

Application for the Incidental Harassment Authorization for the Taking of Whales and Seals in Conjunction with the SAE Proposed 3D Seismic Survey in the Beaufort Sea, Alaska, Summer 2014

April 2014

Prepared for



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1.0 DETAILED DESCRIPTION OF SPECIFIC ACTIVITIES EXPECTED TO RESULT IN THE INCIDENTAL TAKING OF MARINE MAMMALS

SAExploration, Inc. (SAE), in partnership with Kuukpik Corporation (Kuukpik), plans to conduct three-dimensional (3D) nodal or ocean-bottom node (OBN) seismic surveys in state and federal waters in the Beaufort Sea during the open water season of 2014 and 2015. Because this operation could acoustically harass local marine mammals, a form of take as defined under the Marine Mammal Protection Act (MMPA), it is subject to governance under MMPA. Incidental and unintentional harassment takes are permitted with the issuance of an Incidental Harassment Authorization (IHA) from the National Marine Fisheries Service (NMFS). MMPA identifies 14 specific items that must be addressed when applying for an IHA, which allow NMFS to fully evaluate whether the proposed actions remain incidental and unintentional. The 14 items are addressed below relative to the 2014 offshore component of this seismic survey program.

1.1 Overview of Activity

The planned 3D seismic survey would occur in the nearshore waters of the Colville River Delta. The maximum area that could be surveyed in 2014 and 2015 is shown in Figure 1-1, and represents a total area of 1,882 square kilometers (727 square miles).

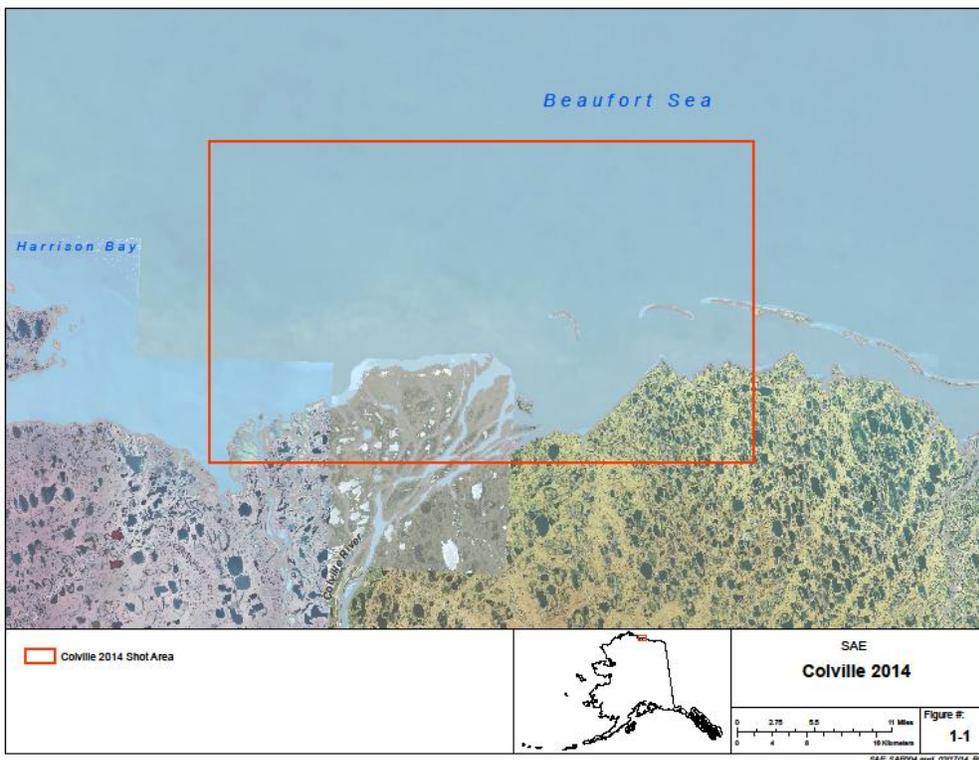


Figure 1-1. Maximum Proposed Seismic Survey Box

The components of the project include laying nodal recording sensors (nodes) on the ocean floor, operating seismic source vessels towing active airgun arrays, and retrieval of nodes. There will also be

additional boat activity associated with crew transfer, recording support, and additional monitoring for marine mammals.

The phases of the operation and specifications of the equipment to be used are addressed individually below.

1.2 Project Details

Survey Design

Marine seismic operations will be based on a “recording patch” or similar approach. Patches are groups of six receiver lines and 32 source lines (Figure 1-2). Each receiver line has submersible marine sensor nodes tethered equidistant (50 meters; 165 feet) from each other along the length of the line. Each node is a multicomponent system containing three velocity sensors and a hydrophone (Figure 1-3). Each receiver line is approximately 8 kilometers (5 miles) in length, and are spaced approximately 402 meters (1,320 feet) apart. Each receiver patch is 19.4 square kilometers (7.5 square miles) in area. The receiver patch is oriented such that the receiver lines run parallel to the shoreline.

Source lines, 12 kilometers (7.5 miles) long and spaced 502 meters (1,650 feet) apart, run perpendicular to the receiver lines (and perpendicular to the coast) and, where possible, will extend approximately 5 kilometers (3 miles) beyond the outside receiver lines and approximately 4 kilometers (2.5 miles) beyond each of the ends of the receiver lines. The outside dimensions of the maximum shot area during a patch shoot will be 12 kilometers by 16 kilometers (7.5 miles by 10 miles) or 192 square kilometers (75 square miles). It is expected to take three to five days to shoot a patch, or 48 square kilometers (18.75 square miles) per day. All shot areas will be wholly contained within the 1,882-square-kilometer survey box depicted in Figure 1-1. Shot intervals along each source line will be 50 meters (165 feet).

It may take a period of three to five days to deploy, shoot, and record a single receiver patch. During recording of one patch, nodes from the previously surveyed patch will be retrieved, recharged, and data downloaded prior to redeployment of the nodes to the next patch. As patches are recorded, receiver lines are moved side to side or end to end to the next patch location so that receiver lines have continuous coverage of the recording area.

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

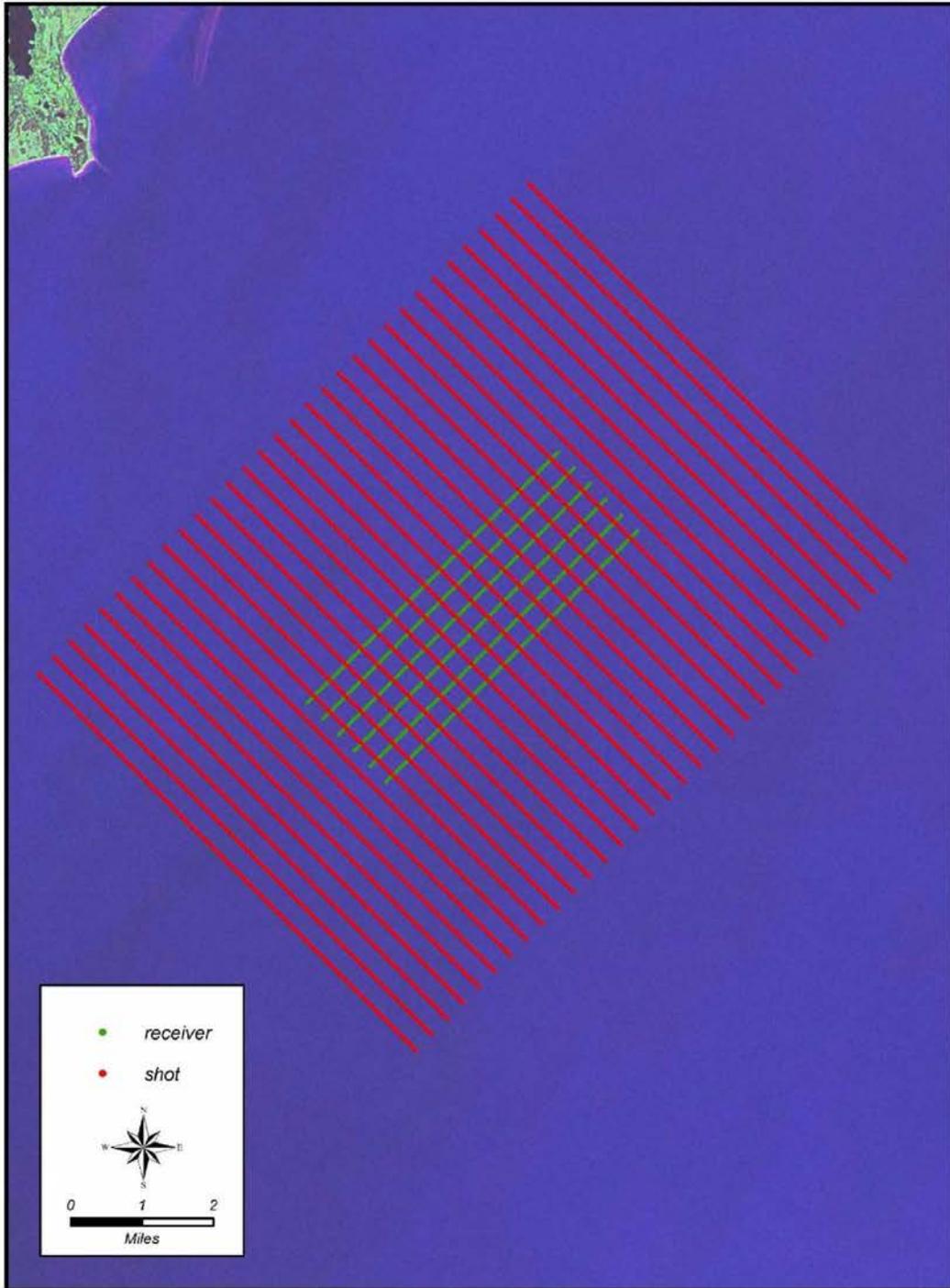


Figure 1-2. Typical Patch Layout.



Figure 1-3. Example Nodes.

Acoustical Sources

The acoustic sources of primary concern are the airguns that will be deployed from the seismic source vessels. However, there are other noise sources to be addressed including the pingers and transponders associated with locating receiver nodes, as well as propeller noise from the vessel fleet.

Seismic Source Array

The seismic sources to be used will include using 880 and 1,760 cubic inch sleeve airgun arrays for use in the deeper waters, and a 440 cubic inch array in the very shallow (<1.5 meters deep) water locations. Each of the arrays will be arrayed in a configuration outlined in Appendix A. The arrays will be towed approximately 15 to 22 meters (50 to 75 feet) behind the source vessel stern, at a depth of 4 meters (12 feet), and towed along predetermined source lines at speeds between 4 and 5 knots. In the shallower waters the smaller arrays will be raised to shallower depths up to 1.3 meters (4.3 feet). Two vessels with full arrays will be operating simultaneously in an alternating shot mode; one vessel shooting while the other is recharging. Shot intervals are expected to be about 8 to 10 seconds for each array resulting in an overall shot interval of 4 to 5 seconds considering the two arrays. Operations are expected to occur 24 hours a day.

Based on the manufacturer's specifications, the 440 cubic inch array has a peak-peak estimated 1-meter sound source of 239.1 dB re 1 μ Pa (9.0 bar-m; Far-field Signature, Appendix A), and root mean square (rms) at 221.1 dB re 1 μ Pa. The 880 cubic inch array produces sound levels at source estimated at peak-peak 244.86 dB re 1 μ Pa @ 1 m (17.5 bar-m; Far-field Signature, Appendix A), and rms at 226.86 dB re 1 μ Pa. The 1,760 cubic inch array has a peak-peak estimated sound source of 254.55 dB re 1 μ Pa @ 1 m (53.5 bar-m; Far-field Signature, Appendix A), with an rms sound source of 236.55 dB re 1 μ Pa. The 1,760 cubic inch array has a sound source level approximately 10 dB higher than the 880 cubic inch array.

The source directivity plots for the three airgun arrays are shown in Appendix A. They clearly indicate that the acoustical broadband energy is concentrated along the vertical axis (focused downward), while

there is little energy focused horizontally. The spacing between airguns results in offset arrival timing of the sound energy. These delays “smear” the sound signature as offset energy waves partially cancel each other, which reduces the amplitude in the horizontal direction. Thus, marine mammals near the surface and horizontal to the airgun arrays would receive sound levels considerably less than a marine mammal situated directly beneath the array, and at levels probably less than predicted by the acoustical spreading model. As a result, the estimates of the distances to NMFS Level A and B take criterion determined for this IHA request should be considered conservative.

Pingers and Transponders

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

Both transceivers and transponders produce noise levels just above or within the most sensitive hearing range of seals (10 to 30 kHz; Schusterman 1981) and odontocetes (12 to ~100 kHz; Wartzok and Ketten 1999), and the functional hearing range of baleen whales (20 Hz to 30 kHz; NRC 2003); although baleen whale hearing is probably most sensitive nearer 1 kilohertz (Richardson et al. 1995). However, given the low acoustical output, the range of acoustical harassment to marine mammals (for the 197 dB transceiver) is about 100 meters (328 feet), or significantly less than the output from the air gun arrays, and is not loud enough to reach injury levels in marine mammals beyond 9 meters (30 feet). Marine mammals are likely to respond to pinger systems similar to air gun pulses, but only when very close (a few meters) to the sources.

Vessels

Several offshore vessels will be required to support recording, shooting, and housing in the marine and transition zone environments. The exact vessels that will be used have not yet been determined. However, the types of vessels that will be used to fulfill these roles are found in Table 1-1.

Table 1-1. Seismic Program Vessels

Vessel	Operation	Size (feet)	Gross Tonnage	No. of Berths	Main Activity/Frequency	Source Levels * (dB)
TBD	Source Vessel	120 x 25	100-250	10-20	Seismic data acquisition 24 hour operation	179.0
TBD	Source Vessel	80 x 25	100-250	10-20	Seismic data acquisition 24 hour operation	165.7
TBD	Node equipment deployment and retrieval	80 x 20	50	16	Deploying and retrieving nodes 24 hour operation	165.3
TBD	Node equipment deployment and retrieval	80 x 20	50	16	Deploying and retrieving nodes 24 hour operation	165.3
TBD	Mitigation/Housing Vessel	90 x 20	100	20-30	House crew 24 hour operation	200.1
TBD	Crew Transport Vessel	30 x 20	20-30	3	Transport crew intermittent 8 hours	191.8
TBD	Bow Picker	30 x 20	20-30	3	Deploying and retrieving nodes Intermittent operation	171.8
TBD	Bow Picker	30 x 20	20-30	3	Deploying and retrieving nodes Intermittent operation	171.8

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

Source Vessels - Source vessels will have the ability to deploy two arrays off the stern using large A-frames and winches and have a draft shallow enough to operate in waters less than 1.5 meters (5 feet) deep. On the source vessels the airgun arrays are typically mounted on the stern deck with an umbilical that allow the arrays to be deployed and towed from the stern without having to re-rig or move arrays. A large bow deck will allow for sufficient space for source compressors and additional airgun equipment to be stored. The marine vessels likely to be used will be the same or similar to those that were acoustically measured by Aerts et al. (2008). The source vessels found to have a source levels of 179.0 dB re 1 μ Pa and 165.7 dB re 1 μ Pa.

Recording Deployment and Retrieval - Jet driven shallow draft vessels and bow pickers will be used for the deployment and retrieval of the offshore recording equipment. These vessels will be rigged with hydraulically driven deployment and retrieval squirters allowing for automated deployment and retrieval from the bow or stern of the vessel. These vessels will also carry the recording equipment on the deck in fish totes. Aerts et al. (2008) found the recording and deployment vessels to have a source level of approximately 165.3 dB re 1 μ Pa, while the smaller bow pickers produce more cavitation resulting in source levels of 171.8 dB re 1 μ Pa.

Housing and Transfer Vessels - Housing vessel(s) will be larger with sufficient berthing to house crews and management. The housing vessel will have ample office and bridge space to facilitate the role as the mother ship and central operations. Crew transfer vessels will be sufficiently large to safely transfer crew

between vessels as needed. Aerts et al. (2008) found the housing vessel to produce the loudest propeller noise of all the vessels in the fleet (200.1 dB re 1 μ Pa), but this vessel is mostly anchored up once it gets on site. The crew transfer vessel also travels only infrequently relative to other vessels, and is usually operated at different speeds. During higher speed runs shore the vessel produces source noise levels of about 191.8 dB re 1 μ Pa, while during slower on-site movements the vessel source levels are only 166.4 dB re 1 μ Pa (Aerts et al. 2008).

Mitigation Vessel - To facilitate marine mammal monitoring of the Level B harassment zone, one dedicated vessel will be deployed to provide a survey platform for 2 or 3 Protected Species Observers (PSOs). These PSOs will work in concert with PSOs stationed aboard the source vessels, and will provide an early warning of the approach of any bowhead whale, beluga, or other marine mammal. The scout/mitigation vessel plans to conduct zig-zag transects from 2 to 6 kilometers ahead of the source vessel (based on water depth and weather conditions) to effectively monitor the 160 dB zone of influence and to also monitor the edge of the 180 dB isopleth. Exact layout of the most effective survey trackline design will be determined in consultation with a line-transect density/DISTANCE analysis expert. Vessel speed is preferred to be approximately 8 knots; however, it may be altered based on distance to the source vessel, water depth or weather conditions. It is assumed that the vessel will be of similar size and acoustical signature as a bowpicker.

1.3 Maintaining Safe Radii

The seismic airguns that will be used during SAE’s Beaufort operation have the potential to acoustically injure marine mammals at close proximity. These Level A takes are not authorized by IHAs and measures must be taken to avoid them. The NMFS criteria for Level A take are 180 dB for whales and 190 dB for seals (all rms). To avoid exposing marine mammals to these received noise levels, safety zones will be established based on the ZOIs for the 440 (221.1 dB source), 880 (226.86 dB source) and 1,760 (236.55 dB source) cubic inch airgun arrays. Based on the transmission losses empirically measured for these arrays by Aerts et al. (2008) elsewhere (BP Liberty) in the Beaufort Sea, the distances to the 190 and 180 dB isopleths (safety zone radii) are found in Table 1-2. Qualified PSOs will be deployed aboard the seismic vessels to monitor the safety zones (See Appendix B, Marine Mammal Monitoring and Mitigation Plan), and alert operations to shut down at the approach of a marine mammal to these safety zones.

Table 1-2. Safety zone radii for pinnipeds (190 dB) and cetaceans (180 dB) for each airgun array.

Array (cubic inch)	Source Level (dB)	190 dB radius (m)	180 dB radius (m)
440	221.10	126	325
880	226.86	167	494
1,760	236.55	321	842

While the pingers and transponders that will be used to relocate nodes generate source sound levels (185 to 193 dB) that exceed Level A criteria, the associated ZOIs are so small (radii of 0 to 6 meters) that marine mammal monitoring is impractical. Operators will, however, ensure that no marine mammals are in the immediate vicinity before deploying pingers and transponders. Both the housing and crew transfer

vessel can produce noise exceeding 190 or 180 dB re 1 μ Pa when traveling at higher speeds, but the safety zone radii only extend from 2 to 4 meters from the vessel, a distance impractical to monitor.

