenology of the species

Climate change is likely to have its most pronounced effects on species whose populations are already in tenuous positions (Isaac 2009). Therefore, we expect the extinction risk of at least some ESA-listed species to rise with global warming. Cetaceans with restricted distributions linked to water temperature may be particularly exposed to range restriction (Learmonth et al. 2006, Isaac 2009). MacLeod (2009) estimated that, based on expected shifts in water temperature, 88 percent of cetaceans will be affected by climate change, 47 percent will be negatively affected, and 21 percent will be put at risk of extinction. Of greatest concern are cetaceans with ranges limited to non-tropical waters, and preferences for shelf habitats (MacLeod 2009).

Arctic sea ice extent, in general, has been in decline since 1979 and has a negative trend (Jeffries et al. 2014). Arctic sea ice thickness and annual minimum sea ice extent (i.e., September sea ice extent) have accelerated in their rate of decline considerably in the first decade of the 21st century and approximately three-quarters of summer Arctic sea ice volume has been lost since the 1980s (IPCC 2013). Perennial sea ice extent has declined at a rate of approximately 12 percent per decade and multi-year ice extent is declining at rate of approximately 15 percent per decade (Comiso 2011). Wang and Overland (2009) estimated that the Arctic will be nearly ice-free (i.e., sea ice extent will be less than 1 million km^2) during the summer by 2021 to 2043.

The depth and duration of snow cover are projected to decline substantially throughout the range of Arctic ringed seals (Hezel et al. 2012). The persistence of the Arctic ringed seal will likely be challenged as decreases in ice and, especially, snow cover lead to increased juvenile mortality from premature weaning, hypothermia, and predation (Kelly et al. 2010). It is likely, within the foreseeable future, the number of Arctic ringed seals will decline substantially, and no longer persist in substantial portions of their range (Kelly et al. 2010). The Beringia DPS bearded seal will likely be challenged as decreases in sea ice lead to the spatial separation of sea ice from shallow feeding areas, loss of suitable molting habitat, and decreases in prey density or availability (Cameron et al. 2010). Within the foreseeable future, demographic problems associated with abundance, productivity, spatial structure, or diversity might place the DPS in danger of extinction (Cameron et al. 2010).

6.2 Fisheries

Worldwide, fisheries interactions are a problem for several marine mammal species. More than 97 percent of whale entanglement is caused by derelict fishing gear (Baulch and Perry 2014). There is also concern that mortality from entanglement may be underreported, as many marine mammals that die from entanglement tend to sink rather than strand ashore. Entanglement may also make marine mammals more vulnerable to additional dangers, such as predation and ship strikes, by restricting agility and swimming speed. Entanglements and rope scars on bowhead whales have been reported during subsistence harvest (Allen and Angliss 2014).

Mortalities associated with commercial fisheries for bearded seals in the Bering Sea/Aleutian Island pollock trawl and flatfish trawl fisheries averaged 1.8 seals per year from 2007 to 2011 (Allen and Angliss 2014). Estimated mortality of ringed seals in the Bering Sea/Aleutian Island pollock trawl, flatfish trawl, Pacific cod trawl, and Pacific cod longline fisheries averaged 3.52 per year from 2007 to 2011 (Allen and Angliss 2014). Lethal take of seals is authorized from 2015 to 2016 resulting from capture in the Bering Sea/Aleutian Island pollock fishery and is limited to 18 Beringia DPS bearded seals and 36 Arctic ringed seals (NMFS 2014d).

Commercial fisheries may indirectly affect whales and seals by reducing the amount of available prey or affecting prey species composition. In Alaska, commercial fisheries target known prey species of bowhead whales and bearded and ringed seals, such as pollock and cod. Additionally, bottom-trawl fisheries may affect bottom-dwelling prey species of these ESA-listed species.

6.3 Harvest

Indigenous peoples have been taking bowhead whales for subsistence purposes for at least 2,000 years (Stoker and Krupnik 1993). Subsistence harvests have been regulated by a quota system under the authority of the International Whaling Commission (IWC) since 1977. Alaska Native subsistence hunters take approximately 0.1 to 0.5 percent of the population of the western Arctic stock per year, primarily from eleven Alaska communities (Philo et al. 1993). An additional 18 western Arctic stock bowhead whales were harvested in Canadian and Russian subsistence hunts from 1991 to 2010 (Allen and Angliss 2014). The current U.S. portion of the IWC quota allows no more than 67 strikes of bowhead whales annually and up to 15 unused strikes from any previous year to be added to the subsequent year's strike allotment (i.e., up to 82 strikes) for the period of 2013 to 2018 (NMFS 2012).

Substantial commercial harvest of both ringed and bearded seals in the late 19th and 20th centuries led to local depletions; however, the commercial harvest of ice seals has been prohibited in U.S. waters since 1972 under the MMPA. Since that time, only subsistence harvests of ringed and bearded seals by Alaska Native subsistence hunters are allowed in U.S. waters. Data on contemporary subsistence harvests of ringed and bearded seals in Alaska are no longer collected (Allen and Angliss 2014). Therefore, absent information to the contrary, we assume that subsistence harvest levels in the action area are similar to historical annual harvest levels that, statewide, resulted in take of an estimated 9,567 ringed seals and 6,788 bearded seals (Allen and Angliss 2014).

6.4 Natural and Anthropogenic Noise

ESA-listed species in the action area are exposed to several sources of natural and anthropogenic noise. Natural sources of underwater noise include sea ice, wind, waves, precipitation, and biological noise from marine mammals, fishes, and crustaceans. Anthropogenic sources of noise in the action area include:

- Vessels
    - Shipping
    - Transportation
    - Research
- Oil and gas activities:
    - Geophysical surveys (including seismic activities)
    - Drilling
    - Construction
    - Dredging
    - Pile-driving
- Icebreaking
- Sonars
- Aircraft

The combination of anthropogenic and natural noises contribute to the total noise at any one place and time.

Because responses to anthropogenic noise vary among species and individuals within species, it is difficult to determine long-term effects. Habitat abandonment due to anthropogenic noise exposure has been found in terrestrial species (Francis and Barber 2013). Clark et al. (2009) identified increasing levels of anthropogenic noise as a habitat concern for whales because of its potential effect on their ability to communicate (i.e. masking). Some research (Parks 2003, McDonald et al. 2006, Parks 2009) suggests marine mammals compensate for masking by changing the frequency, source level, redundancy, and timing of their calls. However, the long-term implications of these adjustments, if any, are currently unknown.

6.5 Natural Mortality

While instances of natural mortality of bowhead whales in the action area are not known, we assume causes of natural mortality in the action area are similar to those for bowhead whales outside the action area. Transient killer whales are the only known predators of bowhead whales (Allen and Angliss 2014). In a study of marks on bowhead whales taken in subsistence harvests, 4.1 to 7.9 percent had scars indicating that they had survived attacks by killer whales (George et al. 1994). Large whales, including bowhead whales, occasionally become entrapped in ice and die (Seton and Lien 1993, Heide-Jørgensen et al. 2002, Ferguson et al. 2010).

Polar bears are the primary predator of bearded and ringed seals and other predators of both species include killer whales and walruses. Additionally, brown bears and sharks are known predators of bearded seals and Arctic and red foxes, wolves, wolverines, and ravens are known predators of ringed seals (Cameron et al. 2010, Kelly et al. 2010).

Relatively little is known regarding diseases in ringed and bearded seals; however, both species are relatively solitary pinnipeds, reducing the transmission potential for infectious diseases caused by viruses (e.g., herpesvirus, calicivirus, and distemper virus) and bacteria (e.g., *Brucella* and *Leptospira*) (Fay 1974). Ringed and bearded seals have tested positive for serum antibodies to phocid herpesvirus-1 and -2, but the disease has not been documented in ringed or bearded seals in Alaska (Zarnke et al. 1997). Quakenbush et al. (2011) identified *Brucella* antibodies in one of 46 tested bearded seals; there is no evidence of exposure in Alaskan ringed seals. There is one report of a bearded seal testing positive for exposure to *Leptospira* in the Bering Sea (Calle et al. 2008); there is no evidence of exposure in ringed seals. Numerous parasites have been found in ringed and bearded seals, including: protozoa (e.g., *Giardia*), cestodes, trematodes, nematodes, lungworms, lice, and nasal mites. In 2011, an unusual mortality event was declared for Northern Alaska pinnipeds after more than 60 dead and 75 diseased seals (mostly ringed seals) and dead walruses were reported (NMFS 2011). The cause of the unusual mortality event remains unknown.[10]

6.6 Oil and Gas Activities

Offshore petroleum exploration activities have been conducted in State of Alaska waters and the Outer Continental Shelf of the Beaufort and Chukchi Sea Planning Areas, in Canada's eastern Beaufort off the Mackenzie River Delta, in Canada's Arctic Islands, and in the Russian Arctic around Sakhalin Island to the south of the Bering Straits (NMFS 2013a). The following sections discuss the activities related to oil and gas activities in the action area.

