

**MARINE MAMMAL MONITORING AND MITIGATION PLAN**

**for**

**LIBERTY UNIT SHALLOW GEOHAZARD SURVEYS, BEAUFORT SEA, ALASKA, 2015**

**Submitted by**

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# 1. Introduction

Hilcorp Alaska, LLC (Hilcorp) plans to conduct a shallow geohazard survey and strudel scour survey with a transition zone component on state lands, and in federal and state waters of Foggy Island Bay in the Beaufort Sea during the open water season of 2015. The geohazard and strudel scour surveys are being conducted in support of the development of the Liberty field. The Liberty reservoir is located in federal waters in Foggy Island Bay about 8 miles (mi) east of the Endicott Satellite Drilling Island (SDI). The project's preferred alternative is to build a gravel island situated over the reservoir and to install a subsea pipeline to transport sales quality crude oil to shore, where an above ground pipeline will transport crude to the existing Badami pipeline.

In support of the preferred alternative, a shallow geohazard survey is planned with an emphasis on obtaining subsurface information for the development of a subsea pipeline. The sonar survey, using multibeam echosounder, sidescan sonar, sub-bottom profiler, and magnetometer is planned over the proposed subsea pipeline corridor area. The purpose of this proposed survey is to evaluate the existence and location of archaeological resources, potential geologic hazards on the seafloor and in the shallow subsurface, and to investigate strudel scours and ice gouges. There is no seismic acoustic component to this project.

The proposed Liberty pipeline route open water survey will consist of the shallow geohazard and strudel scour surveys. Strudel scour surveys investigate the depth and distribution of ice gouges into the seabed and, site clearance and shallow hazard surveys focus on the upper 1,000 m of the seabed within select areas of interest near offshore drilling locations and proposed pipeline corridors. The types of equipment used to conduct these surveys are focused on limited areas and emit low-level, very-high to low frequency acoustic continuous sounds during discrete time periods over very limited areas of the ocean bottom and intervening water column. During data acquisition, the total planned survey lines are approximately 300 miles, not including turns and cross-lines; the source vessels of the proposed Liberty Unit shallow geohazard survey will cover an area of about 2.5 mi<sup>2</sup> in water depths ranging from 3 to 20 ft.

Hilcorp's 4MP is a combination of active monitoring of the area of operations and the implementation of mitigation measures designed to minimize project impacts to marine resources. If marine mammals are observed within or about to enter specific safety radii around the proposed survey activities, mitigation will be initiated by vessel-based protected species observers (PSOs). The operating frequencies of the multibeam, single-beam, and sidescan sonar equipment in this survey are above the hearing range of all marine mammals. Estimated distances to sound pressure levels of 190, 180, and 160 dB re 1 µPa, generated by the proposed sub-bottom equipment is

EQUIPMENT	DISTANCE (IN METERS)				COMMENT
	190 dB	180dB	160dB	120dB	
<b>Sub-bottom profiler (Directional Beam)</b>	< 30	< 30	30	450	Within hearing range of all marine mammal species

Distances (in meters) to four received Sound Pressure Levels (SPLs) [In dB re 1 µPa (rms)] from existing measurements of geophysical equipment, similar to those proposed for this survey. Measurements were conducted in water depths of about 100ft. (~35m). Source: Warner & McCrodan 2011.

Sounds generated by the sub-bottom profiler are within the hearing range of all marine mammal species occurring in the area. Review of current information for similar equipment in the Arctic resulted in estimating the distance to 160 dB re 1  $\mu$ Pa (rms) at 30m (Warner & McCrodan 2011). The mitigation radius of the proposed sub-bottom profiler is:

EQUIPMENT	DISTANCE (IN METERS)
Sub-bottom Profiler	50

Distances (in meters) to be used for mitigation purposes for the proposed 2015 Liberty Unit Shallow Geohazard survey.

Vessel-based monitoring during sonar activity and periods when equipment are not active will provide information on the numbers of marine mammals potentially affected by the survey activities and facilitate real time mitigation to prevent impacts to marine mammals by industrial sounds or activities. Vessel-based PSOs will record the numbers and species of marine mammals observed in the area and any observable reaction of marine mammals to the survey activities.

A unit wide acoustics program will characterize the ambient sound levels occurring during the survey. Passive acoustic monitoring will be conducted to document ambient noise conditions, to examine the spatial and temporal distribution of marine mammals based on acoustic detections of their vocalizations, and to characterize the long-range propagation of sounds produced during the geohazard survey. Marine Survey equipment to be used includes:

EQUIPMENT	Sample Equipment Model Type	OPERATING FREQUENCY	ALONG TRACK BEAM WIDTH	ACROSS TRACK BEAM WIDTH	RMS SOURCE PRESSURE LEVEL (Directional) Re 1 $\mu$ Pa @1m
Multibeam echosounder	Reson 7101 SV <sup>a</sup>	240 kHz	1.5°	1.8°	220 dB
Single-beam echosounder	Odom <sup>b</sup>	210 kHz	3°	3°	220 dB
Side scan sonar	Edgetech 4125 <sup>c</sup>	400 kHz/900 kHz	0.5°	50°	215 dB
High resolution (CHIRP) sub-bottom profiler	Edgetech 3200 <sup>d</sup>	2 to 24 kHz	15° to 24°	15° to 24°	210 dB
Low resolution sub-bottom profiler	Applied Acoustics AA251 <sup>e</sup>	1 to 4 kHz	n/a	n/a	212 dB

<sup>a</sup> Verbal conversation with Kelly Wright, engineer with Teledyne Reson 12/3/14, and Equipment Specification document "SeaBat(r) 7101".