2.0 DATES AND DURATION OF PROPOSED ACTIVITY AND SPECIFIC GEOGRAPHICAL REGION

The request for incidental harassment authorization is for the 2014 open water season (July 1 to October 15), although it will take a second season to survey the entire survey box. All associated activities, including mobilization, survey activities, and demobilization of survey and support crews, would occur inclusive of the above seasonal dates. The actual data acquisition is expected to take a minimum of 70 days, dependent of weather and ice. Based on past similar seismic shoots in the Beaufort Sea, it is expected that effective shooting would occur over about 70 percent of the 70 days (or about 49 days). However, because of competing interests for the seismic survey fleet, SAE plans to complete only a portion of the survey box in 2014, finishing the rest in 2015. Also, if required in the Conflict Avoidance Agreement (CAA), surveys will temporarily cease during the fall bowhead whale hunt to avoid acoustical interference with the Cross Island, Kaktovik, or Barrow based hunts.

3.0 THE SPECIES AND NUMBERS OF MARINE MAMMALS LIKELY TO BE FOUND WITHIN THE ACTIVITY AREA

The species of marine mammals that are most likely to be found in the activity area, at least seasonally, are the bowhead whale, gray whale, beluga whale, ringed seal, spotted seal, and bearded seal. Gray whales are included in this list because they have been found penetrating deeper into the Beaufort Sea in recent years (Green and Negri 2005, Green et al. 2007). Finding summering gray whales in the project area would no longer be considered surprising.

A humpback whale cow/calf pair was observed in Smith Bay, 120 kilometers (75 miles) west of the activity area (Hashagen et al. 2009), but this is considered an extralimital sighting. Other Alaskan marine mammals that might also occur extralimitaly in the Beaufort Sea including the minke whale, fin whale, North Pacific right whale, harbor porpoise, killer whale, ribbon seal, and narwhal. Killer whales have been observed off Point Barrow in recent years (G. Green, pers. obs.), but there are no recent records near the project area. Pacific walrus do occasionally wander into the Beaufort Sea (one was observed offshore Prudhoe Bay in November 2002 [Green et al. 2003]), and polar bears are a regular inhabitant of the activity area vicinity; however, these species (plus the sea otter) are managed by the U.S. Fish and Wildlife Service (USFWS) and, thus, are not addressed further in this document.

The world population and local numbers of the six species most likely to be found in the vicinity of the activity area are found in Table 3-1. Summering bowhead, gray, and beluga whales would be considered rare in the vicinity of the activity area. Small numbers of summering bowhead and gray whales have been recorded in Smith Bay and near Point Barrow (Green and Negri 2005, Green et al. 2007), and the occasionally wandering bowhead whale could be encountered nearly anywhere in the Beaufort Sea (Moore et al. 2010). Beluga whales generally summer within the northern pack ice, but have been observed in small numbers along the Beaufort coast during the summer months. None of these species are expected to be encountered during the July and August activity periods. The likelihood of observing

beluga whales, as well as bowhead whales, in the activity area increases with the southern advance of the pack ice during the fall. Both bowhead and beluga whales migrate through the Alaskan Beaufort Sea from late August to early October, with the peak in September. Only 22 percent of the seismic survey box extends north of the 15-meter (50-foot) depth contour, the recognized southern boundary of the primary bowhead migration corridor within the Alaskan Beaufort Sea. The seismic activities will avoid the peak of the beluga and bowhead fall migration either by shutting down during the fall bowhead whale hunt or by completing the northernmost source lines first where possible.

Table 3-1. Marine Mammals in the Alaskan Beaufort Sea

Species	Abundance	Comment
Bowhead Whale (<i>Balaena mysticetus</i>)	12,631	ESA-listed as Endangered
Gray Whale (<i>Eschrichtius robustus</i>)	19,126	Rare in Beaufort Sea
Beluga Whale (<i>Delphinapterus leucas</i>)	39,258	Beaufort Sea Stock
Beluga Whale (<i>Delphinapterus leucas</i>)	3,710	Eastern Chukchi Sea Stock
Ringed Seal (<i>Phoca hispida</i>)	249,000	ESA-listed as Threatened
Spotted Seal (<i>Phoca largha</i>)	101,568	
Bearded Seal (<i>Erignathus barbatus</i>)	155,000	ESA-listed as Threatened

Source: Boveng et al. (2009), Cameron et al. (2010), Allen and Angliss (2012, 2013)

4.0 A DESCRIPTION OF THE STATUS, DISTRIBUTION, AND SEASONAL DISTRIBUTION (WHEN APPLICABLE) OF THE AFFECTED SPECIES OR STOCKS OF MARINE MAMMALS LIKELY TO BE AFFECTED BY SUCH ACTIVITIES

4.1 Bowhead Whale (*Balaena mysticetus*)

The Western Arctic stock of bowhead whale is one of five stocks recognized by the International Whaling Commission (IWC), and is currently the largest with an estimated population of 12,631 animals (Allen and Angliss 2013). This stock is currently listed as endangered under the Endangered Species Act (ESA) and “depleted” under the MMPA, although it has experienced significant growth in the past 30 years despite subsistence harvest.

This stock summers in the Canadian Beaufort Sea, migrate through the Alaskan Beaufort Sea, Chukchi Sea, and Bering Strait in the fall, and winter in the Bering Sea (Braham et al. 1984, Moore and Reeves 1993). The whales passing through the Chukchi often fall a route along the Siberian coast (Quakenbush 2007, Quakenbush et al. 2010). The whales follow open leads in the sea ice during their spring migration (March to mid-June) back to Canada (Braham et al. 1984, Moore and Reeves 1993). However, individual bowhead whales can be found throughout their range at almost any time of the year (Rugh et al. 2003, Moore et al. 2010), and they have been found summering near Pt. Barrow and Smith Bay (Green and Negri 2005, Green et al. 2007). Mocklin et al. (2012) have reported on bowheads feeding near Pt. Barrow.

Pre-whaling population estimates for bowhead whales range between 10,400 and 23,000 animals. This population was reduced to approximately 3,000 whales by commercial whaling (Woodby and Botkin 1993). Since 1978 the bowhead whale populations has been growing at an annual rate of approximately

3.2 to 3.4 percent (George et al. 2004). NMFS's most recent estimate is 12,631 animals (Allen and Angliss 2013).

Bowhead whales are hunted in the Alaskan Beaufort Sea by whalers from the villages of Kaktovik, Nuiqsut, and Barrow. The Nuiqsut hunters base from Cross Island, 80 kilometers (50 miles) east of the Colville River Delta and 27 kilometers (17 miles) northeast of Prudhoe Bay. Fall migrating whales typically reach Cross Island in September and October (Brower 1996), although some whales might arrive as early as late August. Most bowheads fall migrate through the Alaskan Beaufort in water depths between 15 and 200 meters (50 and 656 feet) deep (Miller et al. 2002), with annual variability depending on ice conditions (whales traveling farther offshore during heavy ice cover years). Hauser et al. (2008) conducted surveys for bowhead whales near the Colville River Delta during August and September 2008, and found most bowheads between 25 and 30 kilometers (15.5 and 18.6 miles) north of the barrier islands (Jones Islands), with the nearest in 18 meters (60 feet) of water about 25 kilometers (16 miles) north of the Colville River Delta. No bowheads were observed inside the 18-meter (60-foot) isobath.

Approximately 22 percent (642 square kilometers) of the potential seismic survey area occurs in water deeper than 15 meters (50 feet) where migrating bowhead whales could most likely be encountered. To avoid whale encounter, the farthest offshore source lines will be surveyed first, prior to the commencement of the fall migration, and, if required by the CAA, seismic surveys will be temporarily ceased during the Cross Island bowhead whale hunt. Much lower densities of bowhead whales might also be encountered in waters between 5 and 15 meters (15 and 50 feet) deep. Waters less than 4.5 meters (15 feet) deep are considered too shallow to support these whales, and in three decades of aerial survey by the Bureau of Ocean Energy Management (BOEM), no bowhead whale has been recorded in waters less than 5 meters (16 feet) deep (Clarke and Ferguson 2010).

4.2 Gray Whale (*Eschrichtius robustus*)

The eastern North Pacific (or California) gray whale is one of two stocks inhabiting the Pacific Ocean (the other the endangered western North Pacific [or Korean] stock found along the Asian coast). The eastern North Pacific stock breeds in the warm-water lagoons of coastal Baja California and Mexico and winters in the shelf waters of the Bering and Chukchi seas (Jones et al. 1984), completing each year an annual round-trip migration of 16,000 to 22,500 kilometers (9,900 to 14,000 miles). Not all whales complete the migration as some whales feed in the coastal waters of the Pacific Northwest (Calambokidis 2002, 2010), and possibly elsewhere along the migration route.

Prior to 1997, reports of gray whales in the Beaufort Sea were very rare. A single gray whale was killed at Cross Island in 1933 (Maher 1960), and small numbers were observed in the Canadian Beaufort Sea approximately 1,100 coastal kilometers (~700 coastal miles) east of Point Barrow in 1980 (Rugh and Fraker 1981). Only one gray whale was observed during extensive aerial surveys conducted in the Beaufort Sea between 1979 and 2009 (Clarke and Ferguson 2010). Sightings in the Beaufort Sea became more common, although still occasional, from 1998 to 2004 (Miller et al. 1999, Treacy 2000, Williams and Coltrane 2002), and then regularly observed from 2005 on (Green and Negri 2005, Green et al. 2007; Jankowski et al. 2008; Lyons et al. 2009). Green and Negri (2005) observed feeding gray whales near Elson Lagoon (immediately east of Pt. Barrow) in 2005, and Green et al. (2007) at Smith's Bay (approximately 100 kilometers east of Pt. Barrow) in 2007. Still, few gray whales have ever been

reported in the Beaufort Sea as far east as Cape Halkett (approximately 160 kilometers east of Pt. Barrow). Their occurrence within potential seismic survey box is not expected.

4.3 Beluga Whale (*Delphinapterus leucas*)

The Beaufort Sea stock of beluga whale is one of five stocks occurring in Alaska (O’Corry-Crowe et al 1997). The most current population estimate is 39,258 animals (Allen and Angliss 2013). However, this estimate is based on aerial surveys conducted in 1992, and includes a smaller more conservative correction factor (to account for availability bias) than has been estimated for other aerial surveys of this species in Alaska (Frost and Lowry 1995, Allen and Angliss 2012). The current population trend is unknown, but subsistence harvest is probably well below the potential biological removal (Allen and Angliss 2012).

Like all Alaska stocks (except the Cook Inlet stock), the Beaufort Sea stock winters in the open leads and polynyas of the Bering Sea (Hazard 1988). In the spring they migrate through coastal leads over 2,000 kilometers (1,200 miles) to their summering grounds in the Mackenzie River delta where they molt, feed, and calve in the warmer estuarine waters (Braham et al. 1977). In late summer, these belugas move into offshore northern waters to feed (Davis and Evans 1982, Harwood et al. 1996, Richard et al. 2001). In the fall, they begin their migration back to their wintering grounds generally following an offshore route as they pass through the western Beaufort Sea (Richard et al. 2001).

Richard et al. (2001) tracked 12 satellite-tagged belugas and found them to pass relatively quickly (average 15 days) through the Alaskan Beaufort Sea during September. The westward routes ranged from coastal to over 650 kilometers (400 miles) offshore with all but one beluga passing at least 100 kilometers (60 miles) north of the Beaufort shoreline. Based on the above and results from numerous aerial and boat-based marine mammal surveys in the Beaufort Sea, some belugas take a more coastal route during their fall migration, but compared to the vanguard of population and the survey effort expended, nearshore travel appears to be relatively rare. Most belugas recorded during aerial surveys conducted in the Alaskan Beaufort Sea in the last two decades were found over 65 kilometers (40 miles) from shore (Miller et al. 1999, Funk et al. 2008, Christie et al. 2010, Clarke and Ferguson 2010, Brandon et al. 2011).

The Eastern Chukchi Sea beluga whale stock also occurs in the Beaufort Sea during the late summer and fall (Suydam et al. 2005). Suydam et al. (2005) satellite-tagged 23 beluga whales in Kasegaluk Lagoon and found nearly all the whales to move into the deeper waters of the Beaufort Sea post-tagging. However, virtually none of the whales were found in continental shelf waters (<200 meters deep) of the Beaufort Sea, and all were in waters at least 65 kilometers (35 nautical miles) north of the proposed seismic survey box.

Few surveys have reported belugas within 40 kilometers (25 miles) of shore where the planned seismic activities would occur. Green and Negri (2005) reported small beluga groups nearshore Cape Lonely (August 26) and in Smith Bay (September 4). Funk et al. (2008) reported a group just offshore of the barrier islands near Simpson Lagoon, while Aerts et al. (2008) reported summer sightings of three groups of eight animals inside the barrier islands near Prudhoe Bay.

Although it is possible for beluga whales to occur in the vicinity of the planned seismic activity during summer and fall periods of operation, any occurrence would be relatively rare, and most likely to occur

during the late August or September migration period when seismic activities will be temporarily suspended to avoid any conflict with the annual fall bowhead whale hunt.

4.4 Ringed Seal (*Phoca hispida*)

Ringed seals are the most common marine mammal in the Beaufort, Chukchi, and Bering seas. This Alaskan stock, a subpopulation of the Arctic subspecies (*P. h. hispida*), was most recently estimated 249,000 animals (Allen and Angliss 2012), although historic estimates have ranged as high as 3.6 million (Frost et al. 1988). Some taxonomists have placed this seal in the genus *Pusa* following Rice (1998), but that usage is not universal. Ringed seals were recently (2012) listed under the Endangered Species Act (ESA) due to diminishing snow and ice from climate change. They survive the winter by digging multiple haul-out shelters and nursery lairs beneath the snow (Kelly 1988). A loss of snow cover, and ice coverage in general, poses a risk to long-term survival (Kelly et al. 2010).

During the open-water season, ringed seals are widely dispersed as single animals or in small groups and they are known to move into coastal areas (Smith 1987, Harwood and Stirling 1992, Moulton and Lawson 2002, Green et al. 2007). During the open-water period ringed seals shift from feeding on Arctic cod associated with sea ice to Saffron cod, shrimp, euphausiids, and amphipods. They were commonly recorded during previous surveys in the vicinity of the seismic survey area (Hauser et al. 2008, Brandon et al. 2011, Green et al. 2007), and are expected to be present during all months of survey.

Ringed seals are harvested by coastal Alaska Natives and are a primary prey of polar bears and arctic foxes at some times of year.

4.5 Spotted Seal (*Phoca largha*)

The spotted seal is found from the Beaufort Sea to the Sea of Japan and is most numerous in the Bering and Chukchi seas (Quakenbush 1988) although small numbers do range into the Beaufort Sea during summer (Rugh et al. 1997, Lowry et al. 1998, Green et al. 2007). The Bering Sea wintering population has been estimated at 200,000 to 250,000 (Bigg 1981), with a more recent estimate of 101,568 based on aerial and icebreaker-based surveys along the ice edge in 2007 and 2008 (Boveng et al. 2009). The latter estimate is currently the best available, although it is provisional (Boveng et al. 2009). A status review of the species was completed in 2009 (Boveng et al. 2009) after the spotted seal was petitioned for listing under ESA relative to climate change and its effects on sea ice. The review found the listing as not warranted.

Pupping occurs along the Bering Sea ice front during March and April, followed by mating and molting in May and June (Quakenbush 1988). During the summer they follow the retreating ice north into the Chukchi and Bering seas, and then begin hauling out on lagoon and river delta beaches during the open water period. Several thousand use Kasegaluk Lagoon in the eastern Chukchi Sea. They begin their migration back to Bering Sea wintering grounds in October (Lowry et al. 1998).

A few spotted seals summer in the Beaufort Sea where they haulout at Oarlock Island, the Piasuk River, and the Colville River Delta (Green et al. 2007). The Colville River Delta and nearby Sagavanirktok River supported as many as 400 to 600 spotted seals, but in recent times fewer than 20 seals have been seen at any one site (Johnson et al. 1999). Spotted seals were recorded during three years (2005-2007) of barging activities between Prudhoe Bay and Cape Simpson (Green and Negri 2005, 2006; Green et al.

2007). They observed between 23 and 54 seals annually, with the peak distributions found off the Colville and Piasuk rivers. Similarly, Savarese et al. (2010) surveyed the central Beaufort Sea from 2006 to 2008 and recorded 59 to 125 spotted seals annually. Summer use of the Beaufort Sea by spotted seals may be higher than haulout counts might indicate, although no haulout site surveys have been conducted in recent years.

Because the Colville River Delta haulout site occurs within the seismic survey area, spotted seals are expected to be encountered during the survey activities. SAE will be working with its partner Kuukpik Corporation to develop measures to monitor and avoid disturbing hauled out spotted seals during the seismic activities.

4.6 Bearded Seal (*Erignathus barbatus*)

The Alaska stock of bearded seals is seasonally found in the shelf waters of the Beaufort, Chukchi, and Bering seas. They are closely associated with ice, preferring to winter in the Bering Sea and summer along the pack ice edge in Chukchi Sea, although many summer in nearshore waters of the Beaufort Sea. Preferring areas of 70 to 90 percent ice coverage, but unlike ringed seals, few bearded seals overwinter in the Chukchi and Beaufort seas (Allen and Angliss 2013). Pupping occurs on ice floes primary in May in the Bering and Chukchi seas.

Bearded seals do not have any special status, but their seasonal dependence ice makes them vulnerable to declining ice conditions due to climate change. As a consequence, they were listed under ESA in December, 2012. There is no reliable population estimate for bearded seals. Cameron et al. (2010) provided a conservative estimate for the Beringia Distinct Population Segment (the population that winters in the Bering and Chukchi seas) of 155,000, based on data collected over the last four decades.

Bearded seals have been commonly observed in the proposed survey box. Aerial and vessel-based surveys associated with seismic programs, barging, and government surveys in this area between 2005 and 2010 reported several sightings (Treacy 2002a, 2002b; Moulton et al. 2003; Green and Negri 2005, 2006; Green et al. 2007; Funk et al. 2008; Hauser et al. 2008; Savarese et al. 2010; Brandon et al. 2011; Reiser et al. 2011; Clarke et al. 2011). These seals are expected to be occasionally encountered during the seismic surveys.

5.0 TYPE OF INCIDENTAL TAKING AUTHORIZATION BEING REQUESTED AND METHOD OF INCIDENTAL TAKING

The incidental taking authorization requested is for Level B noise harassment (noise exceeding 160 dB re 1 μ Pa (rms)) associated with the towed seismic airgun arrays. The actual Level B take will depend upon number of marine mammals occurring within the 160 dB Zone of Influence (ZOI) at the time of seismic activity. No Level A injury takes (noise exceeding 180 dB re 1 μ Pa (rms) for cetaceans and 190 dB re 1 μ Pa (rms) for pinnipeds) are expected with the proposed mitigation measures (see Section 1.3 and Appendix B) in place.