6.6.1 Noise Related to Oil and Gas Operations

NMFS has conducted numerous ESA section 7 consultations related to oil and gas activities in the Beaufort Sea. Many of the consultations have authorized the take (by harassment) of bowhead whales and ringed and bearded seals from sounds produced during geophysical surveys (including seismic surveys) conducted by leaseholders during open water (i.e. summer) months.

NMFS conducted an incremental step consultation with the Bureau of Ocean Energy Management and the Bureau of Safety and Environmental Enforcement on the effects of the authorization of oil and gas leasing and exploration activities in the U.S. Beaufort and Chukchi Seas over a 14-year period, from March 2013 to March 2027 (NMFS 2013b). The incidental take statement in the biological opinion allows the following number of takes (by harassment) from high-resolution, deep penetration, and in-ice deep penetration seismic surveys:

- Bowhead whale: 87,878
- Bearded seal: 91,616
- Ringed seal: 506,898

The biological opinion was developed as an incremental step consultation. Take will be more accurately evaluated for subsequent seismic survey projects that fall under this larger consultation (i.e. step-down consultations), and the cumulative take for all subsequent consultations will be tracked and tiered to this consultation.

[10] Updates on the unusual mortality event can be found on NMFS's Alaska Region website at: http://alaskafisheries.noaa.gov/protectedresources/seals/ice/diseased/default.htm

In 2014, NMFS consulted with the Permits Division on the issuance of regulations and a letter of authorization to take marine mammals incidental to offshore oil and gas operations at the Northstar development in the U.S. Beaufort Sea, from January 13, 2014 to January 14, 2019 (NMFS 2014c). The incidental take statement in the biological opinion allows up to 15 bowhead whales, 5 bearded seals, and 31 ringed seals to be taken (by harassment) as a result of exposure to continuous sounds at received levels at or above 120 dB re 1 μPa_{rms} and impulsive sounds at received levels at or above 160 dB re 1 μPa_{rms}. The incidental take statement also included an additional 5 injurious or lethal takes of ringed seals in the event that ringed seal lairs are crushed or flooded during on-ice construction or transportation.

Also in 2014, NMFS consulted with the Permits Division on the issuance of an IHAto take marine mammals incidental to shallow geohazard surveys in Foggy Island Bay, between July 1 to September 30, 2014 (NMFS 2014e). The incidental take statement in the biological opinion allows up to 1 bowhead whale, 19 bearded seals, and 71 ringed seals to be taken (by harassment) as a result of exposure to continuous sounds at received levels at or above 160 dB re 1 μPa_{rms}.

In 2015, NMFS consulted with the Permits Division on the issuance of an IHA to take marine mammals incidental to ice overflight and ice survey activities conducted by Shell Gulf of Mexico and Shell Offshore Inc. (NMFS 2015c). The incidental take statement authorizes take (by harassment) of 793 Arctic ringed seals and 11 Beringia DPS bearded seals as a result of exposure to visual and acoustic stimuli from aircraft.

Anticipated impacts by harassment from noise associated with oil and gas activities generally include changes in behavioral state from low energy states (i.e., foraging, resting, and milling) to high energy states (i.e., traveling and avoidance).

6.6.2 Spills

Since 1975, 84 exploration wells, 14 continental offshore stratigraphic test (i.e., COST), and 6 development wells have been drilled on the Arctic Outer Continental Shelf (BOEM 2012). Historical data on offshore oil spills for the Alaska Arctic Outer Continental Shelf region consists of all small spills (i.e., less than 1,000 barrels [31,500 gallons]) and cannot be used to create a distribution for statistical analysis (NMFS 2013a). Instead, agencies use a fault tree model[11] to represent expected spill frequency and severity of spills in the Arctic. Table 4 shows the assumptions the Bureau of Ocean Energy Management presented regarding the size and frequency of spills in the Beaufort and Chukchi Seas Planning Area in its final programmatic environmental impact statement (EIS) for the Outer Continental Shelf oil and gas leasing program for 2012 to 2017 (BOEM 2012).

[11] Fault tree analysis is a method for estimating spill rates resulting from the interactions of other events. Fault trees are logical structures that describe the causal relationship between the basic system components and events resulting in system failure. Fault tree models are graphical techniques that provide a systematic estimate of the combinations of possible occurrences in a system, which can result in an undesirable outcome.

Table 4. Oil spill assumptions for the Beaufort and Chukchi Seas Planning Areas, 2012 to 2017.

Spill Type	Assumed Spill Volume (barrels)	Assumed Number of Spill Events	Maximum Volume of Assumed Spill Events (barrels)
Small	≥ 1 to < 50	50 to 190	9,310
	≥ 50 to < 1,000	10 to 35	34,965
Large	≥ 1,000	-	-
Pipeline	1,700	1 to 2	3,400
Platform	5,100	1	5,100
TOTAL	**-**	**-**	**52,775**

Table adapted from (BOEM 2012)

Increased oil and gas development in the U.S. Arctic has led to an increased risk of various forms of pollution to whale and seal habitat, including oil spills, other pollutants, and nontoxic waste (Allen and Angliss 2014).

6.7 Pollutants and Discharges (Excluding Spills)

Previous development and discharges in the action area are the source of multiple pollutants that may be bioavailable (i.e., may be taken up and absorbed by animals) to ESA-listed species or their prey items (NMFS 2013a). Drill cuttings and fluids contain contaminants that have high potential for bioaccumulation, such as dibenzofuran and polycyclic aromatic hydrocarbons. Historically, drill cuttings and fluids have been discharged from oil and gas developments near the action area, and residues from historical discharges may be present in the affected environment (Brown et al. 2010).

The Clean Water Act of 1972 (CWA) has several sections or programs applicable to activities in offshore waters. Section 402 of the CWA authorizes the U.S. Environmental Protection Agency (EPA) to administer the National Pollutant Discharge Elimination System (NPDES) permit program to regulate point source discharges into waters of the United States. Section 403 of the CWA requires that EPA conduct an ocean discharge criteria evaluation for discharges to the territorial seas, contiguous zones, and the oceans. The Ocean Discharge Criteria (40 CFR Part 125, Subpart M) sets forth specific determinations of unreasonable degradation that must be made before permits may be issued.

On October 29, 2012, EPA issued two general permits for exploration discharges to the Beaufort and Chukchi Seas, permit numbers AKG-28-2100 and AKG-28-8100, respectively, and are effective for five years. The general permits authorize discharges from thirteen categories of waste streams, subject to effluent limitations, restrictions, and requirements:

- drilling fluids and drill cuttings
- deck drainage
- sanitary wastes
- domestic wastes
- uncontaminated ballast water
- bilge water
- desalination unit wastes
- blowout preventer fluid
- boiler blowdown
- fire control system test water
- non-contact cooling water
- excess cement slurry
- muds, cuttings, and cement at seafloor

The general permits for exploration discharges include effluent limitations and monitoring requirements specific to each of the discharges, with additional restrictions for the discharge of drilling fluids and drill cuttings, including no discharge starting on August 25 until fall bowhead whale hunting activities have ceased in the communities of Nuiqsut and Kaktovik in the Beaufort Sea. Environmental monitoring programs are required to be conducted at each drill site location before, during, and after drilling activities. The general permits also include numerous seasonal and area restrictions.