<sup>b</sup> Computed using equation for source level of directional circular transducer. Principles of Underwater Sound, Chapter 2, Robert J. Urick, 1975, and Equipment Specification document "SMBB200-3 information sheet".

<sup>c</sup> Edgetech document "4125 source level specification" received via email from Edgetech representative Rob Morris on 7/1/2014, and Equipment Specification document "Edgetech 4125 Side Scan Sonar System".

<sup>d</sup> Edgetech document "3200 SB system transmit level" received via email from Edgetech representative Rob Morris on 7/1/2014, and Equipment Specification document "Edgetech 3200 Sub-bottom Profiling System".

<sup>e</sup> Equipment Specification document "AA251, AA301 Boomer Seismic Sound Source".

Support activities, such as crew transfers and vessel re-supply are primarily planned to occur at West Dock. Equipment staging and on shore support will primarily occur at West Dock, with secondary locations at SDI or the SDI causeway. For protection from weather, the vessel may anchor near West Dock, near the barrier islands, or other safe harbor, near shore locations. Hilcorp plans to conduct marine surveys from a single vessel with another smaller vessel likely surveying shallower areas. Timing of the work will depend on weather, ice conditions, and avoidance of subsistence activities. The marine surveys are planned to begin July 1 and all sonar

activities will cease August 25 when whale hunting traditionally begins. Demobilization of equipment is planned to be complete before the end of September. The total time span of the sonar survey period in the Foggy Island Bay area is estimated to be approximately 45 days. About 25% of downtime is included in this total, so the actual number of days that equipment are expected to be operating is estimated at 34, based on a continuous 24-hr operation.

The 4MP developed for Hilcorp's planned activities support the protection of marine mammal resources in the area, fulfills reporting obligations to the Bureau of Ocean Energy Management (BOEM), the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), and establishes a means for gathering additional data on marine mammals for future operations planning.

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## **2. Marine Mammal Monitoring**

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Hilcorp's 4MP is a combination of active monitoring of the area of operations and the implementation of mitigation measures designed to minimize project impacts to marine resources. Monitoring will provide information on the numbers of marine mammals potentially affected by the exploration operations and facilitate real time mitigation to prevent injury of marine mammals by industrial sounds or activities. These goals will be accomplished in the Foggy Island Bay during 2015 by conducting vessel-based monitoring from the survey vessel(s), and an acoustic monitoring program to document underwater sounds and the vocalizations of marine mammals in the unit. Similar to other programs, Hilcorp will monitor marine mammals from the survey vessel(s) to provide information on impacts that may be specific to these operations.

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

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

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## **3. Vessel-Based Marine Mammal Monitoring Program**

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The vessel-based operations of Hilcorp's 4MP are designed to meet the requirements of Incidental Harassment Authorization (IHA) and Letter of Authorization (LOA) permits issued by NMFS and USFWS, respectively, and to meet any other stipulation agreements between Hilcorp and other agencies or groups. The objectives of the program will be:

- to ensure that disturbance to marine mammals and subsistence hunts is minimized and all permit stipulations are followed,

- to document the effects of the proposed survey activities on marine mammals, and
- to collect data on the occurrence and distribution of marine mammals in the study area during survey activities.

The 4MP will be implemented by a team of experienced PSOs, including both biologists and Inupiat personnel. PSOs will be stationed aboard the marine survey vessel(s). Reporting of the results of the vessel-based monitoring program will include the estimation of the number of “takes” as stipulated in the IHA and LOA.

The vessel-based portion of Hilcorp’s 4MP will be required to support the survey activities in Foggy Island Bay. The survey dates and specific operating areas are described above, but will also depend somewhat upon ice and weather conditions.

The vessel-based work will provide:

- the basis for real-time mitigation, if necessary, as required by the various permits that Hilcorp receives
- information needed to estimate the number of “takes” of marine mammals by harassment, which must be reported to NMFS and USFWS;
- data on the occurrence, distribution, and activities of marine mammals in the areas where the survey program is conducted;
- information to compare the distances, distributions, behavior, and movements of marine mammals relative to the survey vessel at times with and without various activities, and;
- a communication channel to coastal communities including Inupiat whalers and other subsistence users.