6.0 BY AGE, SEX, AND REPRODUCTIVE CONDITION (IF POSSIBLE) THE NUMBER OF MARINE MAMMALS (BY SPECIES) THAT MAY BE TAKEN

6.1 Basis for Estimating Numbers of Marine Mammals That Might Be “Taken by Harassment”

Exposure to impulsive sound levels greater than 160 dB re 1 μ Pa (rms) can elicit behavioral changes in marine mammals that might be detrimental to health and long-term survival where it disrupts normal behavioral routines, and is the Level B criteria for (impulsive) acoustical harassment under MMPA (NMFS 2005). Exposure to sound levels greater than 180 dB re 1 μ Pa (rms) for cetaceans and 190 dB re 1 μ Pa (rms) for pinnipeds can lead to acoustical injury including temporary loss in hearing sensitivity and permanent hearing damage. These values are the MMPA Level A injury criterion. IHAs do not authorize Level A take.

The estimate of the numbers of each species of marine mammals that could be “taken” by exposure to OBC seismic array noise levels is determined by multiplying the maximum seasonal density of each species by the area that will be ensonified by greater than 160 dB re 1 μ Pa (rms). There is no estimate of potential Level A takes, as this will be avoided through mitigation (establishment of shutdown safety zones; see Section 1.3 and Appendix B).

Ensonified Area

The areas ensonified by MMPA criteria exposure levels was determined by assuming that the entire survey area is ensonified (given that the distance to the 160 dB isopleth during seismic survey is greater than the distance spacing between seismic source lines), plus a buffer area around the survey box corresponding to the distance to the 160 dB isopleth. The estimated distance to the 160 dB isopleth is 3 kilometers (1.86 miles) (Table 6-1) based on a sound source of 236.55 dB re 1 μ Pa (rms) for the 1,760 cubic inch seismic array and a spreading model of $18 \text{ LogR} - 0.0047R$ estimated for similar Beaufort nearshore waters (BP Liberty) by Aerts et al. (2008). (Candace Nachman, NMFS, specifically requested that empirical models developed by Aerts et al. (2008) from measurements at the Liberty prospect be used in estimating the ensonified area.) Placing a 3-kilometer buffer around the 1,882-square-kilometer (727-square-mile) seismic source area expands the ensonification (or Zone of Influence [ZOI]) area to approximately 2,295 square kilometers (886 square miles), and represents the ZOI for pinnipeds. (The distance to the 160 dB isopleth when operating the 880 cubic inch airgun array is 1.5 kilometers (0.9 miles).)

Table 6-1. Summary of Distance to NMFS Sound Level Thresholds

Source	Source Level	190 dB	180 dB	160 dB	120 dB
440 cubic inch airgun array	221.08 dB re 1 μ Pa (rms)	126 m	325 m	1.33 km	4.82 km
880 cubic inch airgun array	226.86 dB re 1 μ Pa (rms)	167 m	494 m	1.5 km	6.35 km
1,760 cubic inch airgun array	236.55 dB re 1 μ Pa (rms)	321 m	842 m	2.99 km	9.57 km

Within the 2,295 square kilometer ensonified area, 19 percent (431 square kilometers) falls within the 0 to 1.5 meter depth range, 14 percent (326 square kilometers) falls within the 1.5 to 5 meter range, 39 percent (903 square kilometers) with the 5 to 15 meter range, and 28 percent (635 square kilometers) within waters greater than 15 meters deep (bowhead migration corridor). The distribution of these depth ranges is found in Figure 6-1.

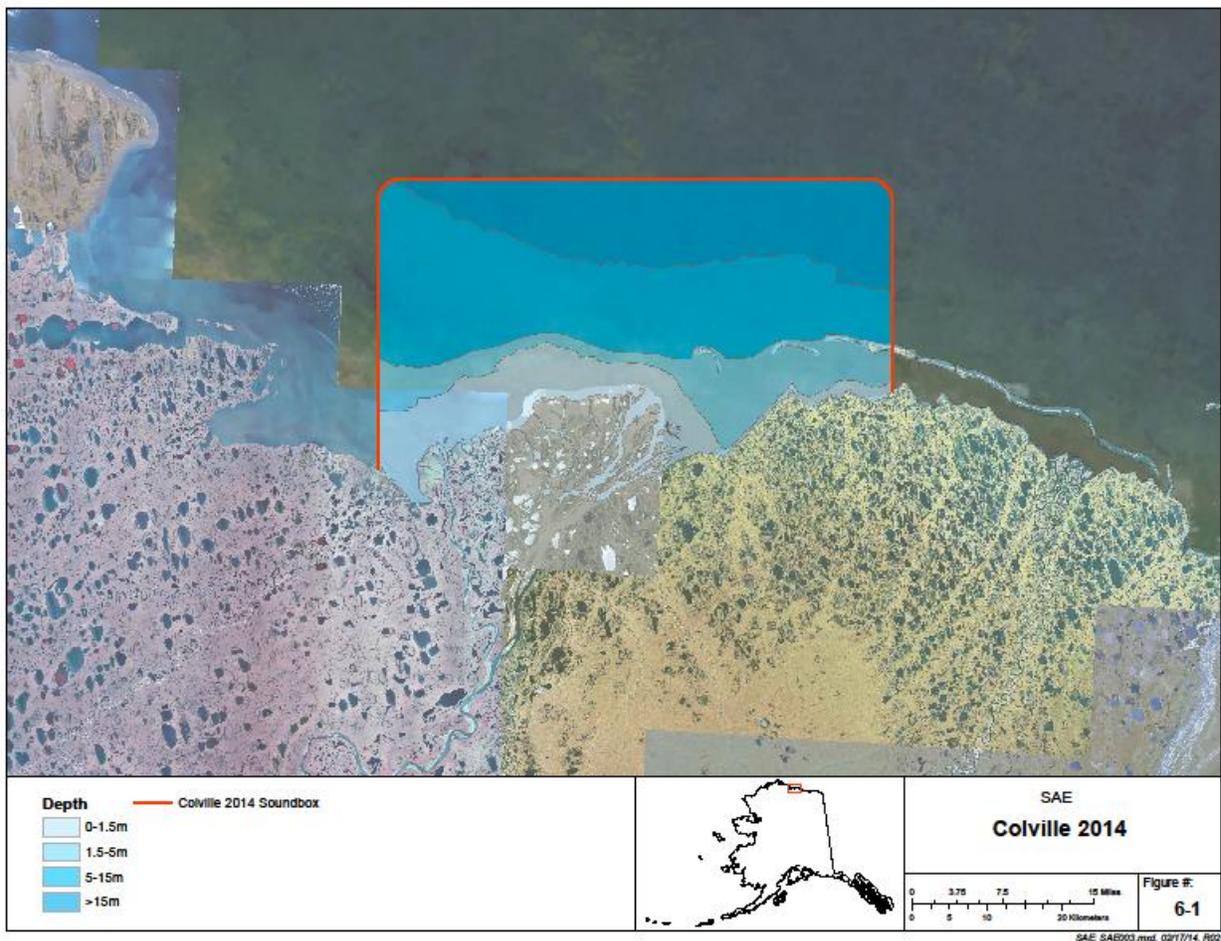


Figure 6-1. Depth contours within the proposed seismic survey box.

Marine Mammal Densities

Density estimates were derived for bowhead whales, beluga whales, ringed seals, spotted seals, and bearded seals as described below and shown in Table 6-2. There are no available Beaufort Sea density estimates for gray whales, or extralimital species such as humpback whales, narwhals, and ribbon seals. Encountering these animals during the seismic program would be unexpected. The density derivations for the five species presented in Table 6.2 are provided in the discussions below.

Table 6-2. Marine Mammal Densities (#/km²) in the Beaufort Sea.

Species	Summer	Fall
Bowhead Whale	0.0672	0.0910
Beluga Whale	0.0327	0.0175
Ringed Seal	0.3547	0.2510
Spotted Seal	0.0177	0.0125
Bearded Seal	0.0177	0.0125

Bowhead Whale

The summer density estimate for bowhead whales was derived from July and August aerial survey data collected in the Beaufort Sea during the Aerial Surveys of Arctic Marine Mammals (ASAMM) program in 2012 and 2013. During this period, 276 bowhead whales were recorded along 24,560 kilometers of transect line, or 0.0112 whales per kilometer of transect line. Applying an effective strip half-width (ESW) of 1.15 (Ferguson and Clarke 2013), results in an uncorrected density of 0.0049. Thomas et al.'s (2002) correction factors ($g(0)$) for availability (0.144) and observer (0.505) bias were applied producing an estimated density of 0.0672 whales per square kilometer. This is a much higher density than previous estimates (e.g., Brandon et al. 2011) due to relatively high numbers of whales recorded in the Beaufort Sea in August 2013. In 2013, 205 whales were recorded along 9,758 kilometers of transect line (corrected density = 0.1251), with 78 percent of the sightings (160 whales) recorded the eastern most blocks 4, 5, 6, and 7. In contrast, 26 of the 71 whales (37%) recorded on-transect during summer 2012 were at or near Barrow Canyon (Block 12), or the western extreme of the Alaskan Beaufort Sea, while another 26 (37%) were recorded at the eastern extreme (Blocks 4, 5, 6, and 7). For both years combined, only 8 of the 276 (2.9%) recorded during the summer were found in Block 3 where the seismic survey is planned.

Fall density estimate was determined from September and October ASAMM data collected from 2006 to 2013. The Western Arctic stock of bowhead whale has grown considerably since the late 1970s; thus, data collected prior to 2006 probably does not well represent current whale densities. From 2006 to 2013, 1,286 bowhead whales were recorded along 84,400 kilometers of transect line, or 0.1524 per kilometer. Using an ESW of 1.15 results in an uncorrected density of 0.0066. Applying the availability and observer bias correction factors from Thomas et al. (2002) derives a corrected fall density estimate of 0.0910.

Beluga Whale

There is little information on summer use by beluga whales in the Beaufort Sea. Moore et al. (2000) reported that only 9 beluga whales were recorded in waters less than 50 meters deep during 11,985 kilometers of transect survey effort, or about 0.00057 whales per kilometer. Assuming an ESW of 0.614 and a 2.62 (Lloyd and Frost 1995) correction factor for whales missed (availability and observer bias of adults) and 1.18 (Brodie 1971) correction factor for dark juveniles, both correction factors used by NMFS

for the annual Alaska Stock Assessment Reports, the derived corrected density would be 0.0014 whales per square mile. The same data did show much higher beluga numbers in deeper waters.

During the summer aerial surveys conducted during the 2012 ASAMM program (Clarke et al. 2013), 5 beluga whales were observed along 1,431 kilometers of transect in waters less than 20 meters deep and between longitudes 140°W and 154°W (the area within which the seismic survey would fall). This equates to 0.0035 whales per kilometer of trackline and an uncorrected density of 0.0028 assuming an ESW of 0.614. Applying correction factors for animals missed (2.62 adults and 1.18 juveniles) results in a corrected summer density estimate of 0.0088. Summer beluga data was also collected in 2013. This data, currently available in posted daily reports, does not parse the data by depth or longitude and, therefore, is not yet directly comparable to the 2012 data. Fourteen whales were observed along 340 kilometers of survey in block 3 in 2013, which is the survey block the proposed seismic survey area falls. Adding the block 3 data to the 2012 data results in 23 whales observed over 1,771 kilometers of transect effort, or 0.0130 whales per kilometer and 0.0107 per square kilometer. Applying correction factors mentioned above, the summer density estimate would increase to 0.0327. This density value is probably inflated due to the limited survey effort in 2013, but does represent a conservative estimate and is the value used in the take estimate.

Calculated fall beluga densities are approximately twice as high as summer. Between 2006 and 2012, 2,210 beluga were recorded along 79,586 kilometers of transect line flown during September and October, or 0.0278 beluga per kilometer of transect. Assuming an ESW of 0.614 gives an uncorrected density of 0.0226, and a corrected density of 0.0699. However, unlike in summer, almost none of the fall migrating belugas were recorded in waters less than 20 meters deep. For years where depth data is available (2006, 2009-2012), only 11 of 1,605 (1%) recorded belugas were found in waters less than 20 meters during the fall. To take into account this bias in distribution, but to remain conservative, the corrected density estimate is reduced to 25 percent, or 0.0175.

Ringed Seal

Surveys for ringed seals have been recently conducted in the Beaufort Sea by Kingsley (1986), Frost et al. (2002), Moulton and Lawson (2002), Green and Negri (2005), and Green et al. (2006, 2007). The shipboard monitoring surveys by Green and Negri (2005) and Green et al. (2006, 2007) were not systematically based, but are useful in estimating the general composition of pinnipeds in the Beaufort nearshore, including the Colville River Delta. Frost et al.'s aerial surveys were conducted during ice coverage and don't fully represent the summer and fall conditions under which the Beaufort surveys will occur. Moulton and Lawson (2002) conducted summer shipboard-based surveys for pinnipeds along the nearshore Beaufort Sea coast and developed seasonal average and maximum densities representative of SAE's Beaufort summer seismic project, while the Kingsley (1986) conducted surveys along the ice margin representing fall conditions.

Spotted Seal

Green and Negri (2005) and Green et al. (2006, 2007) recorded pinnipeds during barging activity between West Dock and Cape Simpson, and found high numbers of ringed seal in Harrison Bay, and peaks in spotted seal numbers off the Colville River Delta where a haulout site is located. Approximately 5% of all phocid sightings recorded by Green and Negri (2005) and Green et al. (2006, 2007) were spotted seals, which provide a suitable estimate of the proportion of ringed seals versus spotted seals in the Colville

River Delta and Harrison Bay. Thus, the estimated densities of spotted seals in the seismic survey area were derived by multiplying the ringed seal densities from Moulton and Lawson (2002) and Kingsley (1986) by 0.05.

Bearded Seal

Bearded seals were also recorded in Harrison Bay and the Colville River Delta by Green and Negri (2005) and Green et al. (2006, 2007), but at lower proportions to ringed seals than spotted seals. However, estimating bearded seal densities based on the proportion of bearded seals observed during the barge-based surveys results in densities estimates that appear unrealistically low given density estimates from other studies, especially given that nearby Thetis Island is used as a base for annually hunting this seal (densities are seasonally high enough for focused hunting). For conservative purposes, the bearded seal density values used in this application are derived from Stirling et al.’s (1982) observations that the proportion of eastern Beaufort Sea bearded seals is 5 percent that of ringed seals, similar as was done for spotted seals.

6.2 Exposure Calculations

The estimated potential harassment take of local marine mammals by the SAE’s Beaufort seismic project was determined by multiplying the animal densities in Table 6-2 with the area ensonified by seismic-generated noise greater than 160 dB re 1 µPa (rms) that constitutes habitat for each respective species. For pinnipeds, which occupy all water depths, this includes the entire seismic survey area plus the additional 3-kilometer (1.86-mile) buffer of noise exceeding 160 dB, or 2,295 square kilometers (886 square miles).

Although the vast majority of bowhead whales migrate through the Beaufort sea in waters greater than 15 meters (50 feet) deep (Miller et al. 2002), feeding and migrating bowheads have been found in waters as shallow as 5 meters (16 feet) (Clarke et al. 2011). Thus, the seismic survey area potentially inhabitable by bowhead whales is all waters greater than 5 meters deep. This area, including the 3-kilometer buffer, is 1,538 square kilometers (594 square miles).

Beluga whales have been observed inside the barrier islands where they would have to traverse water depths as low as 1.8 meters, but these whales are unlikely to inhabit the shallowest water (<1.5 meters deep) inside the barrier islands where stranding risk can be high. For this application, the area of beluga habitat potentially ensonified (>160 dB) by the seismic operations is the waters greater than 1.5 meters (5 feet) deep with the 3-kilometer buffer, or approximately 1,864 square kilometers (720 square miles). The resulting exposure calculations are found in Table 6-3.

Table 6-3. The Average Number of Animals Potentially Exposed to Received Sound Levels >160 dB.

Species	Summer	Fall	Total
Bowhead Whale (>5 m)	103	140	243
Beluga Whale (>1.5 m)	60	33	93
Ringed Seal	814	576	1,390
Spotted Seal	41	29	70
Bearded Seal	41	29	70

The estimated number of marine mammal exposures (Table 6-4) was based on the average density by the area of summer and fall habitat that could be ensounded by SAE’s proposed activities. Given the estimated densities, especially for bowhead and beluga whales, are overestimates of the expected density in Block 3 (based on ASAMM survey data), no adjustments are made to account for variability. Most of the summer sightings are well east or west of Block 3, and the great majority of the fall sightings are in deeper water than Block 3. Further, the take estimate is for the entire survey box, which would be completed over two years. It is impossible to predict how much of the survey box will be completed in 2014 given the influence of ice and weather conditions, and competing interests for the seismic fleet. A conservative estimate would be two-thirds, and is the basis for the 2014 only take authorization request in Table 6-4. The take authorization request also includes requested authorization for species in which the estimated take is zero, but for which records for the Alaskan Beaufort Sea occur (i.e., humpback whale, gray whale, narwhal, and ribbon seal).

Table 6-4. The Estimated and Requested Take of Marine Mammals.

Species	Estimate Exposures	Take Authorization Request 2014-2015	Take Authorization Request 2014 only
Bowhead Whale	243	243	162
Beluga Whale	93	93	62
Ringed Seal	1,390	1,390	926
Spotted Seal	70	70	47
Bearded Seal	70	70	47
Humpback Whale	0	2	2
Gray Whale	0	2	2
Narwhal	0	2	2
Ribbon Seal	0	2	2

The take authorization requests also do not account for mitigation measures that will be implemented including shutting down operations during the fall bowhead hunt (thereby avoiding any noise exposure during the peak of fall bowhead whale and beluga migration) and the plans for completing the seismic survey in waters greater than 15 meters (50 feet) deep in August (thereby avoiding seismic survey within the bowhead whale migration corridor after the fall hunt). These measures, coupled with ramping up of airguns, should greatly reduce the estimated take from seismic survey operations (See Appendix B, *Marine Mammal Monitoring and Mitigation Plan*).

The estimated take as a percentage of the marine mammal stock is 1.7 percent or less in all cases (Table 6-5). The highest percent of population estimated to be taken is for the East Chukchi stock of beluga whale, which may not inhabit the seismic survey at all, and the assumption that all beluga takes would occur from this stock is unrealistic. Thus, the 1.7 percent represents a worst-case scenario. The estimated take of 1.3 percent of the bowhead whale stock is also conservative as, again, the estimated take does not take into account mitigation measures such as possibly curtailing survey activities during the fall bowhead whale hunt, shutdowns within the harassment zone for cow/calf pairs, and possibly completing survey of the more offshore waters in the summer. These actions would reduce the potential encounters of bowhead and beluga whales in the fall.

Table 6-5. Estimated Take as Percentage of Stock.