In the 2013 supplemental draft EIS for the effects of oil and gas activities in the Arctic Ocean, NMFS proposed requirements to ensure reduced, limited, or zero discharge of any or all discharge streams that have the potential to impact marine mammals or marine mammal prey or habitat and requirements to recycle drilling muds (NMFS 2013a). The final supplemental EIS has not yet been released.

The EPA issued a NPDES vessel general permit that authorizes several types of discharges incidental to the normal operation of vessels, such as grey water, black water, coolant, bilge water, ballast, and deck wash (EPA 2013). The permit is effective from December 19, 2013 to December 19, 2017, and applies to owners and operators of non-recreational vessels that are at least 24 m (79 ft) in length, as well as to owners and operators of commercial vessels less than 24 m that discharge ballast water.

The US Coast Guard has regulations related to pollution prevention and discharges for vessels carrying oil, noxious liquid substances, garbage, municipal or commercial waste, and ballast water (33 CFR Part 151). The State of Alaska regulates water quality standards within three miles of the shore.

6.8 Scientific Research

In the following sections, we describe the types of scientific research currently permitted for ESA-listed whales and seals in the action area. NMFS issues scientific research permits that are valid for five years for ESA-listed species. When permits expire, researchers often apply for a new permit to continue their research. Additionally, applications for new permits are issued on an on-going basis; therefore, the number of active research permits is subject to change in the period during which this Opinion is valid.

Species considered in this Opinion also occur in Canadian waters. Although we do not have specific information about any permitted research activities in Canadian waters, we assume they will be similar to those described below.

6.8.1 Whales

Bowhead whales are exposed to research activities documenting their distribution and movements throughout their range. Of the three active research permits authorizing takes of bowhead and humpback whales in Alaska, one has a specific investigation areas outside of the Beaufort Sea (NMFS 2015e). Activities associated with the remaining two permits could occur in the action area, possibly at the same time as the proposed project activities.

Currently permitted research activities include:

- Counting/surveying
- Opportunistic collection of sloughed skin and remains
- Behavioral and monitoring observations
- Various types of photography and videography
- Skin and blubber biopsy sampling
- Fecal sampling
- Suction-cup, dart/barb, satellite, and dorsal fin/ridge tagging

These research activities require close vessel and/or aircraft approach. The permits also include incidental harassment takes to cover such activities as tagging, where the research vessel may come within 91 m (300 ft) of other whales while in pursuit of a target whale.

These activities may cause stress to individual whales and cause behavioral responses, but harassment is not expected to rise to the level where injury or mortality is expected to occur.

6.8.2 Seals

Bearded and ringed seals are exposed to research activities documenting their distribution and movements throughout their ranges. Of the seven active research permits authorizing takes of bearded and ringed seals in Alaska, two have specific investigation areas outside of the action area (NMFS 2015d). Activities associated with the remaining research permits could occur in the action area, possibly at the same time as the proposed project activities.

Currently permitted research activities include capture and restraint (by hand or net), for the purposes of performing the following procedures:

- Injection of sedative
- Administration of drugs (intramuscular, intraperitoneal, subcutaneous, or topical)
- Attachment of instruments to hair or flippers, including flipper tagging
- Insertion of passive integrated transponder tag
- Bioelectrical impedance analysis (skin surface)
- Collection of:
  - blood (including serial samples)
  - clipped hair and nails
  - fecal matter (enema, loop, and swab)
  - nasal, ocular, oral, and all other mucous membrane swabs
  - vibrissae (pulled)
  - skin, blubber, or muscle biopsies

Additional research activities that do not require the capture and handling of seals include the opportunistic collection of molted skin, scat, urine, and vomit. Many permits also include incidental harassment of non-target seals during the course of performing the permitted activities.

These activities may cause stress to individual seals, but, in most cases, harassment is not expected to rise to the level where injury or mortality is expected to occur. Permit No. 15126 allows up to 5 unintentional mortalities of both bearded and ringed seals per year out of the 160 captures permitted for both species (NMFS 2015d).

6.9 Ship Strike

Ship strikes are a serious concern for some species of large whales; however, between 1976 and 1992, only two bowhead whales with ship-strike injuries were identified out of 236 bowhead whales examined during Alaskan subsistence harvests (George et al. 1994). This likely underrepresents the number of ship-struck whales because not all whales survive ship strikes and the subsistence harvest does not represent a random sample of whales; therefore, we assume these sources represent the minimum number of bowhead whales that have collided with vessels in the action area.

The level of threat from shipping to bearded and ringed seals is a function of spatial and temporal overlap with bearded and ringed seal habitats, vessel speed, ship traffic volume, shipping routes, and other factors. To date, no bearded or ringed seal carcasses have been reported with propeller marks.

Icebreakers, ice-breaking cargo ships, and ice-breaking container ships pose additional threats to bearded and ringed seals. These vessels operate year round and are capable of crushing animals, destroying lairs, and harassing animals from noise propagated through air or water. Reeves (1998) noted that some ringed seals have been killed by icebreakers moving through breeding areas in land-fast ice. The presence and movements of ships in the vicinity of ringed seals may cause them to abandon their preferred breeding habitats in areas with high traffic (Smiley and Milne 1979).

6.10 Environmental Baseline Summary

Historically, overexploitation of large whales caused declines in abundance to the point of near-extinction. Commercial whaling of bowhead whales has been eliminated and they are recovering. Bearded and ringed seals have not experienced the same level of historic exploitation. While the primary cause for the listing of the bowhead (commercial whaling) lies in the past, the primary threat to bearded and ringed seals lies in the future (i.e. climate change).

The relationship between sound and marine mammal response to sound is the topic of extensive scientific research and public inquiry. Most observations report only short-term behavioral responses that include cessation of feeding, resting, or social interactions because study design precludes detection of difficult-to-detect long-term effects, if any exist. However, behavioral response could take the form of habitat abandonment, which could have implications at the population level.

7 EFFECTS OF THE ACTION

"Effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. The proposed activities will expose ESA-listed whales and seals to geohazard and strudel scour survey vessels and sounds and physical presence of survey equipment.

The proposed action is expected to result in non-lethal harassment of ESA-listed whales and seals. The ESA does not define harassment and NMFS has not defined this term through regulation pursuant to the ESA. As noted above in footnote 4, the MMPA includes definitions for a Level A and Level B harassment.

Since 1997 NMFS has used generic sound exposure thresholds to determine whether an activity produces underwater sounds that might result in impacts to marine mammals (70 FR 1871). NMFS is currently developing comprehensive guidance on sound levels likely to cause injury and behavioral disruption to marine mammals.[12] Until such guidance is available, NMFS defines Level B harassment under section 3(18)(A)(ii) of the MMPA to occur when received pulse levels are greater than or equal to 160 dB re 1 μPa_{rms}. NMFS defines Level A harassment under section 3(18)(A)(i) of the MMPA to occur when received sound levels are equal to or greater than the following thresholds:

- 180 dB re 1 μPa_{rms} for whales
- 190 dB re 1 μPa_{rms} for seals and sea lions

[12] Information on the status of NMFS' acoustic guidance can be found at http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm.

Our analysis considers that behavioral harassment or disturbance is not limited to the 160 dB acoustic threshold. Our analysis considers an individual to be harassed if the individual changes its behavioral state (e.g., from resting to traveling away from the acoustic source or from traveling to evading), regardless of the received pulse level to which it was exposed (i.e., animals could be harassed at received levels less than 160 dB dB re 1 μPa_{rms}).

7.1 Stressors

During the course of this consultation, we identified the following potential stressors from the proposed activities:

- Vessel discharge
- Vessel strike
- Entanglement in, or collision with
  - towed magnetometer and side-scan sonar
  - AMARs
- Sounds from
  - vessel
  - echosounders
  - side-scan sonar
  - sub-bottom profilers
- Disturbance of sediment

Below we discuss each stressor's potential to affect ESA-listed species.

7.1.1 Stressors Not Likely to Adversely Affect ESA-listed Species

Based on a review of available information, we determined which of the possible stressors may occur, but are discountable or insignificant and, therefore, need not be evaluated further in this Opinion.

7.1.1.1 Vessel Discharge

Vessel discharge in the form of leakages of fuel or oil is possible, though if discharges do occur, we expect the amounts of leakage will be small, will dissipate quickly, and any effects on ESA-listed whales or seals would be minor and not measurable. Therefore, we conclude the effects from this stressor are insignificant.