The 4MP will be operated and administered to be consistent with monitoring programs conducted during previous shallow hazards surveys conducted in the Liberty Unit or such alternative requirements as may be specified in the authorizations issued this project. Any other stipulations from agreements between Hilcorp and agencies or groups such as BOEM, USFWS, the North Slope Borough (NSB), and the Alaska Eskimo Whaling Commission (AEWC) will also be fully incorporated. All PSOs will be provided training through a program approved by NMFS and Hilcorp, as described below. At least one observer on each project vessel will be an Inupiat who will have the additional responsibility of communicating with coastal communities.

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### *3.1. Mitigation Measures during Survey Activities*

Hilcorp’s planned marine surveys incorporate both design features and operational procedures for minimizing potential impacts on marine mammals and on subsistence hunts. The design features and operational procedures have been described in the IHA and LOA applications submitted to NMFS and USFWS, respectively, and are summarized below. Survey design features include:

- timing and locating survey activities to avoid interference with the annual fall bowhead whale hunt;
- limiting the size of the sound sources to minimize energy introduced into the marine environment; and,
- establishing precautionary safety radii based on previous measurements of a similar sound source in the area.

The potential disturbance of marine mammals during survey and equipment maintenance activity will be minimized further through the implementation of several ship-based mitigation measures if mitigation becomes necessary. General mitigation measures, per the NMFS IHA and USFWS LOA stipulations, will be implemented by PSOs aboard all vessels to reduce potential impacts to marine mammals from vessel(s)

movements. These general mitigation measures include reductions in vessel speed and alterations in vessel course to avoid marine mammals and maximize the distance between vessels and animals.

### *3.1.1. Safety and Disturbance Zones*

Under current NMFS guidelines (e.g., NMFS 2000), “safety radii” for marine mammals around industrial sound sources are customarily defined as the distances within which received sound levels are  $\geq 180$  dB re 1  $\mu$ Pa (rms) for cetaceans and  $\geq 190$  dB re 1  $\mu$ Pa (rms) for pinnipeds. These safety criteria are based on an assumption that sound energy received at lower received levels will not injure these animals or impair their hearing abilities, but that higher received levels might have some such effects. Disturbance or behavioral effects to marine mammals from underwater sound may occur after exposure to sound at distances greater than the safety radii (Richardson et al. 1995).

The operating frequencies of the multibeam, single-beam, and sidescan sonar equipment in this survey are above the hearing range of all marine mammals. Estimated distances to sound pressure levels of 190, 180 dB re 1  $\mu$ Pa, generated by the proposed sub-bottom equipment is  $< 30$  m. Sounds generated by the sub-bottom profiler are within the hearing range of all marine mammal species occurring in the area. Review of current information for similar equipment in the Arctic resulted in estimating the distance to 160 dB re 1  $\mu$ Pa (rms) at 30m (Warner & McCrodan 2011). The mitigation radius of the proposed sub-bottom profiler is conservatively set at 50 m. The mitigation measure to be implemented at the conservative radii distance of 50 m will be a shut down. A shut down is the immediate cessation of all sonar energy sources. The sonar equipment will be immediately powered down whenever a marine mammal is sighted approaching close to or within the applicable safety zone.

### *3.1.2. Poor visibility conditions*

Hilcorp plans to conduct 24-hr operations. PSOs will not be on duty during ongoing sonar operations during darkness, given the very limited effectiveness of visual observation at night (there will be no periods of darkness in the survey area until mid-August). The proposed provisions associated with operations at night or in periods of poor visibility include the following:

- If during foggy conditions, heavy snow or rain, or darkness (which may be encountered starting in late August), the full 50 m safety zone is not visible, the sonar equipment cannot resume from a full shut-down.
- If sonar equipment is operational before nightfall or before the onset of poor visibility conditions, they can remain operational throughout the night or poor visibility conditions; on the assumption that marine mammals will be alerted by the sounds from the vessel and have moved away.
- Sonar equipment will not be operated during long transits when exploration activities are not occurring, or if visibility conditions impede safe vessel operations in the survey area. This does not apply to turns when starting a new track line.

### *3.1.3. Protected Species Observers*

Two marine mammal observers (PSOs) will be present on the main sonar vessel. The smaller skiff may only accommodate one at a time. Of these two PSOs, one will be on watch at all times, except ongoing sonar

operations during darkness, to monitor the 50 m safety radius for the presence of marine mammals during sonar operations. The main objectives of the vessel-based marine mammal monitoring are as follows:

1. To implement mitigation measures during sonar operations (e.g. course alteration, power-down, shut-down and ramp-up);
2. To record all marine mammal data needed to estimate the number of marine mammals potentially affected, which must be reported to NMFS within 90 days after the survey.

#### *3.1.4. Protected Species Observer Protocol*

Hilcorp intends to work with PSOs who have had previous experience. All PSOs shall be trained and approved by NMFS. At least one Alaska Native resident, who is knowledgeable about Arctic marine mammals and the subsistence hunt, is expected to be included as an additional team member aboard the vessels. Before the start of the sonar survey the crew of the vessel and skiff(s) will be briefed on the function of the PSOs, their monitoring protocol, and mitigation measures to be implemented.