Species	Abundance	Estimated Take	Percent Population
Bowhead Whale	12,631	162	1.3%
Beluga Whale (Beaufort Stock)	39,258	62	0.2%
Beluga Whale (E. Chukchi Stock)	3,710	62	1.7%
Ringed Seal	249,000	926	0.4%
Spotted Seal	101,568	47	0.1%
Bearded Seal	155,000	47	0.1%
Humpback Whale (West. North Pac.)	938	0	0.0%
Gray Whale	19,126	0	0.0%
Narwhal (Baffin Bay)	45,000	0	0.0%
Ribbon Seal	49,000	0	0.0%

Abundance sources: COSEWIC (2004), Boveng et al. (2009), Cameron et al. (2010), Allen and Angliss (2012, 2013)

7.0 ANTICIPATED IMPACT OF THE ACTIVITY ON THE SPECIES OR STOCK

7.1 Introduction

The primary impact of the proposed OBC seismic survey to local marine mammals is acoustical harassment from the 880 and 1,760 cubic inch airgun operations. Noise generated from the airguns could disrupt normal behaviors of marine mammals where received levels exceed 160 dB re 1 μ Pa. What is known about behavioral responses to noise stimuli by the marine mammals that inhabit the OBC seismic survey area are discussed below. Acoustical injury is possible where received sound levels exceed 180 dB re 1 μ Pa (cetaceans) or 190 dB re 1 μ Pa (pinnipeds), but this potential impact will be mitigated by ramping up of airguns and establishing a shutdown safety zone (see Section 1.2 and Appendix B).

7.2 Behavioral Response

Bowhead and Gray Whales - Bowhead whales, and other baleen whales such as gray and humpback whales, have shown strong overt reactions to seismic airguns. Feeding bowhead whales have shown avoidance behaviors at received levels between 160 and 170 dB re 1 μ Pa (rms) (Richardson et al. 1986, Ljungblad et al. 1988, Miller et al. 2005), but responses have been quite variable. Similarly, McCauley et al. (2000) found resting female humpbacks to remain 7 to 10 kilometers (4 to 6 miles) away from seismic survey operations, while males appeared to be attracted. Malme et al. (1984, 1986) found significant proportions of gray whales summering in the Bering Sea to cease feeding when exposed to seismic received levels between 162 and 173 re 1 μ Pa (rms). Migrating bowhead whales appear even more sensitive to impulsive noises and often deviate from their migration course after exposure to noise less than 160 dB re 1 μ Pa (rms), and at distances 20 to 30 kilometers (12 to 19 miles) from the source (Miller et al. 1999, Richardson et al. 1999). Still, deviating whales still remain well within the general migration corridor, and there is no evidence of long-term effects from seismic noise exposure. Bowhead populations continued to substantially increase in the 1970s and 1980s even in the presence of considerable seismic survey and other oil and gas activities (Richardson et al. 1987).

Beluga Whales – There is some suggestive information that beluga whales actively avoid seismic operations (Miller et al. 2005), but additional information is sparsely available on this species. Vessel-based seismic operations occur during the Arctic open water period when most belugas are in the pack ice

or calving lagoons. Studies on the effects of seismic surveys on other odontocetes have observed varied results. Toothed whales often appear to avoid seismic operations at times (e.g., Calambokidis and Osmeck 1998, Stone 2003), and are attracted to them at other times. Studies by Finneran et al. (2003, 2005) showed that captive beluga whales and bottlenose dolphins showed adverse reactions to sounds of similar duration as seismic arrays, but that they were less sensitive to noise levels. Romano et al. (2004) found elevated stress hormones in captive belugas exposed to playbacted seismic water gun sounds, while Thomas et al. (1990) did not find elevated stress hormones in belugas exposed to drilling playback sounds. Odontocetes are adapted to receiving and vocalizing high frequency sounds and, therefore, may be less sensitive to lower frequency impulse sounds from drilling noises and seismic airguns.

Ringed, Spotted, and Bearded Seals – Pinnipeds in general appear somewhat tolerant of airguns, partially because they can escape underwater pressure levels by exposing their head above the water surface, and their lesser sensitivity to lower frequency noises. Several Alaskan studies (Harris et al. 2001, Moulton and Lawson 2002, Miller et al. 2005) noted that ringed seals frequently did not avoid areas within a few hundred meters of operating airgun arrays. However, telemetry studies by Thompson et al. (1998) suggest that spotted and bearded seals may be less tolerant of even small active airgun arrays than visual studies have suggested. Regardless, seal reactions to seismic activities have been temporary and of short duration; there is no evidence of long-term effects. In general, pinnipeds appear to be more tolerant to loud noise activities than cetaceans as evidenced by their tolerance to acoustical harassment devices designed to drive them away. In her review of the known effects of noise on marine mammals, Weilgart (2007) largely confined her discussion on cetaceans and only once mentioned a possible negative effect on pinnipeds.

7.3 Temporary Threshold Shift and Permanent Threshold Shift

Noise has the potential to induce temporary (temporary threshold shift [TTS]) or permanent (permanent threshold shift [PTS]) hearing loss (Weilgart 2007). The level of loss is dependent on sound frequency, intensity, and duration. Similar to masking, hearing loss reduce the ability for marine mammals to forage efficiently, maintain social cohesion, and avoid predators (Weilgart 2007). For example, Todd et al. (1996) found an unusual increase in fatal fishing gear entanglement of humpback whales to coincide with blasting activities, suggesting hearing damage from the blasting may have compromised the ability for the whales to use sound to passively detect the nets. Experiments with captive bottlenose dolphins and beluga whales found that short duration impulsive sounds can cause TTS (Finneran et al. 2002).

7.4 Masking

Masking occurs when louder airgun noises interfere with marine mammal vocalizations or ability to hear natural sounds in their environment (Richardson et al. 1995), which limit their ability to communicate or avoid predation or other natural hazards. Masking is of special concern for mysticetes that vocalize at low frequencies over long distances, as their communication frequencies overlap with anthropomorphic noises such as shipping traffic and seismic airgun frequencies. Some baleen whales have adjusted their communication frequencies, intensity, and call rate to limit masking effects. For example, McDonald et al. (2009) found that California blue whales have shifted their call frequencies downward by 31 percent since the 1960s, possibly in an attempt to communicate below shipping noise frequencies. Melcon et al. (2012) found blue whales to increase their call rates in the presence of shipping noise, but to significantly decrease call rates when exposed to mid-frequency sonar. Also, Di Iorio and Clark (2010) found blue

whales to communicate more often in the presence of seismic survey, which they attributed to compensating for an increase in ambient noise levels. Fin whales have reduced their calling rate in response to boat noise (Watkins 1986), and were thought to stop singing altogether for weeks in response to seismic surveys (IWC 2007).

7.5 Stress and Mortality

Safety zones will be established to prevent acoustical injury to local marine mammals, especially injury that could indirectly lead to mortality. Also, seismic noise is not expected to cause resonate effects to gas-filled spaces or airspaces in marine mammals based on the research of Finneran (2003) on beluga whales showing that the tissue and other body masses dampen any potential effects of resonance on ear cavities, lungs, and intestines. However, chronic exposure to seismic noise could lead to physiological stress eventually causing hormonal imbalances (NRC 2005). If survival demands are already high, and/or additional stressors are present, the ability of the animal to cope decreases leading to pathological conditions or death (NRC 2005). Affects may be greatest where noise disturbance can disrupt feeding patterns including displacement from critical feeding grounds. However, monitoring hormonal levels in free-ranging marine mammals is difficult if not nearly impossible, and most evidence is by extension from studies on terrestrial species or from studies on marine mammals where stress could not be isolated as the primary pathological causation (NRC 2003).

Romano et al. (2001) did, however, expose captive beluga whales to typical seismic airgun noises (226 dB re 1 μ Pa), but found no changes in hormonal or immune response levels. Chronic exposure to elevated seismic noise is not expected.

8.0 THE ANTICIPATED IMPACT OF ACTIVITY ON AVAILABILITY OF SPECIES OR STOCKS OF MARINE MAMMALS FOR SUBSISTENCE USES

The proposed seismic activities will occur within the marine subsistence area used by the village of Nuiqsut. Nuiqsut was established in 1973 at a traditional location on the Colville River providing equal access to upland (e.g., caribou, Dall sheep) and marine (e.g., whales, seals, and eiders) resources (Brown 1979). Although Nuiqsut is located 40 kilometers (25 miles) inland, bowhead whales are still a major fall subsistence resource. Although bowhead whales have been harvested in the past all along the barrier islands, Cross Island is the site currently used as fall whaling base as it includes cabins and equipment for butchering whales. However, whalers must travel about 160 kilometers (100 miles) to annually reach the Cross Island whaling camp which is located in a direct line over 110 direct kilometers (70 miles) from Nuiqsut. Whaling activity usually begins in late August with the arrival whale migrating from the Canadian Beaufort Sea, and may occur as late as early October depending on ice conditions and quota fulfillment. Most whaling occurs relatively near (<16 kilometers; <10 miles) the island, largely to prevent meat spoilage that can occur with a longer tow back to Cross Island. Since 1993, Cross Island hunters have harvested one to four whales annually, averaging three.

Cross Island is located 70 kilometers (44 miles) east of the eastern boundary of the seismic survey box. (Point Barrow is over 180 kilometers [110 miles] outside the potential survey box.) Seismic activities are unlikely to affect Barrow or Cross Island based whaling, especially if the seismic operations temporarily cease during the fall bowhead whale hunt.

Although Nuiqsut whalers may incidentally harvest beluga whales while hunting bowheads, these whales are rarely seen and are not actively pursued. Any harvest would occur most likely in association with Cross Island.

The potential seismic survey area is also used by Nuiqsut villagers for hunting seals. All three seal species – ringed, spotted, and bearded – are taken. Sealing begins in April and May when villagers hunt seals at breathing holes in Harrison Bay. In early June, hunting is concentrated at the mouth of the Colville River where ice breakup flooding results in the ice thinning and seals becoming more visible. Once the ice is clear of the Delta (late June), hunters will hunt in open boats along the ice edge from Harrison Bay to Thetis Island in a route called “round the world”. Thetis Island is important as it provides a weather refuge and a base for hunting bearded seals. During the July and August ringed and spotted seals are hunted in the lower 65 kilometers (40 miles) of the Colville River proper.

In terms of pounds, approximately one-third of the village of Nuiqsut’s annual subsistence harvest is marine mammals (fish and caribou dominate the rest), of which bowhead whales contribute by far the most (Fuller and George 1999). Seals contribute only 2 to 3 percent of annual subsistence harvest (Brower and Opie 1997, Brower and Hepa 1998, Fuller and George 1999). Fuller and George (1999) estimated that 46 seals were harvested in 1992. The more common ringed seals appear to dominate the harvest although the larger and thicker skinned bearded seals are probably preferred. Spotted seals occur in the Colville River Delta in small numbers, which is reflected in the harvest.

Available harvest records suggest that most seal harvest occurs in the months preceding the July start of seismic survey when waning ice conditions provide the best opportunity to approach and kill hauled out seals. Much of the late summer seal harvest occurs in the Colville River as the seals follow fish runs upstream. Still, open water seal hunting could occur coincident with the seismic surveys, especially bearded seal hunts based from Thetis Island. In general, however, given the relatively low contribution of seals to the Nuiqsut subsistence, and the greater opportunity to hunt seals earlier in the season, the seismic survey impact to seal hunting is likely remote. Impacts to seal populations in general are also very small. Responses of seals to seismic airguns are expected to be negligible. Bain and Williams (2006) studied the responses of harbor seals, California sea lions, and Steller sea lions to seismic airguns and found that seals at exposure levels above 170 dB re 1 μ Pa (peak-peak) often showed avoidance behavior including generally staying at the surface and keeping their heads out of the water, but that the responses were not overt, and there were no detectable responses at low exposure levels.

9.0 THE ANTICIPATED IMPACT OF THE ACTIVITY UPON THE HABITAT OF THE MAMMAL POPULATIONS AND THE LIKELIHOOD OF RESTORATION OF THE AFFECTED HABITAT

The OBC seismic survey area will occur on the Beaufort Sea coastal shelf ecoregion. The physical habitat is characterized as a nearshore, shallow water (0 to 18 meters deep) flat with a mostly mud or sandy mud bottom substrate (Smith 2010). The marine resources associated with this habitat important to local marine mammals include the fish, invertebrates, and zooplankton these cetaceans forage upon.

Beluga whales, ringed seals, and spotted seals feed primarily on fish. Trawl studies conducted in the Beaufort Sea have shown a clear dominance of the fish community by Arctic cod (*Boreogadus saida*)

with locally high populations of capelin (*Mallotus villosus*) (Frost and Lowry 1983, Craig 1984, Cannon et al. 1987, Jarvela and Thorsteinson 1999, Logerwell et al. 2010). Other fish ranking in the community include eelpouts (*Lycodes* spp.), snailfish (*Liparis* spp.), and sculpins (Frost and Lowry 1983, Logerwell et al. 2010), with Arctic cisco (*Coregonus autumnalis*) common along the brackish shorelines (Jarvela and Thorsteinson 1999). Jarvela and Thorsteinson (1999) commented on the relatively low richness in fish species diversity in the Alaskan Beaufort Sea.

Bearded seals feed on fish as well, but their diet is largely dominated by invertebrates (Cameron et al. 2010). Carey et al. (1984) sampled the bivalve population in the project vicinity (near Pingok Island) and found a relatively high abundance of about a dozen species of small clams. One species, *Macoma calcarea*, does grow to sizes exceeding 50 millimeters and may be consumed by local bearded seals. Snow crabs (*Chionoecetes opilio*) are also an important prey item (Cameron et al. 2010), but their presence (or any crab presence for that matter) is unknown in the seismic survey box. Snow crabs, however, are becoming increasingly abundant near Point Barrow (Logerwell et al. 2010) and may be expanding eastward in the Beaufort Sea.

In the Alaskan Beaufort Sea, bowhead whales feed largely on euphausiid and calanoid copepod zooplankton (Moore et al. 2010). These resources are high near Point Barrow where feeding studies have been conducted, but much lower east of Barrow (Smith 2010). Most of the Alaskan bowhead whale population feeds in the Canadian Beaufort Sea during the summer months, and these whales are more likely to migrate through the seismic survey area than stop to feed. Based on stomach contents from whales harvested during the fall migration, bowheads don't appear to feed during migration except near Point Barrow (Moore et al. 2010). Further, seismic impacts to zooplankton are unknown, but if similar to larval fish, then injury impacts (>220 dB) from the seismic airguns would extend out only 2 or 3 meters from the source (Davis et al. 1998).

Project activities that could potential impact marine mammal habitats include laying cable on sea bottom and acoustical injury of prey resources. There are few benthic resources in the survey area that could be impacted by cable-laying, and the nearshore benthic environment is highly resilient given the annual ice scour (Lewis and Blasco 1990). Reimnitz et al. (1977) estimated that the Alaskan Beaufort seabed between 6 and 14 meters depth is completely reworked by ice scour every 50 years. Compared to annual ice scour, cable impacts are considered insignificant.

Relative to fish and crab prey resources, the primary habitat concerns are acoustical effects on Arctic cod, capelin, Arctic cisco, and snow crabs. Christian et al. (2004) studied seismic energy impacts on male snow crabs and found no significant increases in physiological stress due to exposure. No acoustical impact studies have been conducted to date on the above fish species, but studies have been conducted on Atlantic cod and sardine. Davis et al. 1998 cited various studies found no effects to Atlantic cod eggs, larvae, and fry when received levels were 222 dB. What effects were found were to larval fish within about 5 meters, and from airguns with volumes between 3,000 and 4,000 cubic inches. Similarly, effects to sardine were greatest on eggs and 2-day larvae, but these effects were greatest at 0.5 meters, and again confined to 5 meters. Further, Greenlaw et al. (1988) found no evidence of gross histological damage to eggs and larvae of northern anchovy exposed to seismic airguns, and concluded that noticeable effects would result only from multiple, close exposures. Based on these results, the 880 to 1,760 cubic inch airguns planned for the SAE Beaufort seismic survey could damage larval fish, but only out to about

2 or 3 meters at most. Given the airguns' position relative to the ocean bottom, benthic prey would be unaffected. From an ecological community standpoint, potential impacts are considered minor.

Overall, cable laying and acoustical effects on prey resources will have a minor effect at most on the marine mammal habitat within the seismic survey area. Some prey resources might be temporarily displaced, but no long-term effects are unexpected.

10.0 THE ANTICIPATED IMPACT OF THE LOSS OR MODIFICATION OF THE HABITAT ON THE MARINE MAMMAL POPULATIONS INVOLVED

Based on the conclusions of Section 9 above, no loss or modification of marine mammal habitat is expected. Any impacts to prey resources is considered minor or negligible, and no long-term effects would occur.

11.0 AVAILABILITY AND FEASIBILITY OF EQUIPMENT, METHODS, AND MANNER OF CONDUCTING ACTIVITY OR OTHER MEANS OF EFFECTING THE LEAST PRACTICABLE ADVERSE IMPACT UPON THE AFFECTED SPECIES OR STOCKS, THEIR HABITAT, AND ON AVAILABILITY FOR SUBSISTENCE USES

The primary means of minimizing potential impacts to marine mammals include 1) using relative small seismic arrays (1,760, 880, and 440 cubic inch) with sound sources much less than typical 3D seismic arrays, 2) establishing shutdown safety zones to ensure marine mammals are not injured by noise levels exceeding Level A injury thresholds, 3) conducting the surveys outside the seal pupping season, and 4) shutting operations down or moving them inland during the period the main vanguard of migrating bowhead whales pass through the Beaufort Sea. Reducing and mitigating potential acoustical impacts to local marine mammals during seismic activity is fully addressed in the Marine Mammal Monitoring and Mitigation Plan attached as Appendix B.

12.0 LOCATION OF PROPOSED ACTIVITY – IN OR NEAR A TRADITIONAL ARCTIC SUBSISTENCE HUNTING AREA AND IMPACT ON AVAILABILITY OF SPECIES OR STOCK OF MARINE MAMMALS FOR ARCTIC SUBSISTENCE USES

SAE is conducting the planned seismic surveys in a joint partnership agreement with Kuukpik Corporation. As a joint venture partner with Kuukpik, SAE will be working closely with them and the communities on the North Slope to plan operations that will include measures that are environmentally suitable and that do not impact local subsistence use. A Conflict Avoidance Agreement will be developed that will include such measures. A schedule of meetings in the villages of Nuiqsut, Barrow, Kaktovik, and any other affected communities will be developed and meetings attended. The Plan of Cooperation is attached as Appendix C.

As described in Section 8, both bowhead whales and seals contribute to the subsistence of the coastal villages along the Beaufort Sea, with bowhead whales the far more important of the two. Pt. Barrow

occurs over 180 kilometers (110 miles) west and Cross Island 70 kilometers (44 miles) east of the survey box, both well beyond the distance where seismic generated noise is expected to reach ambient (20 kilometers).

The seismic survey area also falls within areas that are used to hunt seals by the villagers of Nuiqsut. However, most of this sealing occurs during freeze up, right at break up, or when the ice edge is nearby, all prior to the open-water period when seismic surveys would occur. Summer hunting for seals largely occurs in the Colville River proper as seals follow fish runs 65 kilometers (40 miles) upstream. The most likely concern is bearded seal hunting from Thetis Island, which can occur during the open water period. The potential impacts to this hunt will be addressed during the conflict avoidance process.

13.0 SUGGESTED MEANS OF ACCOMPLISHING THE NECESSARY MONITORING AND REPORTING THAT WILL RESULT IN INCREASED KNOWLEDGE OF THE SPECIES, THE LEVEL OF TAKING OR IMPACTS ON POPULATIONS OF MARINE MAMMALS THAT ARE EXPECTED TO BE PRESENT WHILE CONDUCTING ACTIVITIES AND SUGGESTED MEANS OF MINIMIZING BURDENS BY COORDINATING SUCH REPORTING REQUIREMENTS WITH OTHER SCHEMES ALREADY APPLICABLE TO PERSONS CONDUCTING SUCH ACTIVITY.