7.1.1.2 Vessel Strike

The possibility of vessel strike is extremely unlikely. The *Sidewinder* will be traveling at low speeds (5.6 km/hr [3 kts]) during surveys, though during transit the *Sidewinder* will have an average cruising speed of 41 to 44 km/hr (22 to 24 kts). The mitigation measures described in Section 2.3 of this Opinion, such as having a PSO on board at all times, requiring the vessel to avoid groups of whales, taking measures to avoid bowhead whales, and reducing vessel speed to less than 9.3 km/hr (5 kts) during time of poor visibility, will further reduce the likelihood of vessel strike. Therefore, we conclude the effects from this stressor are discountable.

7.1.1.3 Entanglement

Though it is possible that the towed magnetometer or sidescan sonar could come in direct contact with ESA-listed species, entanglement is highly unlikely because the lines will be taut while equipment is being towed. During daylight hours, the likelihood of entanglement will be further reduced because PSOs will be monitoring for the presence of marine mammals during all survey activities and should be

aware of their presence near any towed equipment. We do not expect marine mammals to become entangled in the AMAR groundlines, as the lines are weighted and will rest on the seafloor. Though it is possible that marine mammals could come in physical contact with the lines running from the AMARs to their surface buoys, we expect entanglement in those lines is highly unlikely as the lines will remain relatively taut between the AMARs and their buoys. Therefore, we conclude the effects from this stressor are discountable.

7.1.1.4 Sounds from Vessel, Echosounders, and Side-scan Sonar

Noise from the *Sidewinder* and smaller support vessels will propagate into the marine environment. Brief interruptions in communication via masking are possible, though unlikely given the movements of whales and seals as well as the vessels. Therefore, we conclude the effects from this stressor are insignificant.

The echosounders and side scan sonar produce pulsed sounds at frequencies ranging from 210 to 900 kHz (see Table 1). These frequencies are above the assumed hearing range of bowhead whales (0.05 to 5.0 kHz) and bearded and ringed seals (0.075 to 75 kHz); therefore, we do not expect ESA-listed whales and seals to be able to hear these pulsed sounds. In the unlikely event that these frequencies are audible to bowhead whales and bearded and ringed seals, it is unlikely that the pulsed sounds produced by these devices will reach these species. Echosounders and side scan sonar operate at higher frequencies than sub-bottom profilers, meaning that frequencies produced by the echosounders and side-scan sonar will attenuate rapidly. For these reasons, we conclude the effects from these stressors are discountable.

7.1.1.5 Disturbance of Sediment

A small amount of fine sand and silt will be disturbed during deployment of AMARs; however, we expect sediment will disperse in the water column and re-settle on the seafloor quickly. This activity will not impact whales or seals directly and any effects to ESA-listed whale and seal species will be very small, if they occur at all. Therefore, we conclude the effects from this stressor are insignificant.

7.1.1.6 Summary of Stressors Not Likely to Adversely Affect ESA-listed Species

In conclusion, based on review of available information, we determined effects from vessel strike and entanglement are unlikely to occur. Further, we expect ESA-listed whales and seals will not be able to perceive sounds from echosounders and side-scan sonar. We consider the effects from these stressors to be discountable.

We determined three stressors, vessel noise, vessel discharge, and disturbance of sediment will have insignificant effects on ESA-listed whales and seals.

7.1.2 Stressors Likely to Adversely Affect ESA-listed Species

The following sections analyze the one stressor likely to adversely affect ESA-listed species: sound from the sub-bottom profiler. First, we present a brief explanation of the sound measurements used in the discussions of acoustic effects in this Opinion.

"Sound pressure" is the sound force per unit micropascals (μPa), where 1 pascal (Pa) is the pressure resulting from a force of one newton exerted over an area of one square meter. "Sound pressure level" is expressed as the ratio of a measured sound pressure and a reference level. The commonly used reference pressure level in underwater acoustics is 1 μPa, and the units for sound pressure levels are decibels (dB) re 1 μPa. Sound pressure level (in dB) = 20 log (pressure/reference pressure).

Sound pressure level is an instantaneous measurement and can be expressed as "peak" (0-p), "peak-to-peak" (p-p), or "root mean square" (rms). Root mean square, which is the square root of the arithmetic average of the squared instantaneous pressure values, is typically used in discussions of the effects of sounds on vertebrates. All references to sound pressure level in this document are expressed as rms, unless otherwise indicated. In instances where sound pressure levels for airguns were originally expressed as 0-p or p-p, we used the following rough conversions in order to express those values in rms (Harris et al. 2001):

- rms is approximately 10 dB lower than 0-p
- rms is approximately 16 dB lower than p-p

We reported the original 0-p or p-p measurements in footnotes. It should also be noted that sound pressure level does not take the duration of a sound into account.

7.2 Exposure

The number of marine mammals expected to be taken by behavioral harassment is usually calculated by multiplying the expected densities of marine mammals in the survey area by the area ensonified in excess of 160 dB re 1 μPa_{rms}. Based on the operation of a similar sub-bottom profiler in the Arctic, it is expected that the sub-bottom profiler for this survey will ensonify a radius of 30 m to at least 160 dB re 1 μPa_{rms} (Warner and McCrodan 2011); however, Hilcorp proposes to implement a 50-m shutdown zone during operation of the sub-bottom profiler. To find the area expected to be ensonified to at least 160 dB re 1 μPa_{rms} per hour during operation of the sub-bottom profiler (0.556 km^2/hr), Hilcorp multiplied the area expected to be ensonifed (0.0079 km^2 [i.e., $\pi \times (0.05\ km)^2$]) by the speed of the vessel (5.6 km/hr). Hilcorp estimated 816 hours of sub-bottom profiler operation during the survey by assuming 25 percent downtime during a 45-day survey period, assuming 24-hour operation of the sub-bottom profiler. Therefore, the total area expected to be ensonified to at least 160 dB re 1 μPa_{rms} during operation of the sub-bottom profiler is 454 km^2 (0.556 km^2/hr × 816 hr).

In its IHA application, Hilcorp calculated the number of whales expected to be taken by behavioral harassment by multiplying the maximum expected densities of marine mammals in the survey area by the total area expected to be ensonified in excess of 160 dB re 1 μPa_{rms} (i.e., 454 km^2). Because summer seal density data are lacking in the Beaufort Sea, Hilcorp calculated the number of seals expected to be taken by behavioral harassment by multiplying the maximum expected sighting rate (in number of seals sighted per hour) by the total number of hours the sub-bottom profiler will be in operation (816 hours).

In the early stages of this consultation, we reviewed with the Permits Division the whale densities and seal sighting rates Hilcorp used in its IHA application (Hilcorp 2014) and agreed the densities and sighting rates constituted the best available scientific information. Hilcorp used the maximum expected densities of whales and sighting rates of seals to calculate exposure in its IHA application. The Permits Division adopted the calculated exposures for use in the proposed IHA and we have adopted them for our exposure analysis. Table 5 summarizes whale densities, seal sighting rates, and estimated exposures.

Table 5. Estimated exposure of ESA-listed whales and seals to sound levels greater than 160 dB re 1 µPa$_{rms}$ during sub-bottom profiler operation in Foggy Island Bay, Beaufort Sea, Alaska.

Species	Density (# animals/km^2)*	Sighting Rate (# animals/hr)	Estimated Exposure (# of animals)+
Bowhead whale	0.020	N/A	9
Bearded seal	N/A	0.107	87
Ringed seal	N/A	0.397	324

* Densities from Hilcorp's IHA application (2014), which can be accessed at: http://www.nmfs.noaa.gov/pr/permits/incidental/oilgas/hilcorp_2015iha_application.pdf

+ For whales, exposure was calculated by multiplying density by the estimated ensonified area (454 km^2); for seals, exposure was calculated by multiplying sighting rate by the number of hours of operation (816).

We assume the estimated exposure in Table 5 represents the maximum number of whales and seals expected to be exposed to sound levels of at least 160 dB re 1 µPa$_{rms}$ because Hilcorp calculated its exposures using a 50-m radius (20-m larger than the radius calculated for a similar sub-bottom profiler in the Arctic).