Observers will complete a training and refresher session on marine mammal monitoring, to be conducted shortly before the anticipated start of the 2015 open-water season. Any exceptions will have or receive equivalent experience or training.

Primary objectives of the training include:

- review of the marine mammal monitoring plan for this project, including any amendments specified by NMFS or USFWS in the IHA or LOA, by BOEM, BSSE or by other agreements in which Hilcorp may elect to participate;
- review of marine mammal sighting, identification, and distance estimation methods;
- review of operation of specialized equipment (reticle binoculars and GPS system);
- review of, and classroom practice with, data recording and data entry systems, including procedures for recording data on marine mammal sightings, monitoring operations, environmental conditions, and entry error control. These procedures will be implemented through use of a customized computer database and laptop computers;
- review of the specific tasks of the Inupiat Communicator.

The project will have two PSO aboard the source vessel and skiff(s) during the surveys. On all source vessels, at least one observer will monitor for marine mammals at any time during daylight hours (there will be no periods of total darkness until mid-August). PSOs will be on duty in shifts of a maximum of 4 hours at a time, a maximum of 12 hours watch time per day per PSO; although the exact shift schedule will be established by the lead PSO in consultation with the other PSOs.

All sonar source vessels will offer suitable platforms for marine mammal observations. Observations will be made from locations where PSOs have the best view around the vessel. During daytime, the PSO(s) will scan the area around the vessel systematically with reticle binoculars and with the naked eye. Because the main purpose of the PSO on board the vessel is detecting marine mammals for the implementation of mitigation measures according to specific guidelines, we prefer to keep the information to be recorded as concise as

possible. This will allow the observer to focus on detecting marine mammals. The following information will be collected:

- Environmental conditions – consisting of sea state (in Beaufort Windforce scale according to NOAA), visibility (in km, with 10 km indicating the horizon on a clear day), and sun glare (position and severity). These will be recorded at the start of each shift, whenever there is an obvious change in one or more of the environmental variables, and whenever the observer changes shifts.
- Project activity – consisting of sonar activity (on or off), type, and line number. This will be recorded at the start of each shift, whenever there is an obvious change in project activity, and whenever the observer changes shifts.
- Sighting information – consisting of the species (if determinable), group size, position and heading relative to the vessel, behavior, movement, and distance relative to the vessel (initial and closest approach). These will be recorded upon sighting a marine mammal or group of animals.

### *3.1.5. PSO Handbook*

A PSO's Handbook will be prepared for Hilcorp's 2015 vessel-based monitoring program. Handbooks contain maps, illustrations, and photographs, as well as text, and are intended to provide guidance and reference information to trained individuals who will participate as PSOs. The following topics will be covered in the PSO Handbook for the Hilcorp project:

- summary overview descriptions of the project, marine mammals and underwater noise, the marine mammal monitoring program (vessel roles, responsibilities), the NMFS IHA and USFWS LOA and other regulations/permits/agencies, the Marine Mammal Protection Act;
- monitoring and mitigation objectives and procedures, including safety radii;
- responsibilities of staff and crew regarding the marine mammal monitoring plan;
- instructions for ship crew regarding the marine mammal monitoring plan;
- data recording procedures: based on sub-contractor procedures;
- list of species that might be encountered: identification, natural history;
- reticle binocular distance scale;
- table of wind speed, Beaufort wind force, and sea state codes;
- data quality-assurance/quality-control, delivery, storage, and backup procedures;
- safety precautions while onboard;
- scheduling of cruises and watches;
- copies of the NMFS IHA and USFWS LOA when available.

### *3.1.6. Communication Procedures*

When marine mammals in the water are detected within or about to enter the designated safety zones, the shut-down procedures will be implemented immediately. To assure prompt implementation of shut-downs, multiple

channels of communication between the PSOs and the sonar technicians will be established. During the shut-down, the PSO(s) will continue to maintain watch to determine when the animal(s) are outside the safety radius. Sonar operations can be resumed if the observers have visually confirmed that the animal(s) moved outside the safety zone, or if the animal(s) were not observed within the safety zone for 15 minutes (seals) or for 30 minutes (whales). Direct communication with the sonar operator will be maintained throughout these procedures.

### *3.1.7. Data Recording*

All marine mammal observations and any sonar shut-down / resumption will be recorded in a standardized format. Data will be entered into or transferred to a custom database. The accuracy of the data entry will be verified daily through QA/QC procedures. Recording procedures will allow initial summaries of data to be prepared during and shortly after the field program, and will facilitate transfer of the data to other programs for further processing and archiving.

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## *3.2. Monitoring Methodology*

The observer(s) will watch for marine mammals from the best available vantage point on the survey vessels, typically the bridge. The observer(s) will scan systematically with the unaided eye and 7×50 reticle binoculars, or equivalent when needed. Personnel on the bridge will assist the marine mammal observer(s) in watching for marine mammals.