Monitoring and reporting potential acoustical impacts to local marine mammals are fully addressed in the Marine Mammal Monitoring and Mitigation Plan attached as Appendix B.

14.0 LEARNING, ENCOURAGING, AND COORDINATING RESEARCH OPPORTUNITIES, PLANS, AND ACTIVITIES RELATING TO REDUCE AND EVALUATE INCIDENTAL “TAKE”

Potential impacts of seismic noise on marine mammals have been studied, with the results used to establish the noise criteria for evaluating take and to support shutting down seismic operations during the whale hunt. Opportunity to further evaluate seismic effects on bowhead whales is largely not available as seismic operations will be shut down when most bowheads are present in the seismic area. However, all observations of marine mammals, including any observed reactions to the seismic operations will be recorded and reported to NMFS and the North Slope Borough.

15.0 REFERENCES

- Aerts, L.A.M., M. Brees, S. Blackwell, C. Greene, K. Kim, D. Hannay and M. Austin. 2008. Marine mammal monitoring and mitigation during BP Liberty OBC seismic survey in Foggy Island Bay, Beaufort Sea, July-August 2008: 90-day report. LGL Rep. P1011-1. Rep. from LGL Alaska Research Associates Inc., LGL Ltd., Greeneridge Sciences Inc. and JASCO Research Ltd. for BP Exploration Alaska.
- Allen, B.M. and R.P. Angliss. 2012. Alaska Marine Mammal Stock Assessments. 2011. NOAA Technical Memorandum NMFS-AFSC-234. Seattle, Washington, National Marine Fisheries Service. 297 pp.
- Allen, B.M. and R.P. Angliss. 2013. Alaska Marine Mammal Stock Assessments. 2012. NOAA Technical Memorandum NMFS-AFSC-245. Seattle, Washington, National Marine Fisheries Service. 291 pp.
- Bain, D.E. and R. Williams. 2006. Long-range effects of airgun noise on marine mammals: Responses as a function of received sound level and distance. Paper SC/58/E35 presented to the IWC Scientific Committee, June 2006 (unpublished). 13 pp.
- Bigg, M.A. 1981. Harbour seal, *Phoca vitulina* and *P. largha*. p. 1-28 In: S.H. Ridgway and R.J. Harrison (eds.), Handbook of Marine Mammals, Vol. 2: Seals. Academic Press, New York, NY. 359 p.
- Boveng, P. L., J. L. Bengtson, T. W. Buckley, M. F. Cameron, S. P. Dahle, B. P. Kelly, B. A. Megrey, J. E. Overland, and N. J. Williamson. 2009. Status review of the spotted seal (*Phoca largha*). U.S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-200. 153 p.
- Braham, B., D. Krogman, and C.H. Fiscus. 1977. Bowhead (*Balaena mysticetus*) and beluga (*Delphinapterus leucas*) whales in the Bering, Chukchi and Beaufort Seas. In Environmental assessment of the Alaskan continental shelf. Annu. Rep. 1:134-160. U.S. Dep. Commer., NOAA, Environ. Res. Lab., Boulder, Colo.
- Braham, H.W., B.D. Krogman and G.M. Carroll. 1984. Bowhead and white whale migration, distribution, and abundance in the Bering, Chukchi, and Beaufort seas, 1975-78. NOAA Tech. Rep. NMFS SSRF-778. USDOC/NOAA/NMFS. NTIS PB84-157908. 39 p.
- Brandon, J.R., T. Thomas, and M. Bourdon. 2011. Beaufort Sea aerial survey program results. (Chapter 6) In: Reiser, C.M, D.W. Funk, R. Rodrigues, and D. Hannay. (eds.) 2011. Marine mammal monitoring and mitigation during marine geophysical surveys by Shell Offshore, Inc. in the Alaskan Chukchi and Beaufort seas, July–October 2010: 90-day report. LGL Rep. P1171E–1. Rep. from LGL Alaska Research Associates Inc., Anchorage, AK, and JASCO Applied Sciences, Victoria, BC for Shell Offshore Inc., Houston, TX, Nat. Mar. Fish. Serv., Silver Spring, MD, and U.S. Fish and Wild. Serv., Anchorage, AK. 240 pp, plus appendices.
- Brower, H., Jr. 1996. Observations on locations at which bowhead whales have been taken during the fall subsistence hunt (1988 through 1995) by Eskimo hunters based in Barrow, Alaska. North Slope Borough Dept. Wildl. Manage., Barrow, AK. 8 p. Revised 19 Nov. 1996.

Brower, H.K., Jr. and R.T. Opie. 1997. North Slope Borough Subsistence Harvest Documentation Project: Data for Nuiqsut, Alaska, for the Period July 1, 1994 to June 30, 1995. North Slope Borough, Department of Wildlife Management, Barrow, Alaska.

Brower, H.K., Jr. and R.T. Hepa. 1998. North Slope Borough Subsistence Documentation Project: Data for Nuiqsut, Alaska, for the Period July 1, 1994 to June 30, 1995. North Slope Borough, Department of Wildlife Management, Barrow, Alaska.

Brown, William E. 1979. Nuiqsut Heritage a Cultural Heritage. Anchorage, AK: Arctic Environmental Information and Data Center.

Calambokidis, J. and S.D. Osmek. 1998. Marine mammal research and mitigation in conjunction with airgun operation for the USGS SHIPS seismic surveys in 1998. Draft rep. from Cascadia Research, Olympia, WA, for U.S. Geol. Surv., Nat. Mar. Fish. Serv., and Minerals Manage. Serv.

Calambokidis, J., J.D. Darling, V. Deecke, P. Gearin, M. Gosho, W. Megill, C.M. Tombach, D. Goley, C. Toropova and B. Gisborne. 2002. Abundance, range and movements of a feeding aggregation of gray whales (*Eschrichtius robustus*) from California to southeastern Alaska in 1998. *Journal of Cetacean Research and Management* 4:267-276.

Calambokidis, J., J.L. Laake and A. Klimek. 2010. Abundance and population structure of seasonal gray whales in the Pacific Northwest, 1998 - 2008. Paper IWC/62/BRG32 submitted to the International Whaling Commission Scientific Committee. 50 pp.

Cameron, M.F., J. L. Bengston, P.L. Boveng, J.K. Jansen, B.P. Kelly, S.P. Dahle, E.A. Logerwell, J.E. Overland, C.L. Sabine, G.T. Waring, and J.M. Wilder. 2010. Status review of the bearded seal (*Erignathus barbatus*). U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-211, 246 pp.

Cannon, T.C., B.A. Adams, D. Glass, and T. Nelson. 1987. Fish Distribution and Abundance. Chapter 1 *In* Endicott Environmental Monitoring Program, Final Reports, 1985, Volume 6. Report Prepared by Envirosphere Company for U.S. Army Corps of Engineers, Alaska District, Anchorage, Alaska.

Carey, A.G., Jr., Scott, P.H., and Walters, K.W. 1984. Distributional ecology of shallow southwestern Beaufort Sea (Arctic Ocean) bivalve Mollusca. *Marine Ecology Progress Series* 17:124-134.

Christian, J.R., A. Mathieu, and R.A. Buchanan. 2004. Chronic effects of seismic energy on snow crab (*Chionoecetes opilio*). Environmental Studies Research Funds Report No. 158, Calgary, AB.

Christie, K., C. Lyons, and W.R. Koski. 2010. Beaufort Sea aerial monitoring program. (Chapter 7) *In*: Funk, D.W, D.S. Ireland, R. Rodrigues, and W.R. Koski (eds.). 2010. Joint Monitoring Program in the Chukchi and Beaufort seas, open water seasons, 2006–2008. LGL Alaska Report P1050-3, Report from LGL Alaska Research Associates, Inc., LGL Ltd., Greeneridge Sciences, Inc., and JASCO Research, Ltd., for Shell Offshore, Inc. and Other Industry Contributors, and National Marine Fisheries Service, U.S. Fish and Wildlife Service. 499 pp. plus Appendices.

Clarke, J.T. and M.C. Ferguson. 2010. Aerial surveys for bowhead whales in the Alaskan Beaufort Sea: BWASP Update 2000-2009 with Comparisons to Historical Data. IWC Paper SC/62/BRG14.

Clarke, J.T., C.L. Christman, M.C. Ferguson, and S.L. Grassia. 2011. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 2006-2008. Final Report, OCS Study BOEMRE 2010-042. National Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, NOAA, 7600 Sand Point Way NE, F/AKC3, Seattle, WA 98115-6349.

COSEWIC. 2004. COSEWIC Assessment and Update Status Report on the Narwhal, *Monodon monoceros* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 50 pp.

Craig, P.C. 1984. Fish Use of Coastal Waters of the Beaufort Sea: A Review. Transactions of the American Fisheries Society 113:265-282.

Davis, R.A. and C.R. Evans. 1982. Offshore distribution and numbers of white whales in the eastern Beaufort Sea and Amundsen Gulf, summer 1981. Rep. from LGL Ltd., Toronto, Ont., for Sohio Alaska Petrol. Co., Anchorage, AK, and Dome Petrol. Ltd., Calgary, Alb. (co-managers). 76 p.

Davis, R.A., D. Thomson, and C.I. Malme. 1998. Environmental assessment of seismic exploration of the Scotian Shelf. Unpublished Report by LGL Ltd., environmental research associates, King City, ON and Charles I. Malme, Engineering and Science Services, Hingham, MA for Mobil Oil Canada Properties Ltd, Shell Canada Ltd., and Imperial Oil Ltd.

Di Iorio, L. and C.W. Clark. 2010. Exposure to seismic survey alters blue whale acoustic communication. Biology Letters, 6, 51-54.

Ferguson, M. C., and J. T. Clarke. 2013. Estimates of detection probability for BWASP bowhead whale, gray whale, and beluga sightings collected from Twin Otter and Aero Commander aircraft, 1989 to 2007 and 2008 to 2011. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-261, 52 p.

Finneran, J.J. 2003. Whole-lung resonance in bottlenose dolphin (*Tursiops truncatus*) and white whale (*Delphinapterus leucas*). J. Acoust. Soc. Am. 114:529-535.

Finneran, J.J., C.E. Schlundt, R. Dear, D.A. Carder and S.H. Ridgway. 2002. Temporary shift in masked hearing thresholds in odontocetes after exposure to single underwater impulses from a seismic watergun. J. Acoust. Soc. Am. 111(6):2929-2940.

Finneran, J. J., Dear, R., Carder, D. A., and Ridgway, S. H. 2003. Auditory and behavioral responses of California sea lions *Zalophus californianus* to underwater impulses from an arc-gap transducer. J. Acoust. Soc. Am. 114:1667-1677.

Finneran, J.J., D.A. Carder, C.E. Schlundt and S.H. Ridgway. 2005. Temporary threshold shift in bottlenose dolphins (*Tursiops truncatus*) exposed to mid-frequency tones. J. Acoust. Soc. Am. 118(4):2696-2705.

Frost K.J. and L.F. Lowry. 1983. Demersal fishes and invertebrates trawled in the northeastern Chukchi and western Beaufort Seas, 1976-77. NOAA Tech Rep NMFS SSRF-764, 22 pp.

Frost, K.J. and L.F. Lowry. 1995. Radio tag based correction factors for use in beluga whale population estimates. Working paper for Alaska Beluga Whale Committee Scientific Workshop, Anchorage, AK, 5-7 April 1995. 12 pp.

Frost, K. J., L. F. Lowry, J. R. Gilbert, and J. J. Burns. 1988. Ringed seal monitoring: relationships of distribution and abundance to habitat attributes and industrial activities. Final Rep. contract no. 84-ABC-00210 submitted to U.S. Dep. Interior, Minerals Management Service, Anchorage, AK. 101 pp.

Frost, K.J., L.F. Lowry, G. Pendleton, and H.R. Nute. 2002. Monitoring distribution and abundance of ringed seals in northern Alaska. OCS Study MMS 2002-043. Final Rep. prepared by State of Alaska Department of Fish and Game, Juneau, AK, for U.S. Department of Interior, Minerals Management Service, Anchorage, AK. 66 p. + Appendices.

Fuller, A.S. and J.C. George. 1999. Evaluation of subsistence harvest data from the North Slope Borough 1993 census for eight North Slope village: for the calendar year 1992. Barrow: NSB Department of Wildlife Management.

Funk, D., D Hannay, D. Ireland, R. Rodrigues and W. Koski. (eds.). 2008. Marine mammal monitoring and mitigation during open water seismic in the Chukchi and Beaufort Seas, July–November 2007: 90-day report. LGL Rep. P969-1. Rep. from LGL Alaska Research Associates Inc., LGL Ltd., and JASCO Research Ltd. for Shell Offshore, Inc., NMFS, and USFWS. 218 pp. plus appendices.

George, J. C., J. Zeh, R. Suydam, and C. Clark. 2004. Abundance and Population trend (1978-2001) of Western Arctic Bowhead Whales Surveyed near Barrow, Alaska. *Marine Mammal Science*. 20(4):755-773.

Green, G.A., and S. Negri. 2005. Marine Mammal Monitoring Program: FEX Barging Project, 2005. Unpublished report prepared for ASRC Lynx Enterprises, Inc., Anchorage, Alaska, by Tetra Tech EC, Inc., Bothell, Wash.

Green, G.A., and S. Negri. 2006. Marine Mammal Monitoring Program: FEX Barging Project, 2006. Unpublished report prepared for ASRC Lynx Enterprises, Inc., Anchorage, Alaska, by Tetra Tech EC, Inc., Bothell, Wash.

Green, G.A., M. Hall, and M. Newcomer. 2003. Marine Mammal Monitoring Program McCovey Exploration Project, Winter 2002/2003. Report prepared by Foster Wheeler Environmental Corporation, Bothell, WA, for EnCana Oil & Gas (USA) Inc., Anchorage, AK, and Lynx Enterprises, Anchorage, AK.

Green, G.A., K. Hashagen, and D. Lee. 2007. Marine mammal monitoring program, FEX barging project, 2007. Report prepared by Tetra Tech EC, Inc., Bothell, WA, for FEX L.P., Anchorage, AK.

Greenlaw, C.F., D.V. Holliday, R.E. Pieper and M.E. Clark. 1988. Effects of air gun energy releases on the northern anchovy. *J. Acoust. Soc. Am.* 84:S165.

Harris, R.E., G.W. Miller and W.J. Richardson. 2001. Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. *Mar. Mamm. Sci.* 17(4):795-812.

Harwood, L.A. and I. Stirling. 1992. Distribution of ringed seals in the southeastern Beaufort Sea during late summer. *Can. J. Zool.* 70(5):891-900.

Harwood, L., S. Innes, P. Norton and M. Kingsley. 1996. Distribution and abundance of beluga whales in the Mackenzie estuary, southeast Beaufort Sea, and the west Amundsen Gulf during late July 1992. *Can. J. Fish. Aquatic Sci.* 53(10):2262-2273.

Hashagen, K.A., G.A. Green, and W. Adams. 2009. Observations of humpback whales, *Megaptera novaeangliae*, in the Beaufort Sea, Alaska. *Northwestern Naturalist* 90:160-162.

Hauser, D.D.W., V.D. Moulton, K. Christie, C. Lyons, G. Warner, C. O'Neill, D. Hannay, and S. Inglis. 2008. Marine mammal and acoustic monitoring of the Eni/PGS open-water seismic program near Thetis, Spy and Leavitt islands, Alaskan Beaufort Sea, 2008: 90-day report. LGL Rep. P1065-1. Rep. from LGL Alaska Research Associates Inc. and JASCO Research Ltd., for Eni US Operating Co. Inc., PGS Onshore, Inc., NMFS, and USFWS. 180 pp.

Hazard, K. 1988. Beluga whale, *Delphinapterus leucas*. p. 195-235 In: J.W. Lentfer (ed.), *Selected Marine Mammals of Alaska*. Mar. Mamm. Comm., Washington, DC. NTIS PB88-178462. 275 pp.

International Whaling Commission (IWC). 2007. Report of the scientific committee. Annex K. Report of the Standing Working Group on environmental concerns. *J. Cetacean Res. Manage.* 9 (Suppl.):227–296.

Jankowski, M.M., Fitzgerald, B. Haley, and H. Patterson. 2008. Beaufort Sea vessel-based monitoring program. Chapter 6 In Funk, D.W., R. Rodrigues, D.S. Ireland, and W.R. Koski (eds.). *Joint monitoring program in the Chukchi and Beaufort seas, July-November 2007*. LGL Alaska Report P971-2. Report from LGL Alaska Research Associates, Inc., Anchorage, AK, LGL Ltd., environmental research associates, King City, Ont., JASCO Research, Victoria, BC., and Greeneridge Sciences, Inc., Goleta, CA, for Shell Offshore, Inc., ConocoPhillips Alaska, Inc., and National Marine Fisheries Service, and U.S. Fish and Wildlife Service.

Jarvela L.E. and L.K. Thorsteinson. 1999. The epipelagic fish community of Beaufort Sea coastal waters, Alaska. *Arctic* 52:80-94.

Johnson, C.B., B.E. Lawhead, J.R. Rose, M.D. Smith, A.A. Stickney and A.M. Wildman. 1999. Wildlife studies on the Colville River Delta, Alaska, 1998. Rep. from ABR, Inc., Fairbanks, AK, for ARCO Alaska, Inc., Anchorage, AK.

Jones, M.L., S.L. Swartz and S. Leatherwood. 1984. *The Gray Whale: Eschrichtius robustus*. Academic Press, Inc. Orlando, Fl. 600 pp.

Kelly, B.P. 1988. Bearded seal, *Erignathus barbatus*. p. 77-94 In: J.W. Lentfer (ed.), *Selected Marine Mammals of Alaska/Species Accounts with Research and Management Recommendations*. Marine Mammal Commission, Washington, DC. 275 pp.

Kelly, B.P., J.L. Bengtson, P.L. Boveng, M.F. Cameron, S.P. Dahle, J.K. Jansen, E.A. Logerwell, J.E. Overland, C.L. Sabine, G.T. Waring, and J.M. Wilder. 2010. Status review of the ringed seal (*Phoca hispida*). U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-212, 250 pp.

Kingsley, M.C.S. 1986. Distribution and Abundance of Seals in the Beaufort Sea, Amundsen Gulf, and Prince Albert Sound, 1984. *Environmental Studies Revolving Funds Report No. 25*. 16 pp.

LAMA Ecological/OASIS Environmental. 2011. Incidental Harassment Authorization Request for the Non-lethal Harassment of Whales and Seals during the Simpson Lagoon OBC Seismic Survey, Beaufort Sea, Alaska, 2012.

Lewis, C.F.M., and Blasco, S.M. 1990. Character and distribution of sea-ice and iceberg scours. In: Clark, J.I., ed. Workshop on ice scouring and design of offshore pipelines, 18–19 April 1990, Calgary, Alberta. Ottawa: Energy Mines and Resources Canada and Indian and Northern Affairs Canada.