We expect that each whale or seal exposed to sound levels of at least 160 dB re 1 µPa$_{rms}$ during operation of the sub-bottom profiler may exhibit behavioral responses. We expect exposure will be brief, as the sub-bottom profiler will be shut down if any marine mammals are observed entering the 50-m ZOI during daylight hours. We expect individuals could be exposed multiple times throughout the survey. Exposed individuals may be male or female and of any age.

We expect exposures will be limited to Level B harassment because the area ensonified to 180 dB re 1 µPa$_{rms}$ (for whales) and 190 dB re 1 µPa$_{rms}$ (for seals) is less than 30 m from the source. During daylight hours, sub-bottom profiler operations will be shut down immediately if marine mammals enter the 50-m ZOI; therefore, whales and seals will not be exposed to 180 or 190 dB re 1 µPa$_{rms}$. During hours of darkness, we expect it will be extremely unlikely for whales to be exposed to received levels of 180 dB re 1 µPa$_{rms}$ or greater or seals to be exposed to received levels of 190 dB re 1 µPa$_{rms}$ or greater for the following reasons:

1. Mitigation measures require that sub-bottom profiler operation may not begin during darkness or poor visibility conditions and that sub-bottom profiler operations may only continue these conditions if sub-bottom profilers were in operation before the onset of poor visibility conditions.
2. Hours of darkness during the project will be limited to about two hours per night beginning in mid-August (i.e., it will be dark for approximately 10 hours out of the proposed 816 hours of sub-bottom profiler operation).
3. Though animals may enter the area ensonified to 160 dB re 1 µPa$_{rms}$, we expect whales will avoid the area ensonified to 180 dB re 1 µPa$_{rms}$ and seals will avoid the area ensonified to 190 dB re 1 µPa$_{rms}$ (see Section 7.3 for further discussion about the expected avoidance of these ensonified areas).

7.3 Response

Strong underwater sound pulses can result in physical effects on the marine environment that can affect marine organisms. Possible responses by bowhead whales and ringed and bearded seals to the impulsive sound produced by the sub-bottom profilers considered in this analysis are:

- Threshold shifts
- Auditory interference (masking)
- Behavioral responses
- Non-auditory physical or physiological effects

This analysis also considers information on the potential for whale stranding and potential effects on the prey of ESA-listed species in the action area.

7.3.1 Threshold Shifts

Exposure of marine mammals to very strong sound pulses can result in physical effects, such as changes to sensory hairs in the auditory system, which may temporarily or permanently impair hearing. Temporary threshold shift (TTS) is a temporary hearing change and its severity is dependent upon the duration, frequency, sound pressure, and rise time of a sound (Finneran and Schlundt 2013). TTSs can last minutes to days. Full recovery is expected and this condition is not considered a physical injury. At higher received levels, or in frequency ranges where animals are more sensitive, permanent threshold shift (PTS) can occur. When PTS occurs, auditory sensitivity is unrecoverable (i.e., permanent hearing loss). Both TTS and PTS can result from a single pulse or from accumulated effects of multiple pulses. In the case of exposure to multiple pulses, each pulse need not be as loud as a single pulse to have the same accumulated effect. TTS and PTS occur only in the frequencies to which an animal is exposed.

Few data are available to define the hearing range, frequency sensitivities, or sound levels necessary to induce TTS or PTS in all ESA-listed whales. The best available information (based upon captive studies of toothed whales, our understanding of terrestrial mammal hearing, and extensive modeling) supports energy levels of approximately 196 to 201 dB re 1 μPa_{rms} are required to induce low-level TTS from a single pulse at a given frequency (Southall et al. 2007). To experience TTS during the proposed activities, a whale will have to be directly under or within a few meters of the sub-bottom profilers to be exposed to sound levels of 196 dB re 1 μPa_{rms}. PTS is expected at levels approximately 6 dB greater than TTS levels on a peak-pressure basis (Southall et al. 2007). If exposed to several pulses greater than 196 dB re 1 μPa_{rms} during the proposed activities, an individual could experience PTS.

Data are lacking on effects to pinnipeds exposed to pulsed sounds (Southall et al. 2007, NOAA 2013), and the energy levels required to induce TTS or PTS in pinnipeds are not known. Finneran et al. (2003) exposed two California sea lions to single underwater pulses up to 183 dB re 1 μPa_{p-p} and found no measurable TTS following exposure. Southall et al. (2007) estimated TTS will occur in pinnipeds exposed to a single pulse of sound at 212 dB re 1 μPa_{0-p} and PTS will occur at 218 dB re 1 μPa_{0-p}. To experience TTS during the proposed activities, a seal will have to be directly under the low-resolution sub-bottom profiler to be exposed to sound levels of 212 dB re 1 μPa_{rms}. If exposed to several pulses greater than 212 dB re 1 μPa_{rms} during the proposed activities, an individual could experience PTS. The source level of the high-resolution sub-bottom profiler is 210 dB re 1 μPa_{rms}; therefore, exposure to pulses from it are not expected to induce TTS or PTS in seals.

We do not expect TTS or PTS will occur in bowhead whales or seals as a result of exposure to sounds from sub-bottom profilers because we assume individuals will move away from the vessel as it approaches and ramp-ups will reduce the probability of TTS exposure at the start of surveys. During daylight hours, shut-downs will be initiated if a marine mammal is observed within 50 m of the *Sidewinder* (i.e. before the animal experiences sound levels where TTS may occur). During hours of darkness, it is possible that bowhead whales or bearded or ringed seals could be exposed to multiple pulses from the sub-bottom profilers by matching speed with the vessel and swimming directly under the sub-bottom profiler, thus inducing TTS or PTS; however, we expect it is highly unlikely for individuals to behave in such a manner.

7.3.2 Auditory Interference (Masking)

Auditory interference, or masking, occurs when an interfering noise is similar in frequency and loudness to (or louder than) the auditory signal received by an animal while it is processing echolocation signals or listening for acoustic information from other animals (Francis and Barber 2013). Masking can interfere with an animal's ability to gather acoustic information about its environment, such as predators, prey, conspecifics, and other environmental cues (Francis and Barber 2013).

There are overlaps in frequencies between sub-bottom profiler noise and vocalizations of bowhead whales and bearded and ringed seals. The proposed surveys could mask whale and seal calls. This could affect communication among individuals or affect their ability to receive information from their environment. However, the durations of the pulses are less than one second (see Table 1). Therefore, if masking does occur, we do not expect the pulses will mask vocalizations or interfere with communication of whales or seals to a significant extent, given the short duration of pulses from the sub-bottom profilers.

7.3.3 Behavioral Responses

We expect the majority of bowhead whale and bearded and ringed seal responses to the proposed activities will occur in the form of behavioral response.

7.3.3.1 Whales

Whales may exhibit a variety of behavioral changes in response to underwater sound, which can be generally summarized as:

- Modifying or stopping vocalizations
- Changing from one behavioral state to another
- Movement out of feeding or breeding areas

In cases where whale response is brief (i.e., changing from one behavior to another, relocating a short distance, or ceasing vocalization), effects are not likely to be significant at the population level, but could rise to the level of take of individual whales.

Marine mammal responses to anthropogenic sound vary by species, state of maturity, prior exposure, current activity, reproductive state, time of day, and other factors (Ellison et al. 2012). This is reflected in a variety of aquatic, aerial, and terrestrial animal responses to anthropogenic noise that may ultimately have fitness consequences (Francis and Barber 2013). We are not aware of studies which address behavioral responses of ESA-listed whales and seals to the types of sonar sound considered in this Opinion, though several studies have investigated the responses of bowhead whales and bearded and

ringed seals to airguns. Though airguns produce stronger acoustic output (source levels up to 260 dB re 1 µPa at 1 m) at lower frequencies (0.005 to 0.3 kHz) (National Research Council 2003) than the sub-bottom profilers proposed for use in this project, these studies are relevant in determining the responses of bowhead whales and bearded and ringed seals to sounds in the action area.