PSOs aboard the marine survey vessel(s) will give particular attention to the areas within the marine mammal exclusion zones around the source vessel, the 50 m safety radii.

Information to be recorded by PSOs will include the following:

- Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if determinable), bearing and distance from observer, apparent reaction to activities (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and pace.
- Time, location, speed, and activity of the vessel, sea state, ice cover, visibility, and sun glare.
- The positions of other vessel(s) in the vicinity of the observer location.

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

Distances to nearby marine mammals will be estimated with binoculars (7×50 reticle 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. However, previous experience has shown that a civilian grade laser rangefinder was not able to measure distances to seals more than about 70 m (230 ft.) away. The device was very useful in improving the distance estimation abilities of the observers at distances up to about 600 m (1968 ft.)—the maximum range at which the device could measure distances to highly reflective objects such as other vessels. Humans observing objects of more-or-less known size via a standard observation protocol, in this case from a standard height above water, quickly become able to estimate distances within about ±20% when given immediate feedback about actual distances during training.

When a marine mammal is seen within the safety radius applicable to that species, the marine survey crew will be notified immediately so that mitigation measures called for in the applicable authorization(s) are implemented.

### *3.2.1. Monitoring At Night and In Poor Visibility*

Hilcorp plans to conduct 24-hr operations. PSOs will not be on duty during ongoing sonar operations during darkness, given the very limited effectiveness of visual observation at night (there will be no periods of darkness in the survey area until mid-August). The proposed provisions associated with operations at night or in periods of poor visibility include the following:

- If during foggy conditions, heavy snow or rain, or darkness (which may be encountered starting in late August), the full 50 m safety zone is not visible, the sonar equipment cannot resume from a full shut-down.
- If sonar equipment is operational before nightfall or before the onset of poor visibility conditions, they can remain operational throughout the night or poor visibility conditions; on the assumption that marine mammals will be alerted by the sounds from the vessel and have moved away.
- Sonar equipment will not be operated during long transits when exploration activities are not occurring, or if visibility conditions impede safe vessel operations in the survey area. This does not apply to turns when starting a new track line.

### *3.2.2. Field Equipment*

Hilcorp will provide or arrange for the following specialized field equipment for use by PSOs aboard the survey vessel: reticle binoculars, GPS unit, laptop computer(s), digital still and possibly digital video cameras.

### *3.2.3. Field Data-Recording, Verification, Handling, and Security*

The observers will record their observations directly into computers running a sub-contractor custom designed software package. Paper datasheets will be available as backup if necessary. The accuracy of the data entry will be verified in the field by computerized validity checks as the data are entered, and by subsequent manual checking of the database printouts. These procedures will allow initial summaries of data to be prepared during and shortly after the field season, and will facilitate transfer of the data to statistical, graphical or other programs for further processing. Quality control of the data will be facilitated by (1) the start-of-season training session, (2) subsequent supervision by the onboard field crew leader, and (3) ongoing data checks during the field season.

In addition to routine PSO duties, observers will have available Traditional Knowledge and Natural History datasheets and voice recorders to document observations that are not captured by the sighting or effort data. Copies of these records will be available to observers for reference if they wish to prepare a statement about their observations. If prepared, this statement would be included in the 90-day and final reports documenting the monitoring work.

### *3.2.4. Field Reports*

Throughout the survey program, observers will prepare a report each day or at such other intervals as NMFS, USFWS, BOEM, or Hilcorp may require, summarizing the recent results of the monitoring program. The reports will summarize the species and numbers of marine mammals sighted. These reports will be provided to NMFS and to the survey operators.

### 3.2.5. Reporting

The results of the 2015 vessel-based monitoring, including estimates of “take by harassment”, will be presented in 90-day and final technical reports. Reporting will address the requirements established by NMFS and USFWS.

The technical report(s) will include:

- summaries of monitoring effort: total hours, total distances, and distribution of marine mammals through the study period accounting for sea state and other factors affecting visibility and detectability of marine mammals;
- analyses of the effects of various factors influencing detectability of marine mammals including sea state, number of observers, and fog/glare;
- species composition, occurrence, and distribution of marine mammal sightings including date, water depth, numbers, age/size/gender categories, group sizes, and ice cover;
- analyses of the effects of survey operations:
  - sighting rates of marine mammals during periods with and without airgun activities (and other variables that could affect detectability);
  - initial sighting distances versus airgun activity state;
  - closest point of approach versus airgun activity state;
  - observed behaviors and types of movements versus airgun activity state;
  - numbers of sightings/individuals seen versus airgun activity state;
  - distribution around the survey vessel versus airgun activity state;
  - multiple estimates of “take by harassment.”