Ljungblad, D.K., B. Würsig, S.L. Swartz and J.M. Keene. 1988. Observations on the behavioral responses of bowhead whales (*Balaena mysticetus*) to active geophysical vessels in the Alaskan Beaufort Sea. *Arctic* 41(3):183-194.

Logerwell, E. A., K. Rand, S. Parker-Stetter, J. Horne, T. Weingartner, and B. Bluhm. 2010. Beaufort Sea Marine Fish Monitoring 2008: Pilot Survey and Test of Hypotheses - Final Report. US Department of the Interior, Minerals Management Service, Alaska OCS Region, Anchorage, Alaska, BOEMRE-2010-048.

Lowry, L.F., K.J. Frost, R. Davis, D.P. DeMaster and R.S. Suydam. 1998. Movements and behavior of satellite-tagged spotted seals (*Phoca largha*) in the Bering and Chukchi Seas. *Polar Biol.* 19(4):221-230.

Lyons, C., W.R. Koski, and D.S. Ireland. 2009. Beaufort Sea aerial marine mammal monitoring program. (Chapter 7) In: Ireland, D.S., D.W. Funk, R. Rodrigues, and W.R. Koski (eds.). Joint monitoring program in the Chukchi and Beaufort seas, open water seasons, 2006–2007. LGL Alaska Report P971-2. Report from LGL Alaska Research Associates, Inc., Anchorage, AK, LGL Ltd., environmental research associates, King City, Ont., JASCO Research Ltd., Victoria, B.C., and Greeneridge Sciences, Inc., Santa Barbara, CA, for Shell Offshore, Inc., Anchorage AK, ConocoPhillips Alaska, Inc., Anchorage, AK, and the National Marine Fisheries Service, Silver Springs, MD, and the U.S. Fish and Wildlife Service, Anchorage, AK. 485 pp. plus Appendices.

Maher, W.J. 1960. Recent records of the California gray whale (*Eschrichtius glaucus*) along the north coast of Alaska. *Arctic* 13(4):257-265.

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack and J.E. Bird. 1984. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior/Phase II: January 1984 migration. BBN Rep. 5586. Rep. from Bolt Beranek & Newman Inc., Cambridge, MA, for U.S. Minerals Manage. Serv., Anchorage, AK. NTIS PB86-218377.

Malme, C.I., B. Würsig, J.E. Bird and P. Tyack. 1986. Behavioral responses of gray whales to industrial noise: feeding observations and predictive modeling. *Outer Cont. Shelf Environ. Assess. Progr.*, Final Rep. Princ. Invest., NOAA, Anchorage, AK 56(1988):393-600. BBN Rep. 6265. 600 p. OCS Study MMS 88-0048; NTIS PB88-249008.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000. Marine seismic surveys a study of environmental implications. *APPEA Journal* 40:692-708.

- McDonald M.A., Hildebrand J.A., Mesnick S. 2009. Worldwide decline in tonal frequencies of blue whale songs. *Endang. Species Res.* 9:13-21.
- Melcon M.L., Cummins A.J., Kerosky S.M., Roche L.K., Wiggins S.M., et al. 2012. Blue whales respond to anthropogenic noise. *PLoS ONE* 7(2):e32681. doi:10.1371/journal.pone.0032681
- Miller, G.W., R.E. Elliott, W.R. Koski, V.D. Moulton and W.J. Richardson. 1999. Whales. p. 5-1 to 5-109 In: W.J. Richardson (ed.), *Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1998*. LGL Rep. TA2230-3. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for Western Geophysical, Houston, TX and U.S. Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 390 pp.
- Miller, G.W., R.E. Elliot, T.A. Thomas, Moulton, V.D. and W.R. Koski. 2002. Distribution and numbers of bowhead whales in the eastern Alaska Beaufort Sea during late summer and autumn, 1979-2000. In: Richardson, W.J. and D.H. Thomson (eds). 2002. *Bowhead whale feeding in the eastern Alaskan Beaufort Sea: update of scientific and traditional information*. OCS Study MMS 2002-012; LGL Rep. TA2196-7. 697 pp. 2 vol.
- Miller, G.W., V.D. Moulton, R.A. Davis, M. Holst, P. Millman, A. MacGillivray and D. Hannay. 2005. Monitoring seismic effects on marine mammals—southeastern Beaufort Sea, 2001-2002. p. 511-542 In: S.L. Armsworthy, P.J. Cranford, and K. Lee (eds.), *Offshore Oil and Gas Environmental Effects Monitoring/Approaches and Technologies*. Battelle Press, Columbus, OH.
- Mocklin, J., George, J., Ferguson, M., Vate Brattström, L., Beaver, V., Rone, B., Christman, C., Brower, A., Shea, B., Accardo, C. 2012. Aerial photography of bowhead whales near Barrow, Alaska, during the 2011 spring migration. Paper presented to the IWC 64 Scientific Committee, Panama City, Panama.
- Moore, S.E. and R.R. Reeves. 1993. Distribution and movement. p. 313-386 In: J.J. Burns, J.J. Montague and C.J. Cowles (eds.), *The Bowhead Whale*. Spec. Publ. 2. Soc. Mar. Mammal., Lawrence, KS. 787 pp.
- Moore, S.E., D.P. DeMaster and P.K. Dayton. 2000b. Cetacean habitat selection in the Alaskan Arctic during summer and autumn. *Arctic* 53(4):432-447.
- Moore, S.E., K.M. Stafford, and L.M. Munger. 2010. Acoustic and visual surveys for bowhead whales in the western Beaufort and far northern Chukchi seas. *Deep-Sea Research II* 57:153-157.
- Moulton, V.D. and J.W. Lawson. 2002. Seals, 2001. p. 3-1 to 3-46 In: W.J. Richardson and J.W. Lawson (eds.), *Marine mammal monitoring of WesternGeco's open-water seismic program in the Alaskan Beaufort Sea, 2001*. LGL Rep. TA2564-4. Rep. from LGL Ltd., King City, Ont., for WesternGeco LLC, Anchorage, AK; BP Explor. (Alaska) Inc., Anchorage, AK; and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 95 pp.
- Moulton, V.D., W.J. Richardson and M.T. Williams. 2003. Ringed seal densities and noise near an icebound artificial island with construction and drilling. *ARLO* 4(4): 112-117.
- National Marine Fisheries Service (NMFS). 2005. Endangered fish and wildlife; Notice of Intent to prepare an Environmental Impact Statement. *Fed. Regist.* 70:1871-1875.

- National Research Council (NRC). 2003. Ocean Noise and Marine Mammals. National Academies Press, Washington, D.C. 192 pp.
- National Research Council (NRC). 2005. Marine Mammal Populations and Ocean Noise. National Academies Press, Washington, D.C. 126 pp.
- O'Corry-Crowe, G.M., R.S. Suydam, A. Rosenberg, K.J. Frost and A.E. Dizon. 1997. Phylogeography, population structure and dispersal patterns of the beluga whale *Delphinapterus leucas* in the western Nearctic revealed by mitochondrial DNA. *Molec. Ecol.* 6(10):955-970.
- Quakenbush, L.T. 1988. Spotted seal, *Phoca largha*. p. 107-124 In: J.W. Lentfer (ed.), Selected Marine Mammals of Alaska/Species Accounts with Research and Management Recommendations. Marine Mammal Comm., Washington, DC. 275 pp.
- Quakenbush, L. 2007. Preliminary satellite telemetry results for Bering-Chukchi-Beaufort bowhead whales. *Int. Whal. Commn SC/59/BRG12*. 2 pp.
- Quakenbush, L., J.J. Citta, J.C. George, R. Small, M.P. Heide-Jorgensen. 2010. Fall and winter movements of bowhead whales (*Balaena mysticetus*) in the Chukchi Sea and within a potential petroleum development area. *Arctic*. 63(3):289-307.
- Reimnitz, E., Barnes, P.W., Toimil, L.J., and Melchoir, J. 1977. Ice gouge recurrence and rates of sediment reworking, Beaufort Sea, Alaska. *Geology* 5:405-408.
- Reiser, C.M, D.W. Funk, R. Rodrigues, and D. Hannay. (eds.) 2011. Marine mammal monitoring and mitigation during marine geophysical surveys by Shell Offshore, Inc. in the Alaskan Chukchi and Beaufort seas, July-October 2010: 90-day report. LGL Rep. P1171E-1. Rep. from LGL Alaska Research Associates Inc., Anchorage, AK, and JASCO Applied Sciences, Victoria, BC for Shell Offshore Inc, Houston, TX, Nat. Mar. Fish. Serv., Silver Spring, MD, and U.S. Fish and Wild. Serv., Anchorage, AK. 240 pp, plus appendices.
- Rice, D. W. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy.
- Richard, P.R., A.R. Martin and J.R. Orr. 2001. Summer and autumn movements of belugas of the eastern Beaufort Sea stock. *Arctic* 54(3):223-236.
- Richardson, W.J., B. Würsig and C.R. Greene. 1986. Reactions of bowhead whales, *Balaena mysticetus*, to seismic exploration in the Canadian Beaufort Sea. *J. Acoust. Soc. Am.* 79(4):1117-1128.
- Richardson, W.J., R.A. Davis, C.R. Evans, D.K. Ljungblad and P. Norton. 1987. Summer distribution of bowhead whales, *Balaena mysticetus*, relative to oil industry activities in the Canadian Beaufort Sea, 1980-84. *Arctic* 40(2):93-104.
- Richardson, W.J., C.R. Greene, Jr., C.I. Malme and D.H. Thomson. 1995. Marine Mammals and Noise. Academic Press, San Diego. 576 pp.

- Richardson, W.J., G.W. Miller and C.R. Greene Jr. 1999. Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. *J. Acoust. Soc. Am.* 106(4, Pt. 2):2281.
- Romano, T., M.J. Keogh, C. Schlundt, J. Finneran, and D.A. Carder. 2001. Approaches in understanding the effects of loud sound on marine mammal health. Abstract. Fourteenth Biennial Conference on the Biology of Marine Mammals. Vancouver, BC.
- Romano, T.A., Keogh, M.J., Kelly, C., Feng, P., Berk, L., Schlundt, C.E., Carder, D.A., and Finneran, J.J. 2004. Anthropogenic sound and marine mammal health: measures of the nervous and immune systems before and after intense sound exposure. *Can. J. Fish. Aquat. Sci.* 61: 1124–1134. doi:10.1139/f04-055.
- Rugh, D.J. and M.A. Fraker. 1981. Gray whale (*Eschrichtius robustus*) sightings in eastern Beaufort Sea. *Arctic* 34(2):186-187.
- Rugh, D.J., K.E.W. Shelden and D.E. Withrow. 1997. Spotted seals, *Phoca largha*, in Alaska. *Mar. Fish. Rev.* 59(1):1-18.
- Rugh, D., D. Demaster, A. Rooney, J. Breiwick, K. Shelden and S. Moore. 2003. Bowhead whale (*Balaena mysticetus*) stock identity. *J. Cet. Res. Manag.* 5(3), 267–280.
- Savarese, D.M., C.M. Reiser, D.S. Ireland, R. Rodrigues. 2010. Beaufort Sea vessel-based monitoring program. (Chapter 6) In: Funk, D.W, D.S. Ireland, R. Rodrigues, and W.R. Koski (eds.). 2010. Joint Monitoring Program in the Chukchi and Beaufort seas, open water seasons, 2006–2008. LGL Alaska Report P1050-2, Report from LGL Alaska Research Associates, Inc., LGL Ltd., Greeneridge Sciences, Inc., and JASCO Research, Ltd., for Shell Offshore, Inc. and Other Industry Contributors, and National Marine Fisheries Service, U.S. Fish and Wildlife Service. 506 pp. plus Appendices.
- Schusterman, R. J. 1981. Behavioral capabilities of seals and sea lions: A review of their hearing, visual, learning, and diving skills. *Psychol. Rec.* 31:125–143.
- Shell Offshore, Inc. 2011. Application for Incidental Harassment Authorization for the Non-Lethal Taking of Whales and Seals in Conjunction with Planned Exploration Drilling Program During 2012 Near Camden Bay in the Beaufort Sea, Alaska.
- Smith, T.G. 1987. The ringed seal, *Phoca hispida*, of the Canadian Western Arctic. *Can. Bull. Fish. Aquat. Sci.* 216: 81 pp.
- Smith, M.A. 2010. Arctic Marine Synthesis: Atlas of the Chukchi and Beaufort Seas. Audubon Alaska and Oceana: Anchorage; Habitat Management Guide, Alaska Department of Fish & Game.
- Stirling, I., M. Kingsley, and W. Calvert. 1982. The Distribution and Abundance of Seals in the Eastern Beaufort Sea, 1974-79. *Can. Wildl. Serv. Occas. Pap.* 47. 25 pp.
- Stone, C.J. 2003. The effects of seismic activity on marine mammals in UK waters, 1998-2000. Joint Nature Conservation Committee Report No. 323.

- Suydam, R.S., L.F. Lowry, and K.J. Frost. 2005. Distribution and movements of beluga whales from the eastern Chukchi Sea stock during summer and early autumn. OCS Study MMS 2005-035, Final Report. 48 pp.
- Thomas, J. A., R.A. Kastelein, and F.T. Awbrey. 1990. Behavior and blood catecholamines of captive belugas during playbacks of noise from an oil drilling platform. *Zoo Biology* 9(5):393-402.
- Thomas, A.T., W.R. Koski and W.J. Richardson. 2002. Correction factors to calculate bowhead whale numbers from aerial surveys of the Beaufort Sea. In: Richardson, W.J. and D.H. Thomson (eds). 2002. Bowhead whale feeding in the eastern Alaskan Beaufort Sea: update of scientific and traditional information. OCS Study MMS 2002-012; LGL Rep. TA2196-7. 697 pp. 2 vol.
- Thompson, D., M. Sjöberg, E.B. Bryant, P. Lovell and A. Bjørge. 1998. Behavioural and physiological responses of harbour (*Phoca vitulina*) and grey (*Halichoerus grypus*) seals to seismic surveys. Abstr. World Mar. Mamm. Sci. Conf., Monaco.
- Todd, S., Stevick, P., Lien, J., Marques, F. and Ketten, D. 1996. Behavioural effects of exposure to underwater explosions in humpback whales (*Megaptera novaeangliae*). *Can. J. Zool.* 74:1661–1672.
- Treacy, S.D. 2000. Aerial surveys of endangered whales in the Beaufort Sea, fall 1998-1999. OCS Study MMS 2000-066. U.S. Minerals Manage. Serv., Anchorage, AK. 135 pp.
- Treacy, S.D. 2002a. Aerial surveys of endangered whales in the Beaufort Sea, fall 2000. OCS Study MMS 2002-014. U.S. Minerals Manage. Serv., Anchorage, AK. 111 pp.
- Treacy, S.D. 2002b. Aerial surveys of endangered whales in the Beaufort Sea, fall 2001. OCS Study MMS 2002-061. U.S. Minerals Manage. Serv., Anchorage, AK. 117 pp.
- Wartzok, D. and D.R. Ketten. 1999. Marine mammal sensory systems. Pages 117-148 in J.E. Reynolds III and S.A. Rommel (eds), *Biology of Marine Mammals*. Washington D.C.: Smithsonian Institution Press.
- Watkins, W.A. 1986. Whale reactions to human activities in Cape Cod waters. *Marine Mammal Science* 2.4:251-262.
- Weilgart, L.S. 2007. The impacts of anthropogenic ocean noise on cetaceans and implications for management. *Canadian Journal of Zoology* 85:1091–1116.
- Williams, M.T. and J.A. Coltrane (eds.). 2002. Marine mammal and acoustical monitoring of the Alaska Gas Producers Pipeline Team's open water pipeline route survey and shallow hazards program in the Alaskan Beaufort Sea, 2001. LGL Rep. P643. Rep. from LGL Alaska Res. Assoc. Inc., Anchorage, AK, for BP Explor. (Alaska) Inc., ExxonMobil Production, Phillips Alaska Inc., and Nat. Mar. Fish. Serv. 103 pp.
- Woodby, D.A. and D.B. Botkin. 1993. Stock sizes prior to commercial whaling. p. 387-407 In: J.J. Burns, J.J. Montague and C.J. Cowles (eds.), *The Bowhead Whale*. Spec. Publ. 2. Soc. Mar. Mamm., Lawrence, KS. 787 pp.

Appendix A

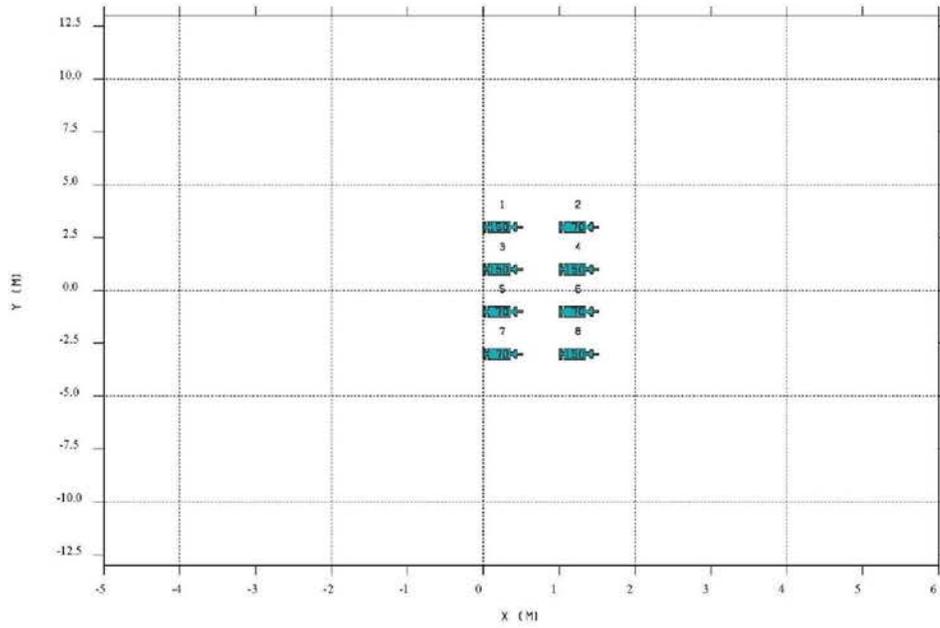
The 1,760 and 880 cui Array Configurations, Far-field Signatures, and Directivity Plots

Note on Directivity Plots: The manufacturer-provided directivity plots below illustrate how the airgun acoustical energy, measured in decibels, is focused downward to maximum the reflective return of the acoustical signal. Between 0 and 150 Hertz, there is little immediate loss in energy within a 120 degree arc centered straight down. However, for regions of the water column nearest the surface, the received energy relative to source is 30 to 60 decibels less. These plots do not provide a measure of how energy dissipates over time and distance, but rather illustrates that the airgun energy is not omni-directional, but rather focused vertically. Received sound levels horizontal of the source are much less than levels vertical of (immediately below) the source.