Several studies describe bowhead whale calling behavior in response to sounds from airguns in the Beaufort Sea. In general, calling rates of bowhead whales tend to decrease in the presence of seismic activities at distances up to 45 km (28 mi) (Greene Jr. et al. 1999, Blackwell et al. 2010, Blackwell et al. 2013); however, there is no consensus on the cause of the decrease. Calling rates may decrease in the presence of airgun sound because bowhead whales are making fewer calls, avoiding the area, or a combination of both. An increase in bowhead calling rate near seismic surveys has also been documented; though this could have been the result of insufficient data for comparison of calling rates (Greene Jr. et al. 1999).

Exposure to sound from the sub-bottom profiler may cause bowhead whales to change from one behavioral state to another. An individual whale's behavioral response to sound is likely a function of many factors, including sound frequency, intensity, duration, the behavior in which the whale is engaged, and other factors. Possible responses include alterations in breathing patterns, feeding patterns, migration routes, and behavioral shifts (Richardson et al. 1986, Ljungblad et al. 1988, Richardson et al. 1995, Miller et al. 1999, Richardson et al. 1999). We do not expect every whale to respond to sounds from the proposed activities in the same manner. For whales that do exhibit behavioral responses, we expect the most impactful effect to be temporary displacement from feeding areas (Richardson et al. 1986) to other, perhaps less productive, feeding areas. We do not expect the proposed activities to substantially impact feeding opportunities. Because the sounds produced from the proposed activities will attenuate much more rapidly than sounds from seismic activities described above (i.e., sounds from the sub-bottom profilers will not reach the same distances that sounds from airguns do), we do not expect traveling or migrating whales will alter their routes as they may do in response to airgun array operation (Miller et al. 1999, Funk et al. 2010).

7.3.3.2 Seals

Information on behavioral reactions of pinnipeds in water to multiple pulses is known from exposures to small explosives used in fisheries interactions, impact pile driving, and seismic surveys. In general, exposure of pinnipeds in water to multiple pulses of sound pressure levels ranging from approximately 150 to 180 dB re 1µPa$_{rms}$ has limited potential to induce avoidance behavior (Southall et al. 2007). Received levels exceeding 190 dB re 1µPa$_{rms}$ are likely to induce avoidance responses in at least some ringed seals (Harris et al. 2001, Blackwell et al. 2004, Miller et al. 2005). During seismic operations in the Beaufort Sea, seals tended to avoid entering the zone around the seismic vessel in which received levels exceeded 190 dB re 1µPa$_{rms}$, though some seals did enter that zone (Harris et al. 2001). Most ringed seals exposed to airgun pulses from approaching seismic vessels showed little avoidance unless received levels were high enough that TTS was likely (Southall et al. 2007). Seals at the surface of the water experience less powerful sounds than they do if they are the same distance away, but underwater, which may account for the apparent lack of strong reactions in ice seals (NMFS 2013a).

The examples provided above involve much more powerful acoustic sources than those proposed for use in this project; therefore, we do not expect bearded and ringed seals will exhibit strong behavioral reactions to the proposed activities. Because seals do not tend to avoid areas of received sound pressure levels of 150 to 180 dB re 1µPa$_{rms}$, we expect that bearded and ringed seals will occasionally enter the

50-m ZOI during the operation of sub-bottom profilers. During daylight hours, sub-bottom profiler operations will be powered down if marine mammals are observed approaching the ZOI and shut down if marine mammals are observed entering the ZOI. During hours of darkness or reduced visibility, we expect bearded and ringed seals will occasionally enter the ZOI, but we expect they will avoid the area in which received levels are greater than 190 dB re 1µPa_{rms} (i.e., the area directly under the sub-bottom profilers). Because we do not expect bearded or ringed seals will exhibit strong reaction to the operation of the sub-bottom profilers, we do not expect project activities will impact feeding, breeding, or resting opportunities.

7.3.4 Physical and Physiological Effects

Individuals exposed to noise can experience stress and distress, where stress is an adaptive response that does not normally place an animal at risk, and distress is a stress response resulting in a biological consequence to the individual. Both stress and distress can affect survival and productivity (Curry and Edwards 1998, Cowan and Curry 2002, Herráez et al. 2007, Cowan and Curry 2008). Mammalian stress levels can vary by age, sex, season, and health status (St. Aubin et al. 1996, Gardiner and Hall 1997, Hunt et al. 2006, Keay et al. 2006, Romero et al. 2008).

Loud noises generally increase stress indicators in mammals (Kight and Swaddle 2011). During the time following September 11, 2001, shipping traffic and associated ocean noise decreased along the northeastern U.S. This decrease in ocean noise was associated with a significant decline in fecal stress hormones in North Atlantic right whales, suggesting that chronic exposure to increased noise levels, although not acutely injurious, can produce stress (Rolland et al. 2012). These levels returned to their previous level within 24 hrs after the resumption of shipping traffic. Exposure to loud noise can also adversely affect reproductive and metabolic physiology (Kight and Swaddle 2011). In a variety of factors, including behavioral and physiological responses, females appear to be more sensitive or respond more strongly than males (Kight and Swaddle 2011).

Whales and seals use hearing as a primary way to gather information about their environment and for communication; therefore, we assume that limiting these abilities is stressful. Stress responses may also occur at levels lower than those required for TTS (NMFS 2006). Therefore, exposure to levels sufficient to trigger onset of PTS or TTS are expected to be accompanied by physiological stress responses (National Research Council 2003, NMFS 2006).

As discussed in Section 7.3.1, we do not expect individuals to experience TTS or PTS; therefore, we also do not expect whales or seals to experience stress responses at high levels during daylight hours. We assume that stress responses could be associated with displacement, due to disruption of feeding. If whales and seals are not displaced and remain in a stressful environment (i.e. near sounds associated with the sub-bottom profilers), we expect the stressors will dissipate shortly after the survey vessel (and stressors) moves away. In any of the above scenarios, we do not expect significant or long-term harm to individuals from a stress response.

7.3.5 Strandings

There is evidence that sound from some sonar sources has played a role in the strandings of marine mammals. Investigations of a 2008 stranding event in Madagascar suggested a 12 kHz multibeam sonar played a significant role in the mass stranding of melon-headed whales (Southall et al. 2013). Though the authors note that pathological data suggesting direct physical effects are lacking, all other possibilities were either ruled out or believed to be of much lower likelihood as a cause of or contributor

to the stranding (Southall et al. 2013). This incident highlights the caution needed when interpreting effects that may or may not stem from anthropogenic sound sources, such as the sub-bottom profilers proposed for use in this project. Though the use of this type of sonar is common worldwide and effects of this magnitude have not been documented for ESA-listed species, it is possible that the combination of exposure to 12 kHz sonar with other factors, such as those below, could combine to produce a response that is greater than would otherwise be anticipated or has been documented (Ellison et al. 2012, Francis and Barber 2013):

- Behavioral and reproductive state
- Oceanographic and bathymetric conditions
- Movement of the source
- Previous experience of individuals with the stressor

The high-resolution sub-bottom profiler proposed for use in this project is capable of operating at a frequency of 12 kHz (frequencies will range from 2 to 24 kHz); however, it differs from the 12 kHz multibeam sonar system used in Madagascar in the following ways (Southall et al. 2013):

- The multibeam sonar's source levels were higher (236 to 242 vs. 210 dB re 1µPa_{rms})
- The vertical beamwidth was greater (150 vs. 15 to 24°)
- The system was composed of 191 beams

Because of these differences, the area ensonifed by the high-resolution sub-bottom profiler will be much smaller than the multibeam sonar used in Madagascar. The low-resolution sub-bottom profiler will not operate at frequencies of 12 kHz (frequencies will range from 1 to 4 kHz).

Stranding events associated with the operation of naval sonar suggest that mid-frequency sonar sounds may have the capacity to cause serious impacts to marine mammals (NMFS and Navy 2001). The systems proposed for use on this project differ from sonars used during naval operations, which generally have a longer pulse duration and more horizontal orientation than the downward-directed sub-bottom profilers. The sound energy received by any individuals exposed to these systems during the proposed activities is lower than that of naval sonars, and will be briefer. The area of possible influence is also smaller, consisting of a small area around and below the source.

There is some concern regarding marine mammal strandings and seismic surveys, along with anecdotal accounts associating the two in space and time; however, no conclusive evidence has linked stranding events to seismic surveys (Hogarth 2002, Yoder 2002, IAGC 2004, Cox et al. 2006, IWC 2006).