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## **PASSIVE ACOUSTIC MONITORING PLAN**

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### **2015 Liberty Geohazard Survey**

December 18, 2014

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This document provides a proposed approach for passive acoustic monitoring in support of Hilcorp’s proposed summer 2015 geohazard survey in support of the Liberty development project. This acoustic monitoring plan is designed to fulfill National Marine Fisheries Service (NMFS) requirements for the collection of data to assist with assessing effects from industry on the marine environment and the availability of local subsistence resources. This acoustic monitoring plan has been designed to inform about ambient conditions and to quantify marine mammal presence in the project area.

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## 1. Passive Acoustic Monitoring Study Plan

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### 1.1. Purpose

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

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### 1.2. Methods - Equipment

The acoustic data will be collected with autonomous acoustic recording systems deployed on the seabed for an extended period. JASCO will make acoustic measurements using its specialized Autonomous Multichannel Acoustic Recorder (AMAR) systems (Figure 1). These systems will be deployed on the seabed and will record continuously at 64 kHz sample rate and 24-bit samples. The AMARs will be calibrated using pistonphone calibrators immediately before and after each deployment. These calibrations are accurate to less than 0.5 dB absolute.

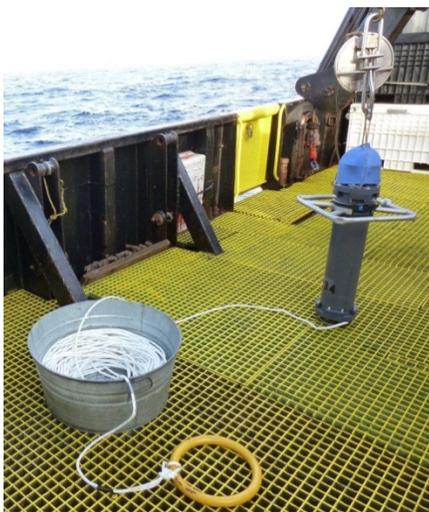


Figure 1 AMAR being deployed in the Chukchi Sea.

The AMARS will be configured with a single channel using a sensitive hydrophone and will be configured to record at 64 kHz for up to 90 days. They are capable of recording marine mammal sounds and making both ambient and anthropogenic noise measurements. This sampling frequency will capture the lower frequency

range of beluga whale vocalizations and will fully capture bowhead vocalizations. We will also be able to detect sounds from seals with this sample rate. Two recorders are proposed to be deployed near the Liberty prospect and will be aligned with the planned geohazard survey line, at distances of 500 m and 5000 m from the offshore end of the survey line. The recorders will be located inside of the barrier islands, an area where there is not expected to be high numbers of bowhead or beluga whale detections.

The proposed stations for the recorders are shown in Figure 2.