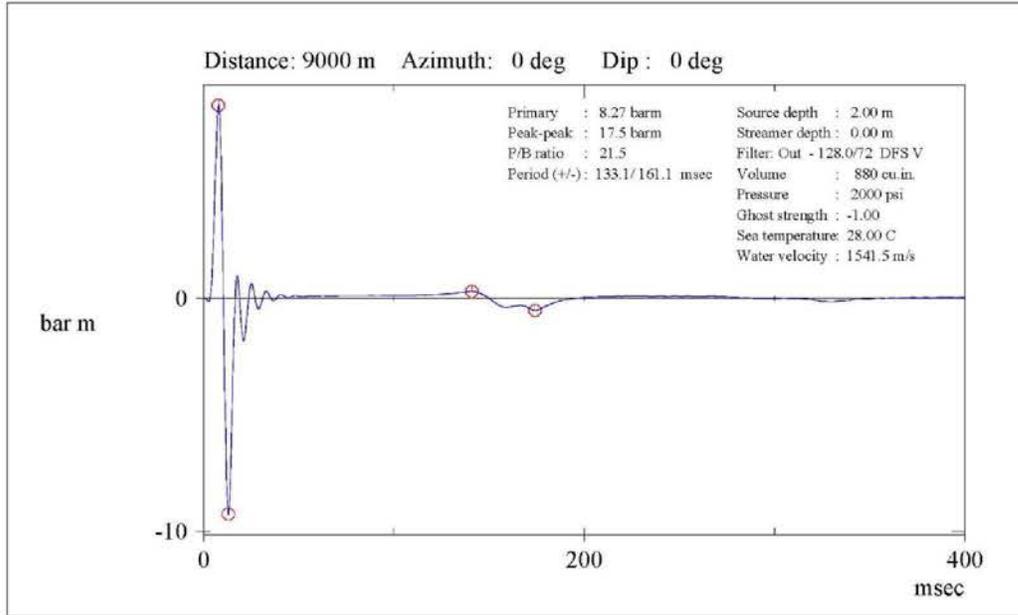
Array : SeaScan_USW_4x220_2m

Total volume : 880.0 cubic inch

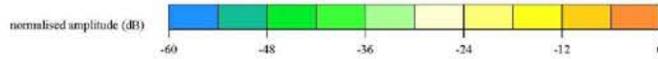
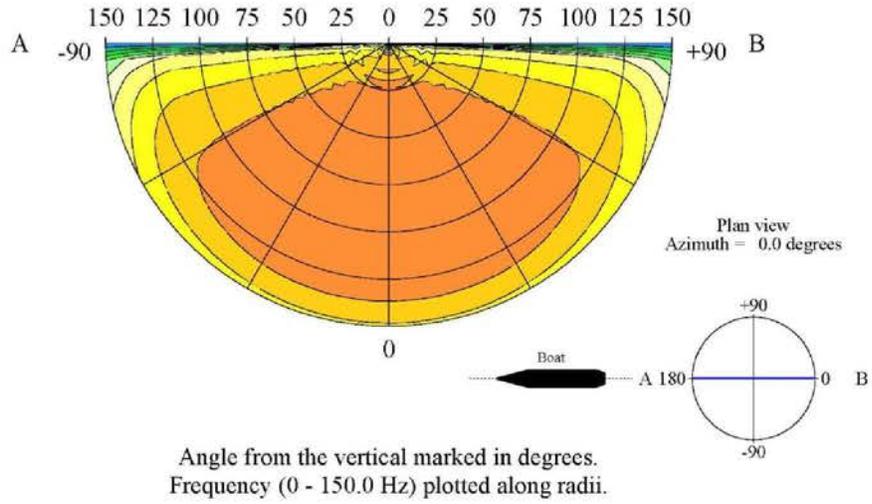
- Inactive guns
- Single guns
- Cluster guns



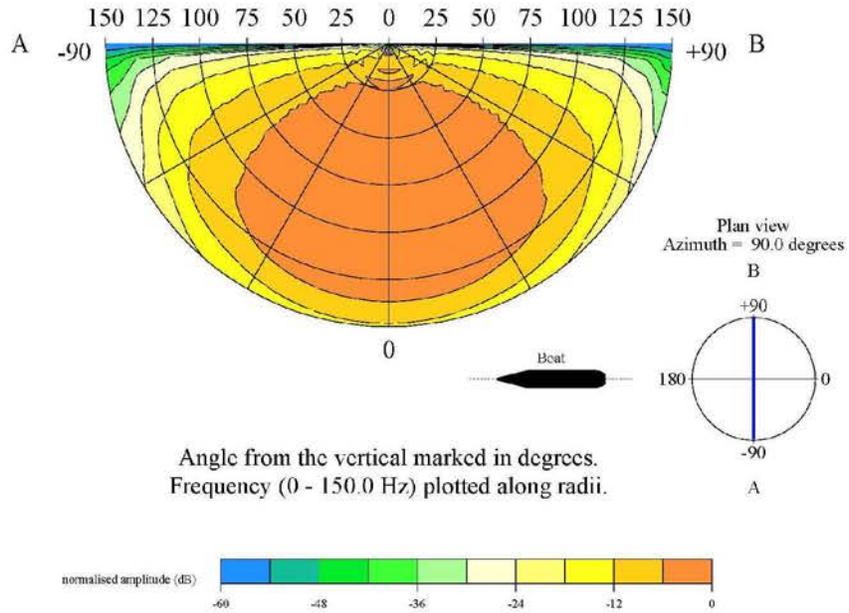
Farfield signature : SeaScan_USW_4x220_2m

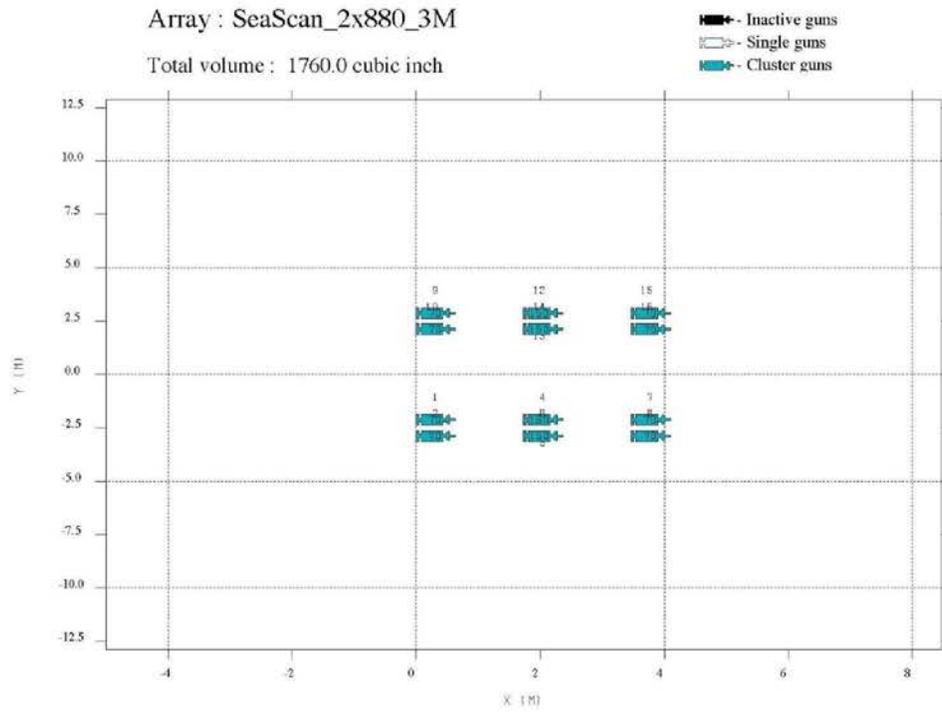


Source Directivity Plot - azimuth : 0.0 degrees - array SeaScan_USW_4x220_2m

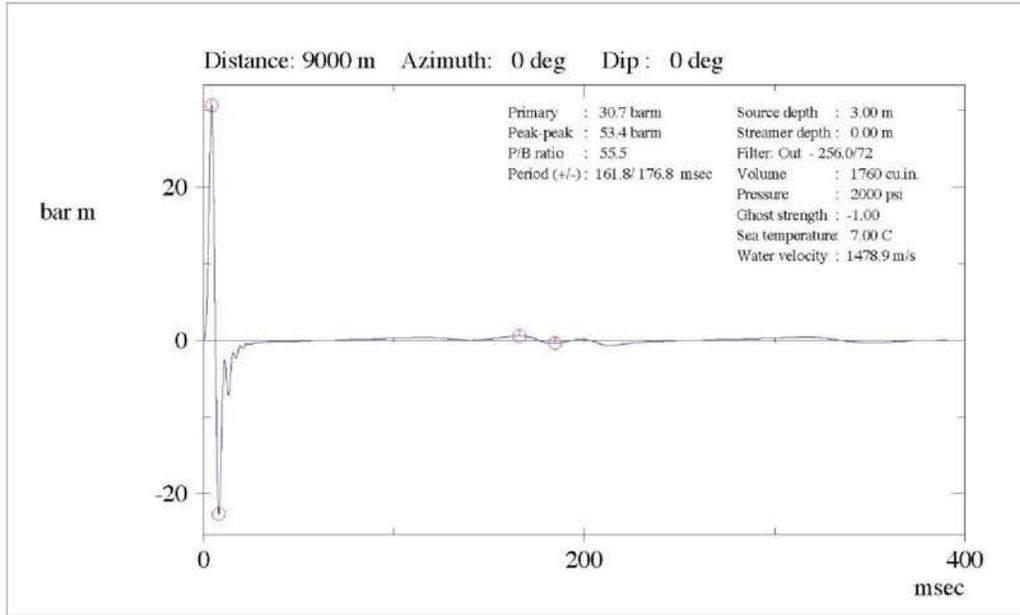


Source Directivity Plot - azimuth : 90.0 degrees - array SeaScan_USW_4x220_2m



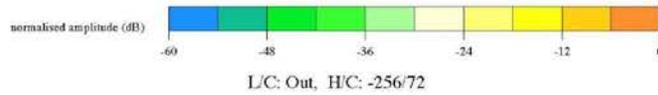
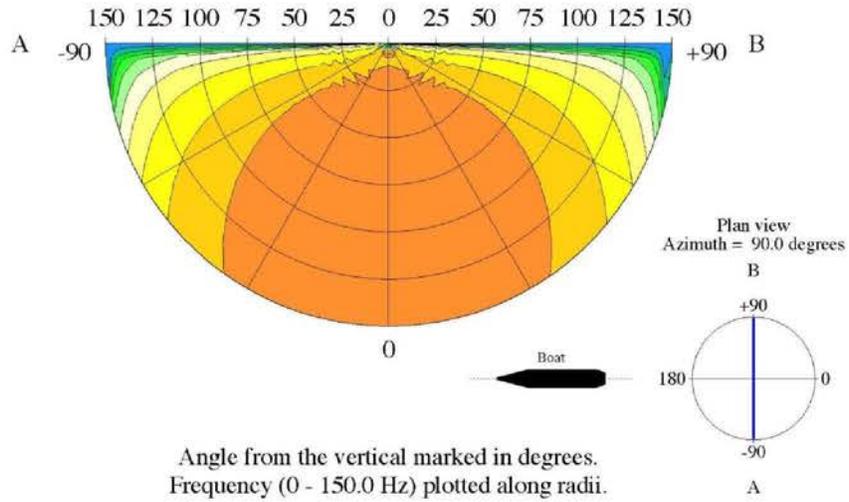


Farfield signature : SeaScan_2x880_3M

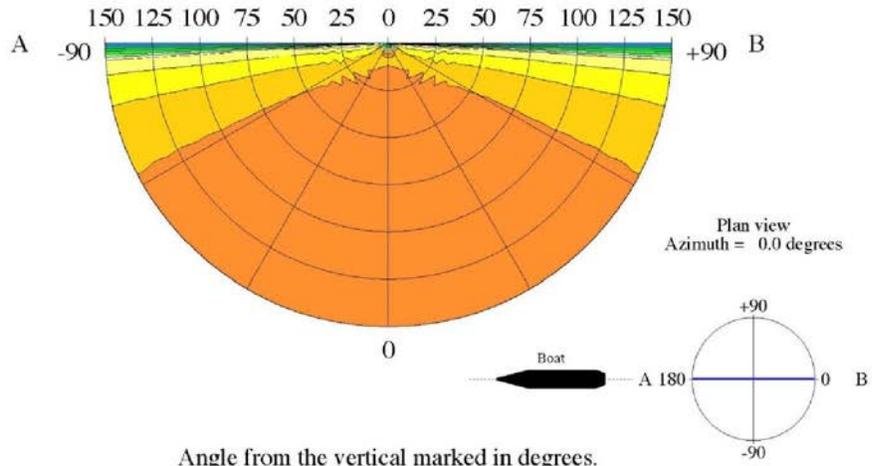


L/C: Out, H/C: -256/72

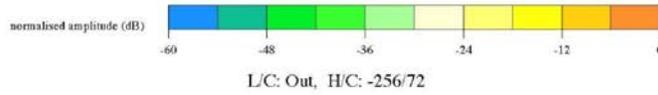
Source Directivity Plot - azimuth : 90.0 degrees - array SeaScan_2x880_3M



Source Directivity Plot - azimuth : 0.0 degrees - array SeaScan_2x880_3M



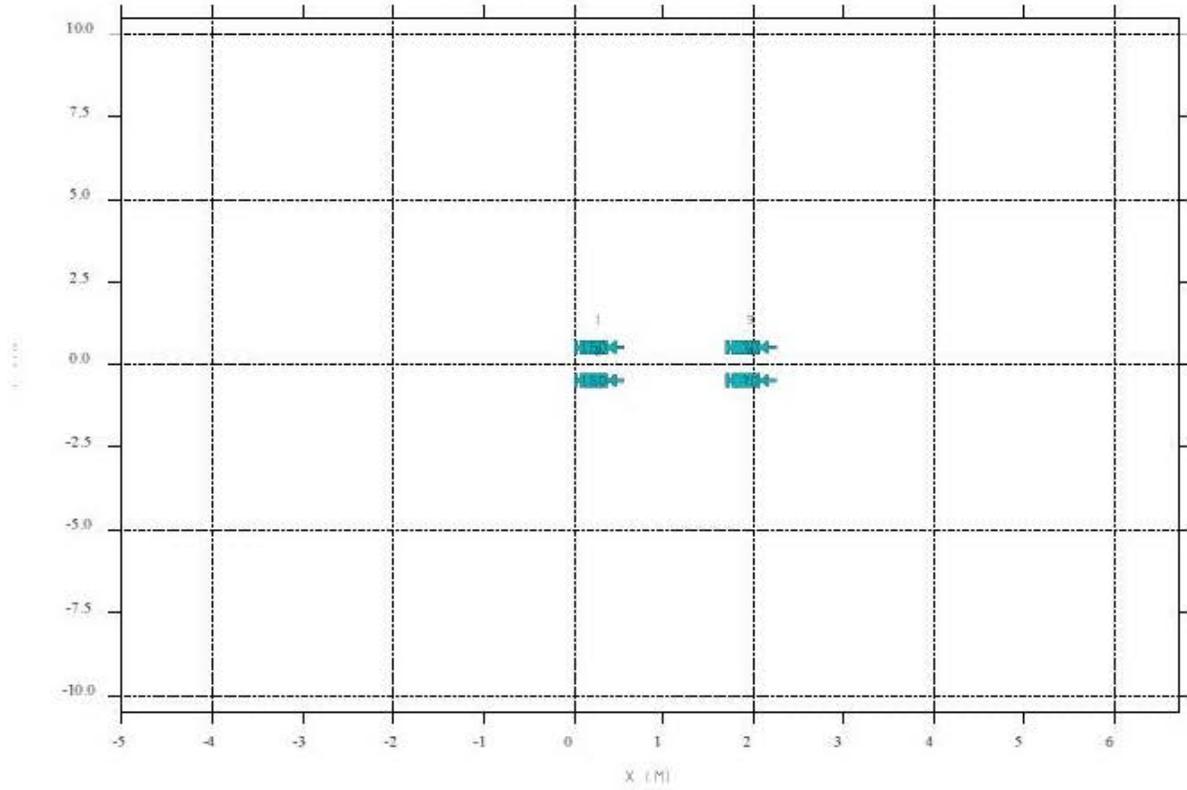
Angle from the vertical marked in degrees.
Frequency (0 - 150.0 Hz) plotted along radii.



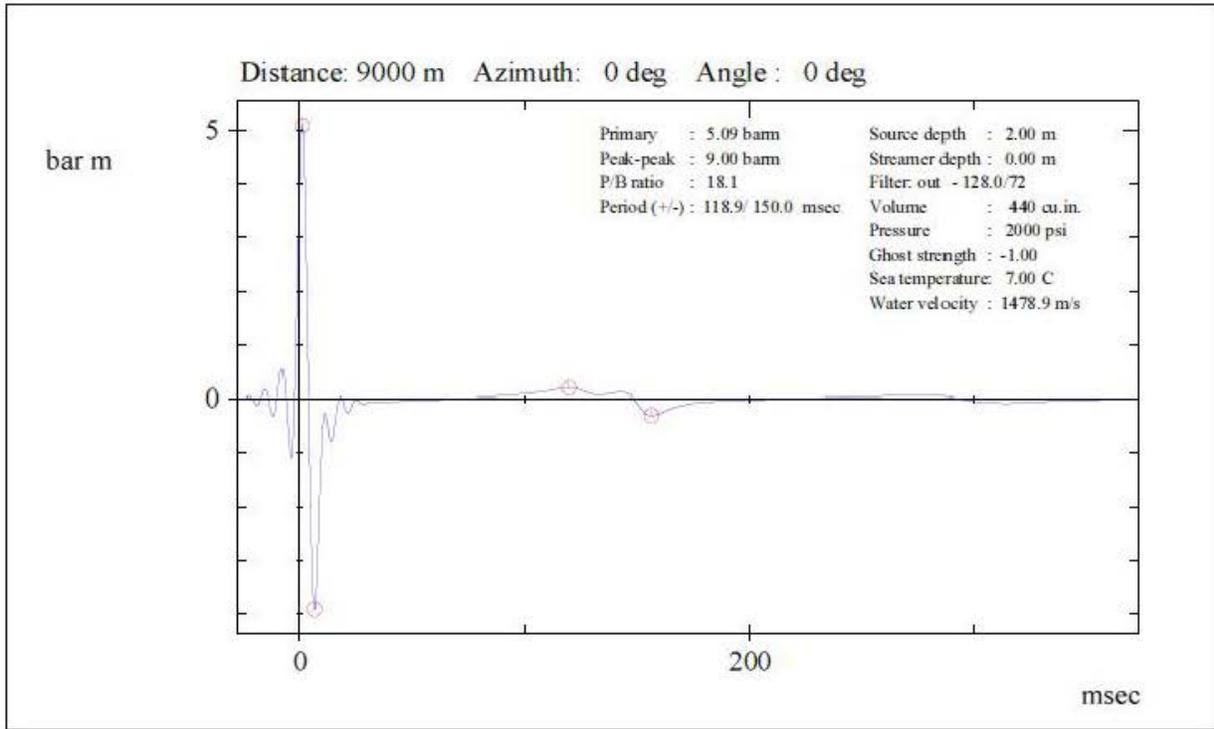
Array : SeaScan_USW_440_2m

Total volume : 440.0 cubic inch

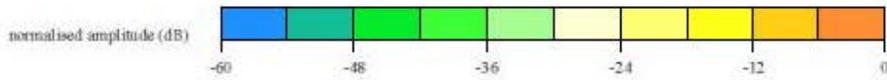
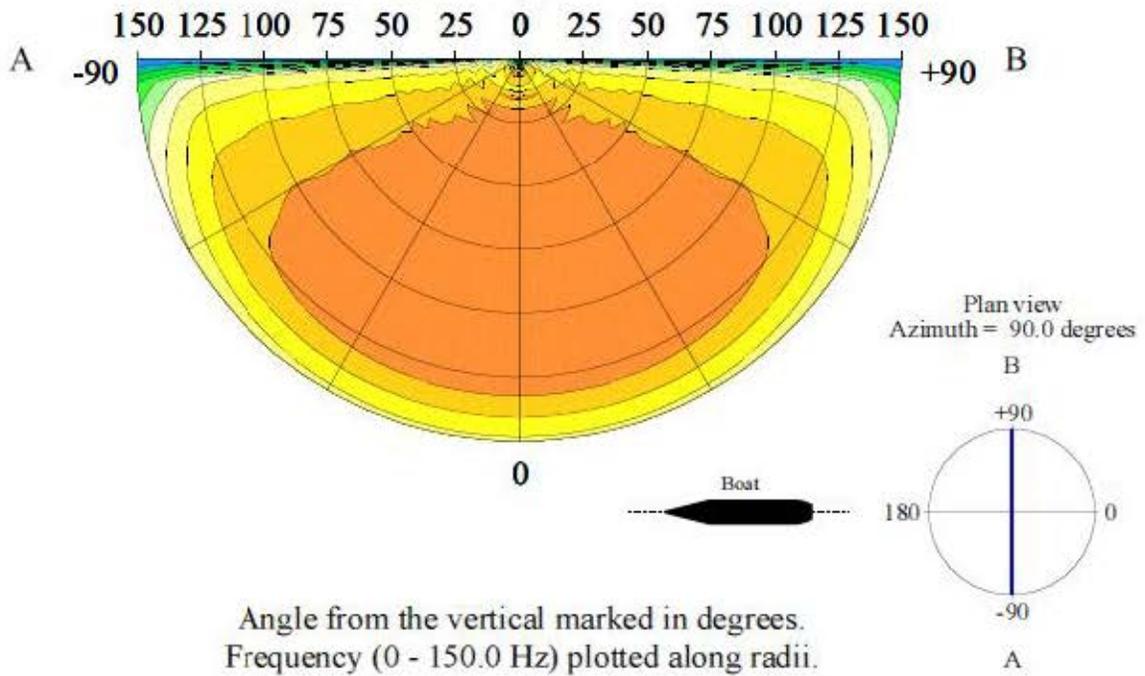
- - Inactive guns
- - Single guns
- - Cluster guns