Bowhead whales may be exposed to sounds from the sub-bottom profilers, especially during hours of darkness. If exposed, we expect bowhead whales may respond briefly (i.e., startling or increasing swimming speed). Additionally, the surveys will generally begin in shallow water and work toward deeper water to mitigate any potential "herding" effect exposure to the sub-bottom profilers may have on marine mammals. We do not expect exposure to sounds from sub-bottom profilers will result in stranding events.

7.3.6 Marine Mammal Prey

Anthropogenic noises may also have indirect, adverse effects on prey availability through lethal or sub-lethal damage, stress responses, or alterations in their behavior or distribution. Species-specific information about prey of bowhead whales and bearded and ringed seals is generally not available; however, we expect that prey of these species will react to anthropogenic noise in manners similar to the fish and invertebrates described below.

Effects from exposure to high-intensity sound sources have been documented in fish and invertebrates, including stress (Santulli et al. 1999), injury (McCauley et al. 2003), TTS (Popper et al. 2005), and changes in balance (Dalen and Knutsen 1986). In general, we expect fish will be capable of moving away from the sub-bottom profilers if they experience discomfort. We expect the area in which stress, injury, TTS, or changes in balance, of prey species could occur will be limited to a few meters directly below the sub-bottom profiler.

The most common response to airgun sounds by fishes is a startle response, where fish react momentarily by changing orientation, swimming speed, or their vertical distribution in the water column (Chapman and Hawkins 1969, Dalen and Knutsen 1986, Pearson et al. 1992, Turnpenny and Nedwell 1994, Engås et al. 1996, La Bella et al. 1996, McCauley et al. 2000, Thomsen 2002, Slotte et al. 2004, Løkkeborg et al. 2012, McCauley and Fewtrell 2013); however startle responses to airguns were not found in some studies (Pickett et al. 1994, Turnpenny and Nedwell 1994). A mixture of responses was found in other studies. La Bella et al. (1996) found no differences in trawl catch data before and after seismic operations, and echosurveys of fish occurrence did not reveal changes in pelagic biomass after seismic operations; however, fish kept in cages did show behavioral responses to approaching airguns. Pollock did not respond to received airgun sounds of 185 to 208 dB re 1 μPa_{rms}[13], though startle responses were exhibited, and fish fled from the seismic source when it became visible (Wardle et al. 2001).

The typical response of fishes and invertebrates to airgun exposure is to exhibit startle responses and undergo vertical and horizontal movements away from the sound field. Because airguns produce louder, more intense sounds at lower frequencies than those produced by the sub-bottom profilers proposed for use, we expect the proposed project activities will elicit less pronounced responses from whale and seal prey species than the responses described above. Prey species may startle and disperse when exposed to sounds from the sub-bottom profiler, but we expect any disruptions will be temporary. We do not expect effects to prey species will be sufficient to affect ESA-listed whales and seals.

7.3.7 Response Summary

Of the responses considered above, we do not expect TTS or PTS or strandings will occur. We expect masking, behavioral responses, physical and physiological effects, and responses by prey species may occur. Though project activities may cause brief interruptions in communications (masking), displacement from preferred feeding areas, and stress associated with these disruptions in exposed whales and seals, we expect all effects will be temporary. Prey species may startle and disperse when exposed to sounds from the sub-bottom profiler, but we expect these disruptions will also be temporary.

8 CUMULATIVE EFFECTS

"Cumulative effects" are those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the action area (50 CFR 402.02). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation, per section 7 of the ESA.

We searched for information on non-federal actions reasonably certain to occur in the action area. We did not find any information about non-federal actions other than what has already been described in the Environmental Baseline (Section 6 of this Opinion). We expect impacts from climate change, fisheries,

[13] Originally reported as 195 to 218 dB re 1 $\mu Pa_{0\text{-}p}$

harvest, noise, natural mortality, oil and gas activities, pollutants and discharges, scientific research, and ship strike will continue into the future. We expect moratoria on commercial whaling and bans on commercial sealing will remain in place, aiding in the recovery of ESA-listed whales and seals.

9 INTEGRATION AND SYNTHESIS OF EFFECTS

The narrative that follows integrates and synthesizes the information contained in the Status of the Species (Section 5), the Environmental Baseline (Section 6) and the Effects of the Action (Section 7) sections of this Opinion to assess the risk that the proposed activities pose to ESA-listed whales and seals.

The survival and recovery of bowhead whales, and Arctic ringed and Beringia DPS bearded seals within the action area may be affected by:

- Climate change
    - prey distribution
    - habitat quality
- Fisheries interactions
- Subsistence harvests
- Natural and anthropogenic noise
- Natural mortality
    - predation
    - disease
    - parasites
    - stranding and entrapment in ice
    - unusual mortality event in seals
- Oil and gas activities
- Pollutants and discharges
- Scientific research
- Ship strike

Despite these pressures, available trend information indicates bowhead whale populations are increasing. Population trends for Arctic ringed and Beringia DPS bearded seals are not known, but we expect loss of seasonal sea ice will endanger these species in the foreseeable future.

We concluded in the Effects of the Action (Section 7 of this Opinion) that ESA-listed whales and seals may be harassed by the proposed activities. We expect the following number of whales represent the maximum number of individuals that will be exposed to sounds of at least 160 dB re 1 μPa_{rms} but less than 180 dB re 1 μPa_{rms} (i.e., will be exposed to Level B harassment) from the sub-bottom profilers:

- 9 bowhead whales

We expect the following number of seals represent the maximum number of individuals that will be exposed to sounds of at least 160 dB re 1 μPa_{rms} but less than 190 dB re 1 μPa_{rms} (i.e., will be exposed to Level B harassment) from the sub-bottom profilers:

- 324 Arctic ringed seals
- 87 Beringia DPS bearded seals

We expect these exposures may cause brief interruptions in communication (i.e., masking) and could elicit the following temporary behavioral responses:

- Avoidance of the ensonified area
- Displacement from feeding areas

We expect low-level, brief stress responses will accompany these responses. We do not expect whales or seals exposed to these sounds to experience a reduction in fitness.

Prey species may also exhibit temporary displacement when exposed to sounds from the sub-bottom profiler. We do expect this displacement will limit the prey available to whales and seals.

In summary, we do not expect exposure to any of the stressors related to the proposed project to reduce fitness in any individual whale or seal. Therefore, we do not expect fitness consequences to ESA-listed whale and seal populations or species.

10 CONCLUSION

After reviewing the current status of ESA-listed whale and seal species, the environmental baseline for the action area, the anticipated effects of the proposed activities, and the possible cumulative effects, it is NMFS's biological opinion that the Permits Division's proposed action of issuing an IHA to Hilcorp is not likely to jeopardize the continued existence of the following species:

- Bowhead whale
- Arctic ringed seal
- Beringia DPS bearded seal

11 INCIDENTAL TAKE STATEMENT

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

The measures described below are nondiscretionary, and must be undertaken by the Permits Division so that they become binding conditions for the exemption in section 7(o)(2) to apply. Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA and the proposed action may incidentally take individuals of ESA-listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species.

Section 7(b)(4)(C) of the ESA specifies that in order to provide an incidental take statement for an endangered or threatened species of marine mammal, the taking must be authorized under section 101(a)(5) of the MMPA. Accordingly, **the terms of this incidental take statement and the exemption from Section 9 of the ESA become effective only upon the issuance of MMPA authorization to take the marine mammals identified here (Section 9 of the ESA, however, does not apply to ringed or bearded seals)**. Absent such authorization, this incidental take statement is inoperative.

The ESA does not prohibit the taking of threatened species unless special regulations have been promulgated, pursuant to ESA Section 4(d), to promote the conservation of the species. ESA Section 4(d) rules have not been promulgated for the Arctic ringed or Beringia DPS bearded seals; therefore, ESA section 9 take prohibitions do not apply. This incidental take statement includes numeric limits on taking of these species because this amount of take was analyzed in our jeopardy analysis. These numeric limits provide guidance to the action agency on its requirement to re-initiate consultation when the amount of take estimated in the jeopardy analysis of this biological opinion is exceeded. This ITS includes reasonable and prudent measures and terms and conditions designed to minimize and monitor take of these threatened species.