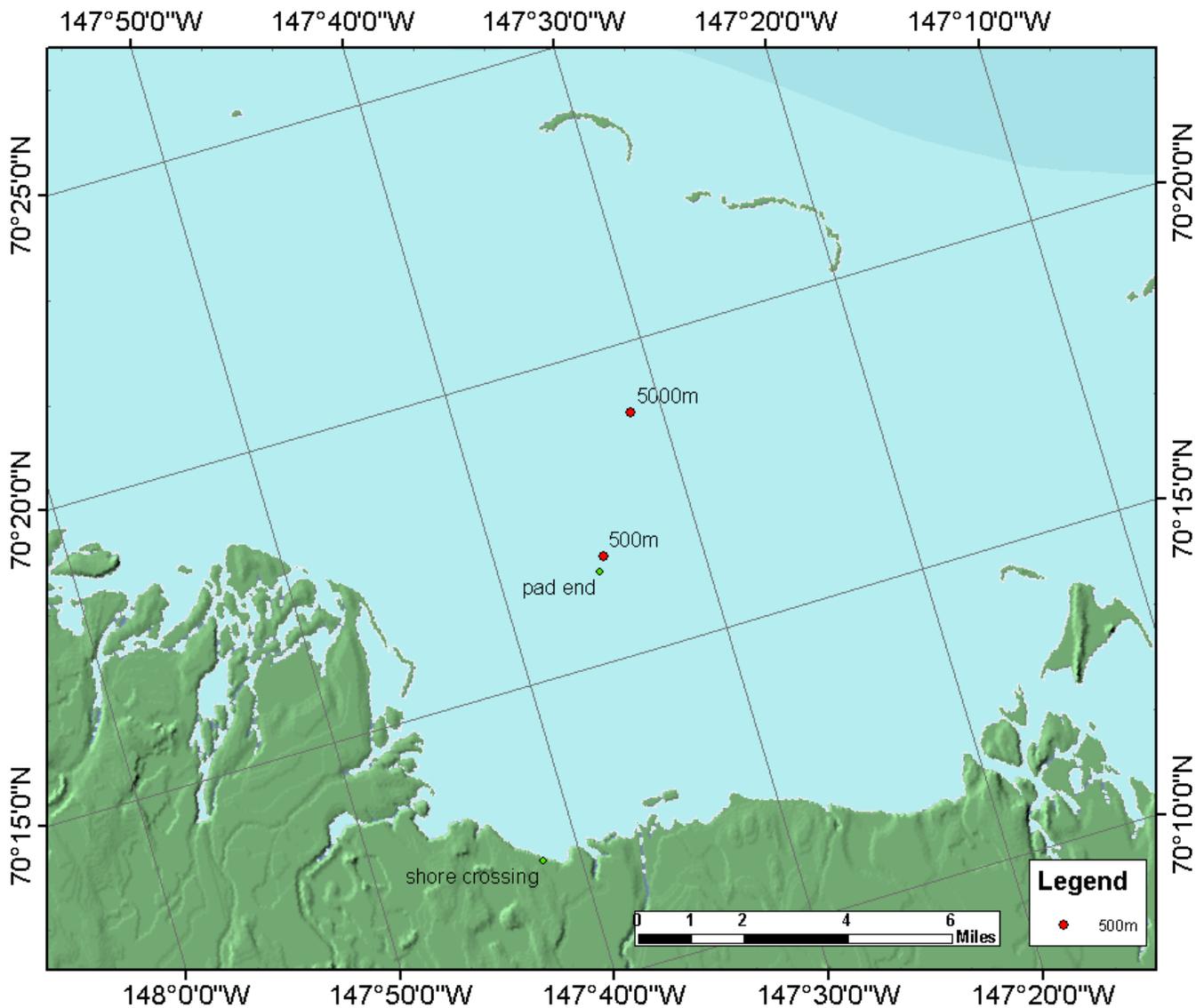


Figure 2 Proposed acoustic recorder deployment locations at 500m and 5000m from the proposed Liberty island location.

### 1.3. Methods - Analysis

PAM recordings will be processed at the end of the season using JASCO's marine mammal detection and classification software. JASCO has performed manual and automated detection of marine mammal vocalizations in data recorded during the Chukchi Sea Environmental Studies Program since 2006, gaining

extensive experience in the detection and classification of the marine mammals that are present in the Beaufort and Chukchi Seas. Our detection capabilities include vocalizations from bowhead, walrus, beluga, ringed seals, bearded seals, ribbon seals, fin whales, humpbacks, killer whales, grey whales and minke whales. Particular attention will be given to the detection of bowhead and beluga whale vocalizations since these are species are important for local subsistence hunting. We will analyze the temporal and spatial patterns of the detected calls. Figure 3 is an example plot showing numbers of bowhead call detections by recorder location (station) as a function of time. The percentage of ice cover at each station is also plotted.

A specialized computing platform operating at about 700 times greater than real-time recording (e.g., 700 h of recorded data could be analyzed in 1 h of computing time) will be used to perform automated detection tasks. A selection of the data will also be processed manually for validation of the automated classifier and for further species identification.

JASCO’s automated processing software will also be used to detect and quantify ambient sound levels. A vessel detector in the automated processing software will be used to quantify vessel presence (example shown in Figure 4). Vessel noise is the source of noise from the geohazard survey that is most likely to be detectable beyond the immediate vicinity of the survey. We will be able to characterize the decay of this vessel noise as a function of range. Finally, a statistical assessment of ambient noise conditions will also be computed by the automated software. Percentiles will be computed, as a function of frequency, showing the statistical distribution of ambient sound levels throughout the recordings. An example plot showing statistical distributions of 1/3-octave band ambient sound levels and power spectral density is shown in Figure 5.

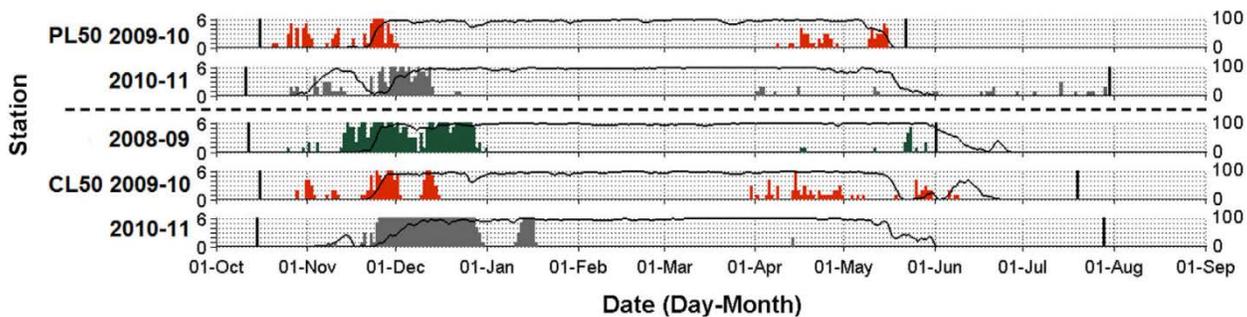


Figure 3 Example plot showing hours-per-day with bowhead call detections, by day and recording station. Black line indicates the percent ice coverage at each station.

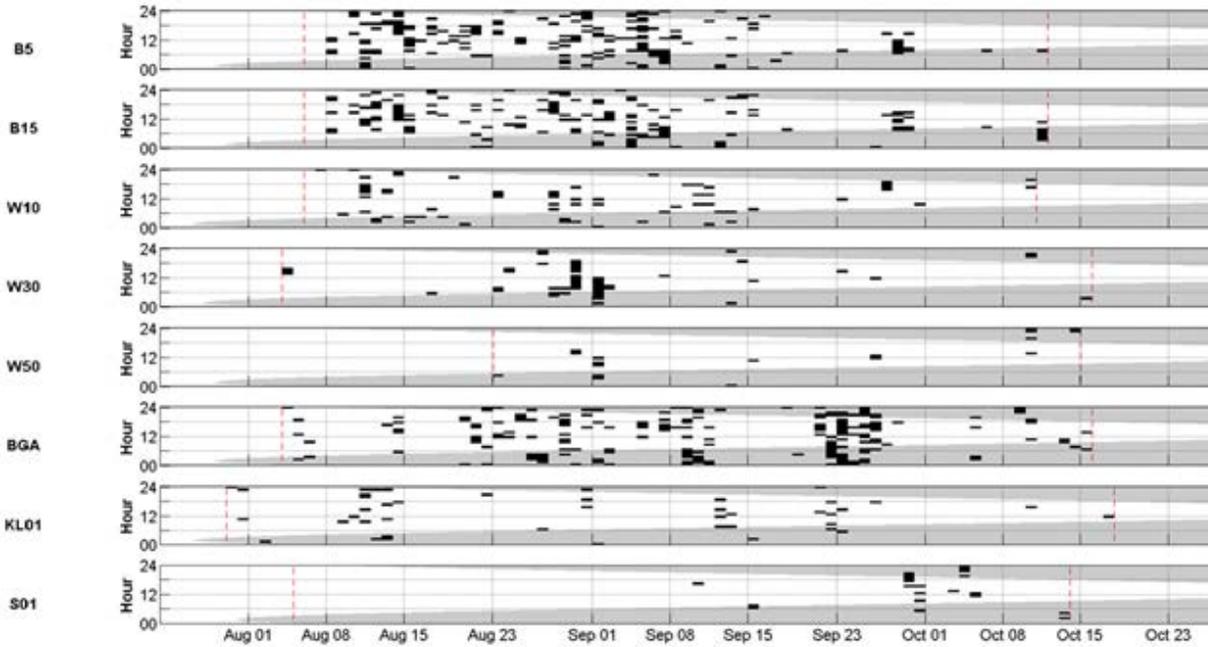


Figure 4 Example plot of vessel detections as a function of location, day and hour. Grey bands indicate hours of darkness. Black bars indicate hours with vessels detected.

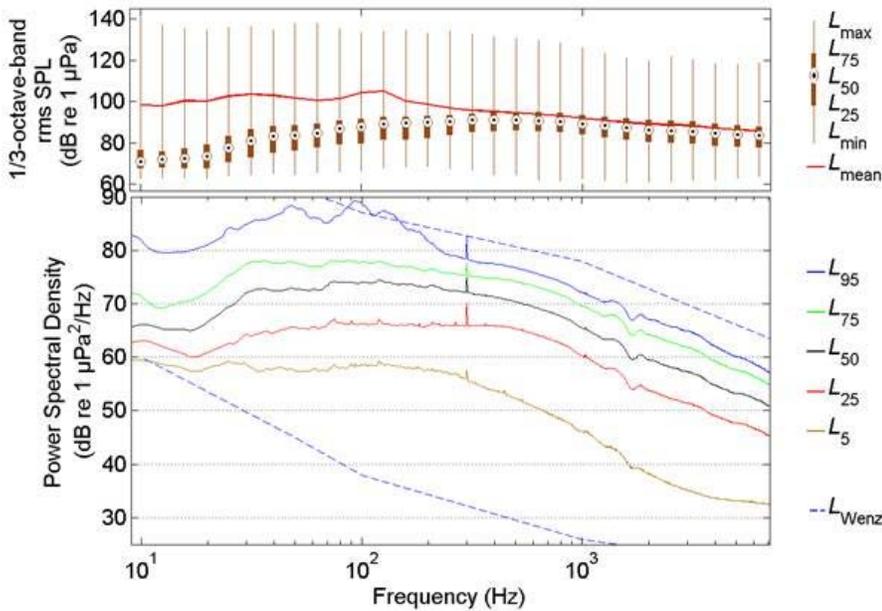


Figure 5 Example plot showing statistical distributions of 1/3-octave band and power spectral density ambient sound levels. Top: 1/3-octave-band rms sound pressure levels. The boxes indicate the first (25%), second (50%), and third (75%) quartiles. The red line indicates the linear mean. Bottom: Exceedance percentiles of ambient noise power spectral density levels (1-min average) over the recording period. The  $N$ th percentile corresponds to the sound level that was exceeded by  $N\%$  of the data.