11.1 Amount or Extent of Take

NMFS anticipates the proposed shallow geohazard and strudel scour surveys in Foggy Island Bay, Beaufort Sea, is likely to result in the incidental take of ESA-listed species by harassment. As presented in Table 5 in Section 7.2 of this Opinion, the proposed action is expected to take, by Level B harassment, the following number of ESA-listed individuals:

- 9 bowhead whales
- 87 Beringia DPS bearded seals
- 324 Arctic ringed seals

Harassment of these individuals will occur by exposure to received sound levels greater than 160 dB re 1 μPa_{rms} (i.e., within the 50-m ZOI) but less than 180 dB re 1 μPa_{rms} (for whales) and less than 190 db re 1 μPa_{rms} (for seals). These estimates are based on the best available information of whale and seal densities in the area that will be ensonified at sound pressure levels equal to or greater than 160 dB re 1 μPa_{rms}. This incidental take will result primarily from exposure to acoustic energy from sub-bottom profilers and will be in the form of harassment. Death or injury is not expected for any individual whales or seals that are exposed to these sounds.

Harassment is not expected for ESA-listed whales or seals exposed to sub-bottom profiler sounds at levels less than 160 dB re 1 μPa_{rms}. However, if overt reactions (e.g., startle responses or rapid departures from the area) by bowhead whales, Arctic ringed seals or Beringia DPS bearded seals occur at received sound pressure levels less than 160 dB re 1 μPa_{rms} while sub-bottom profilers are operating, this may constitute take that is not covered in this Incidental Take Statement. The Permits Division must contact NMFS Alaska Region to determine whether reinitiation of consultation is required because of such operations.

Marine mammals observed within the 50-m ZOI during operation of the sub-bottom profiler will be considered to be taken, regardless of subsequent shut-downs, and even if they exhibit no overt behavioral reactions.

Any incidental take of ESA-listed whales and seals considered in this consultation is restricted to the permitted action as proposed. If the actual incidental take exceeds the predicted level or type, the Permits Division must reinitiate consultation. Likewise, if the action deviates from what is described in section 2 of this Opinion, the Permits Division must reinitiate consultation. All anticipated takes will be "takes by harassment", as described previously, involving temporary changes in behavior.

11.2 Effect of the Take

In this Opinion, NMFS has determined that the level of incidental take is not likely to jeopardize the continued existence of any ESA-listed species.

11.3 Reasonable and Prudent Measures

NMFS concludes the Reasonable and Prudent Measure described below is necessary and appropriate to minimize the amount of incidental take of ESA-listed whales resulting from the proposed actions. This measure is non-discretionary and must be a binding condition of the Permits Division's authorization for the exemption in section 7(o)(2) to apply. If the Permits Division fails to ensure Hilcorp's compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse:

- The Permits Division must require Hilcorp to implement and monitor the effectiveness of mitigation measures incorporated as part of the proposed authorization for the incidental taking of ESA-listed marine mammals pursuant to section 101(a)(5)(D) of the MMPA, as specified below.

This Reasonable and Prudent Measure, along with its implementing terms and conditions, is also designed to minimize the impact of incidental take of Beringia DPS bearded seals and Arctic ringed seals that might otherwise result from the proposed action. NMFS concludes the Reasonable and Prudent Measure is necessary and appropriate to minimize or to monitor the incidental take of Arctic ringed and Beringia DPS bearded seals resulting from the proposed action.

11.4 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the Permits Division must require Hilcorp to comply with the following terms and conditions, which implements the Reasonable and Prudent Measure described above and outline the mitigation, monitoring, and reporting measures required by section 7 regulations (50 CFR 402.14(i)). These terms and conditions are non-discretionary. If the Permits Division fails to ensure compliance with these terms and conditions and their implementing Reasonable and Prudent Measures, the protective coverage of section 7(o)(2) may lapse.

To implement the Reasonable and Prudent Measure, the Permits Division shall ensure that Hilcorp adhere to all portions of the description of the action (Section 2 of this Opinion), especially those measures described in Section 2.3.1 of this Opinion, Mitigation Monitoring and Reporting Requirements. The Permits Division shall also ensure that Hilcorp adhere to the following Terms and Conditions:

4. All ESA-listed marine mammal observations and takes (i.e., takes that occur in the manner and extent as described in Section 11.1 of this Opinion) must be reported to NMFS in writing within 30 days of the conclusion of the project at the following contacts:
   - 4.1. Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, by email to Jolie.Harrison@noaa.gov and Shane.Guan@noaa.gov
   - 4.2. Greg Balogh, Supervisory Biologist, Anchorage Protected Resources Office, NMFS, by email to Greg.Balogh@noaa.gov and Bridget.Crokus@noaa.gov
5. Reports of observations and take must include the following:
   - 5.1. Species, age, sex, and number of animal(s) involved
   - 5.2. Time, date, and location (latitude and longitude, to the nearest second) of observation or take
   - 5.3. Primary, and, if observed, secondary behavior (i.e., behavioral changes) of the animals at the time of observation or take

6. For all takes of ESA-listed marine mammals, the report must also include the following:
   6.1. The name and type of vessel involved
   6.2. The vessel's speed during and leading up to the incident
   6.3. Description of the incident
   6.4. Status of all sound sources at the time of the take
   6.5. Mitigation measures implemented prior to and after the animal entered the 50-m ZOI
   6.6. Closest approach to the marine mammal by the source vessel during full sonar operations and reduced sonar operation (i.e., power-down)
   6.7. Water depth
   6.8. Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility)
   6.9. The fate of the animal(s)
   6.10. Photographs or video footage of the animal (if available)
7. If prohibited take (i.e., take that exceeds the amount or extent or occurs in a manner not described in Section 11.1 of this Opinion) of ESA-listed marine mammals occurs, Hilcorp will immediately cease operations and immediately report the incident (including all information listed in Terms and Conditions 5 and 6) to the following contacts:
   7.1. Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, NMFS
      7.1.1. by phone at 301-427-8401
      7.1.2. by email to Jolie.Harrison@noaa.gov and Shane.Guan@noaa.gov
   7.2. Greg Balogh, Supervisory Biologist, Anchorage Protected Resources Office, NMFS
      7.2.1. by phone at 907-271-3023
      7.2.2. by email to Greg.Balogh@noaa.gov and Bridget.Crokus@noaa.gov
   7.3. Alaska Regional Stranding Coordinators
      7.3.1. by phone at (907) 586-7235 or (907) 271-5006
      7.3.2. by email at Aleria.Jensen@noaa.gov and Barbara.Mahoney@noaa.gov)
   7.4. NMFS Alaska-wide 24-hour stranding hotline
      7.4.1. by phone at (877) 925-7773

12 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on ESA-listed species or critical habitat, help implement recovery plans, or develop information (50 CFR 402.02).

We recommend the following conservation recommendation, which will provide information for future consultations involving the issuance of permits that may affect ESA-listed whales and seals:

- **Behavioral responses of whales and seals**. We recommend that the Permits Division summarize findings from past IHA holders about behavioral responses of ESA-listed whales and seals to sounds from sub-bottom profilers. Better understanding of how ESA-listed whales and seals respond to sounds from sub-bottom profilers will better inform our exposure and response analyses.

In order for the NMFS Alaska Region to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting, ESA-listed species or their habitats, the Permits Division should notify the NMFS Alaska Region of any conservation recommendations they implement in their final action.

13 REINITIATION NOTICE

This concludes formal consultation on the proposed issuance of an IHA to Hilcorp for shallow geohazard and strudel scour surveys in Foggy Island Bay, Beaufort Sea, Alaska. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if:

- The amount or extent of proposed take is exceeded.
- New information reveals effects of the agency action that may affect ESA-listed species or critical habitat in a manner, or to an extent, not considered in this opinion.
- The agency action is subsequently modified in a manner that causes an effect to the ESA-listed species, or critical habitat not considered in this opinion.
- A new species is ESA-listed or critical habitat designated that may be affected by the action.

In instances where the amount or extent of authorized take is exceeded, the Permits Division must immediately request reinitiation of section 7 consultation.

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