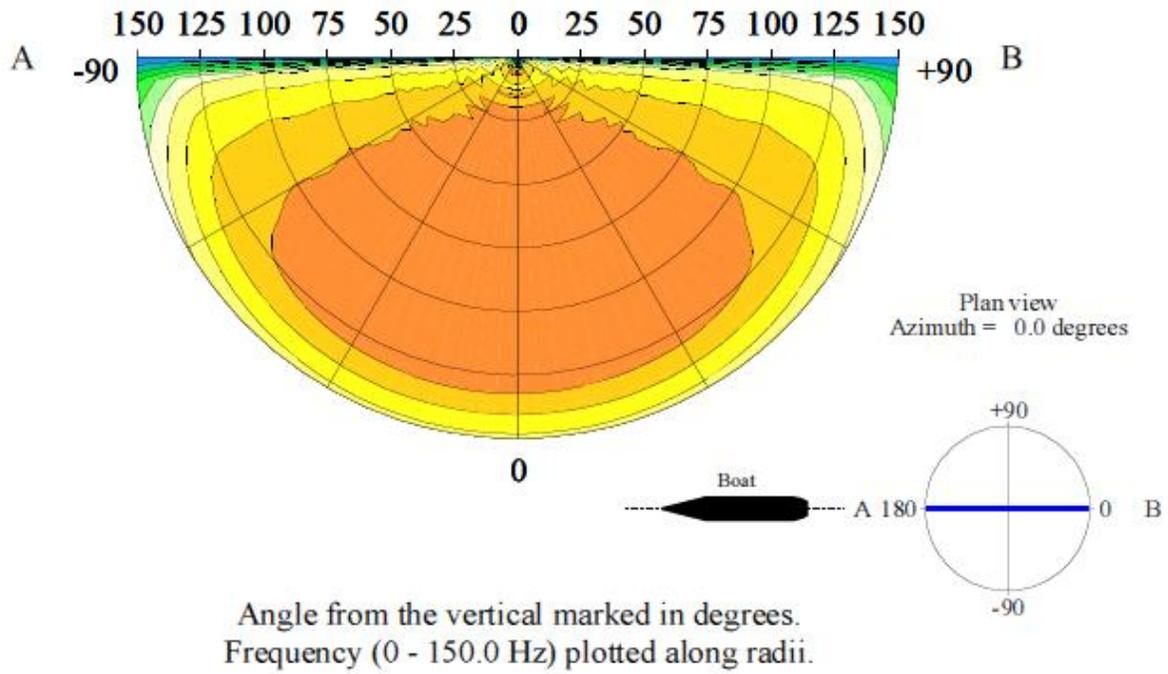
Far-field signature of array : SeaScan_USW_440_2m



Source Directivity Plot - azimuth : 90.0 degrees - array SeaScan_USW_440_2m



Source Directivity Plot - azimuth : 0.0 degrees - array SeaScan_USW_440_2m



Appendix B

Marine Mammal Monitoring and Mitigation Plan

Marine Mammal and Monitoring Mitigation Plan

SAExploration Colville 3D Seismic Survey Operations - 2014

Introduction

SAExploration (SAE) proposed marine mammal monitoring and mitigation plan for the proposed Colville (Beaufort Sea) seismic exploration program is described below. SAE understands that this monitoring and mitigation plan will be subject to review by NMFS, the North Slope Borough, and the Alaska Eskimo Whaling Commission, and others, and that refinements may be required. In order to avoid any takes by injury (Level A), SAE will employ NMFS approved Protected Species Observers (PSOs) to monitor and implement mitigation measures. PSOs will monitor both from the seismic vessels and from a dedicated mitigation vessel to provide both early warning of approaching migrating whales and to assist in monitoring the 160 dB harassment zone..

Proposed Safety and Harassment Monitoring Radii

PSOs will establish and monitor a safety zone for cetaceans and pinnipeds surrounding the airgun array on the source vessel where the received level would be 180 dB and 190 dB. PSOs will establish and monitor a harassment zone for bowhead and gray whales surrounding the airgun array on the source vessel where the received level would be 160 dB. Whenever aggregations of bowhead whales or gray whales that appear to be engaged in non-migratory significant biological behavior (e.g. feeding, socializing) are observed during a vessel monitoring program within the 160-dB harassment zone around the seismic activity, the seismic operation will not commence or will shut down.

Preliminary monitoring zones for the 190, 180, and 160 dB with the various airgun configurations were estimated. These estimates are provided in Table 1. SAE proposes to monitor these zones for marine mammals before, during, and after the operation of the airguns. Monitoring will be conducted using qualified PSOs on vessels. All the preliminary monitoring zones will be adjusted as needed based on the results of the sound source verification test (see below).

Table 1. Summary of Distance to NMFS Sound Level Thresholds

Source	Source Level	190 dB	180 dB	160 dB
440 cubic inch airgun array	221.08 dB re 1 μ Pa (rms)	126 m	325 m	1.33 km
880 cubic inch airgun array	226.86 dB re 1 μ Pa (rms)	167 m	494 m	1.5 km
1,760 cubic inch airgun array	236.55 dB re 1 μ Pa (rms)	321 m	842 m	2.99 km

Sound Source Verification

Sound source verification (SSV) testing of the air gun arrays is planned to be conducted for this project as soon as the first seismic surveys commence. (No SSV testing is planned for the vessels as the same vessels planned for this operation were previously tested in association with the BP Liberty project [Aerts et al. 2008]). The SSV will be conducted by an acoustical firm with prior experience conducting SSV tests in Alaska. The methodology to be used will be provided to NMFS prior to testing to ensure the results meet the agency's expectations. The results of the test will be used to establish and monitor new 180-dB and 190-dB marine mammal safety zones, and the 160-dB harassment zone. Results of the SSV will be available and implemented within 72 hours of the completion of the test.

Visual Vessel-Based Monitoring

The vessel-based monitoring will be designed to cover the requirements of the Incidental Harassment Authorization for this project. The objectives of the vessel-based monitoring will be to:

- ensure that disturbance to marine mammals is minimized and all permit stipulations are followed;
- document the effects of the proposed seismic activities on marine mammals; and
- collect data on the occurrence and distribution of marine mammals in the proposed project area.

The monitoring and mitigation plan will be implemented by a team of experienced PSOs, including both biologists and Inupiat communicators. PSOs will be stationed aboard source and mitigation vessels to monitor and implement mitigation measures during all daytime seismic operations. A lead PSO will be designated on the source and mitigation vessel for effective communication and to oversee the monitoring and mitigation program. With NMFS consultation, PSOs will be hired by SAE. PSOs will follow a schedule so observers will monitor marine mammals near the seismic vessel during all ongoing operations and air-gun ramp ups. PSOs will normally be on duty in shifts no longer than 4 hours and no more than a total of 12 hours per day.

Source vessels will employ PSOs to identify marine mammals during all hours of air gun operations. Two PSOs will be on the source vessels and three PSOs on the support vessel in order to better observe the exclusion zone. As in the past, the mitigation vessel will be positioned north and east of the source vessels, or essentially upstream of the bowhead and beluga migration route. When marine mammals are about to enter or are sighted within designated exclusion zones, air gun operations will be shut down immediately. The vessel-based observers will watch for marine mammals at the seismic operation during all periods of source effort and for a minimum of 30 minutes prior to the planned start of air gun or pinger operations after an extended shut down. SAE vessel crew and operations personnel will also watch for marine mammals (insofar as practical) to assist and alert the observers for the air gun(s) to be shut down if marine mammals are observed in or about to enter the exclusion zone. Seismic operations will not be initiated or continue when adequate observation of the designated applicable exclusion zone is not possible due to environmental conditions such as high sea state, fog, ice and low light. Termination of seismic operations will be at the discretion of the lead PSO based on continual observation of environmental conditions and communication with other PSOs.

The source and support vessels are suitable platform for marine mammal observations. When stationed on the flying bridge, the observer will have an unobstructed view around the entire vessel. If surveying from the bridge, the observer's eye level will be about 6 meters (20 feet) above sea level. During operations, the PSO(s) will scan the area around the vessel systematically with reticle binoculars (e.g., 7×50 and 16-40x80) and with the naked eye. Laser range finders (Leica LRF 1200 laser rangefinder or equivalent) will be available to assist with distance estimation. Range finders will be used for training observers to estimate distances visually, but are generally not useful in measuring distances to animals directly.

All observations and air gun shut downs will be recorded in a standardized format. Data will be entered into a custom database using a notebook computer. The accuracy of the data entry will be verified daily by the lead PSOs by a manual checking of the database. These 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 statistical, graphical, or other programs for further processing and archiving.

The vessel-based observation will provide:

- the basis for real-time mitigation, if necessary, as required by the IHA;
- information needed to estimate the number of “Level B takes” of marine mammals by harassment, which must be reported to NMFS;
- data on the occurrence, distribution, and activities of marine mammals in the areas where the seismic operations are conducted;
- information to compare the distances, distributions, behavior, and movements of marine mammals relative to the source vessels at times with and without seismic activity;
- a communication channel to coastal communities including Inupiat whalers; and
- employment opportunities for local residents and development/experience for Inupiat Communicators and PSOs.

Mitigation Measures

Shut-Down Procedure

A shut-down occurs when all air gun activity is suspended. The operating air gun(s) will be shut down completely if a marine mammal approaches the applicable exclusion zone. The shutdown procedure will be accomplished within several seconds (of a “one shot” period) of the determination that a marine mammal is either in or about to enter the applicable exclusion zone.

The operations will not proceed with air gun activity until the marine mammal has cleared the zone and the trained PSOs on duty are confident that no marine mammals remain within the appropriate exclusion zone. The animal will be considered to have cleared the exclusion zone if it:

- Is visually observed to have left the applicable exclusion zone;
- Has not been seen within the zone for 15 min in the case of pinnipeds;
- Has not been seen within the zone for 30 min in the case of cetaceans.

Power Down Procedure

Whenever a marine mammal is detected outside the exclusion zone radius and based on its position and motion relative to the ship track is likely to enter the exclusion zone, PSOs may request that the seismic

operations implement a power down (de-energize the air gun array). A power down procedure involves reducing the number of air guns in use such that the radius of the 180 dB (or 190 dB) zone is decreased to the extent that marine mammals are not in the exclusion zone. Alternatively, a shutdown procedure occurs when all air gun activity is suspended. During a power down, a mitigation air gun (air gun of small volume such as the 10 cu in) is operated. If a marine mammal is detected outside the safety radius (either injury or harassment) but is likely to enter that zone, the air guns may be powered down before the animal is within the safety radius, as an alternative to a complete shutdown.

Similar to a shutdown, after a power down, air gun activity will not resume until the marine mammal has cleared the applicable exclusion zone. The animal will be considered to have cleared the applicable exclusion zone if it:

- is visually observed to have left the applicable exclusion zone, or
- has not been seen within the zone for 15 min in the case of pinnipeds, or
- has not been seen within the zone for 30 min in the case of cetaceans.

Ramp Up Procedure

A “ramp up” procedure gradually increases air gun volume at a specified rate and involves a step increase in the number and total volume of airguns until the full volume is achieved. The purpose of the ramp up or “soft start” is to warn marine mammals potentially in the area and provide sufficient time for them to leave the project area and avoid any potential injury. Ramp up is used at the start of air gun operations, including a power down, shut down, and after any period greater than 10 minutes in duration without air gun operations. The air gun array begins operating after a specified-duration period without air gun operations. The rate of ramp up will be no more than 6 dB per 5 minute period. Ramp up will begin with the smallest gun in the array that is being used for all air gun array configurations. During the ramp up, the applicable exclusion zone for the full air gun array will be maintained.

If the complete applicable exclusion zone has not been visible for at least 30 minutes prior to the start of operations, ramp up will not start unless the mitigation gun has been operating during the interruption of seismic survey operations. This means that it will not be permissible to ramp up the full source from a complete shut-down in thick fog or at other times when the outer part of the applicable exclusion zones are not visible.

It will not be permissible to commence ramp-up if the complete safety radii are not visible for at least 30 minutes prior to ramp-up in either daylight or nighttime and not commence ramp-up at night unless the seismic source has maintained a sound source pressure level at the source of at least 180 dB during the interruption of seismic survey operations.

Speed or Course Alteration

Whenever a marine mammal is detected outside the exclusion zone radius and based on its position and motion relative to the ship track is likely to enter the exclusion zone, PSOs may request that the seismic operations implement an alternative ship speed or track. If a marine mammal is detected outside the safety radius and, based on its position and the relative motion, is likely to enter the safety radius, the vessel's speed and/or direct course may, when practical and safe, be changed that also minimizes the effect on the seismic operations. This can be used in coordination with a power down procedure. The marine mammal

activities and movements relative to the seismic and support vessels will be closely monitored to ensure that the marine mammal does not approach within the applicable exclusion zone. If the mammal appears likely to enter the exclusion zone, further mitigation actions will be taken; for example, either further course alterations, power down, or shut down of the air gun(s).

As an additional mitigation procedure, with or without seismic operations taking place, SAE proposes to reduce vessel speed when within 1 kilometer of whales and those vessels capable of steering around such groups will do so. Vessels may not be operated in such a way as to separate members of a group of whales from other members of the group. Vessel captains will avoid multiple changes in direction and speed when within 1 kilometer of whales.

Protected Species Observers

Vessel-based monitoring for marine mammals will be done by trained PSOs throughout the period of seismic operations to comply with expected provisions in the IHA and CAA. The observers will monitor the occurrence and behavior of marine mammals near the source and mitigation vessels during all daylight periods during operation, and during most daylight periods when seismic operations are not occurring. PSO duties will include watching for and identifying marine mammals; recording their numbers, distances, and reactions to the seismic acquisition operations; and documenting exposures of animals to sound levels that may constitute harassment as defined by NMFS.

Protected Species Observers

PSO teams will consist of Inupiat observers and experienced field biologists. An experienced field crew leader and an Inupiat observer will be members of every PSO team onboard the source and mitigation vessel during the seismic acquisition program. Inupiat PSOs will also function as Native language communicators with hunters and whaling crews and with the Communications and Call Centers (Com Centers) in Native villages along the Beaufort Sea coast.

A sufficient number of PSOs will be required onboard each seismic vessel and the mitigation vessel to meet the following criteria:

- 100 percent monitoring coverage during all periods of seismic operations in daylight;
- maximum of 4 consecutive hours on watch per PSO; and
- maximum of ~12 hours of watch time per day per PSO.

PSO Role and Responsibilities

When onboard the seismic and support vessels, there are three major parts to the PSO position:

- 1) Observe and record sensitive wildlife species.
- 2) Ensure mitigation procedures are followed accordingly.
- 3) Follow monitoring and data collection procedures.

The main roles of the PSO and the monitoring program are to ensure compliance with regulations set in place by NMFS and other agencies to ensure that disturbance of marine mammals is minimized, and potential effects on marine mammals are documented. The PSOs will implement the monitoring and

mitigation measures specified in the NMFS issued IHA and in this 4MP. The primary purposes of the PSOs on board of the vessels are:

- Mitigation: Implement mitigation clearing and ramp up measures, observe for and detect marine mammals within, or about to enter the applicable safety radii and implement necessary shut down, power down and speed/course alteration mitigation procedures when applicable. Advise marine crew of mitigation procedures.
- Monitoring: Observe for marine mammals and determine numbers of marine mammals exposed to sound pulses and their reactions (where applicable) and document those as required.

The PSOs will observe for marine mammals, stationed at the best available vantage point on the source and support vessels. Ideally this vantage point is an elevated stable platform such as the bridge or flying bridge from which the PSO has an unobstructed 360 degree view of the water. The observer(s) will scan systematically with the unaided eye and 7x50 reticle binoculars, supplemented with 16-40x80 long-range binoculars and night-vision equipment when needed. New or inexperienced PSOs will be paired with an experienced PSO or experienced field biologist so that the quality of marine mammal observations and data recording is kept consistent.

The following information about marine mammal sightings will be carefully and accurately recorded:

- species, group size, age/size/sex categories (if determinable);
- physical description of features that were observed or determined not to be present in the case of unknown or unidentified animals;
- behavior when first sighted and after initial sighting, heading (if consistent);
- bearing and distance from observer, apparent reaction to activities (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and behavioral pace;
- time, location, speed, and activity of the source and mitigation vessels, sea state, ice cover, visibility, and sun glare; and positions of other vessel(s) in the vicinity.

Passive Acoustical Monitoring

Prior to commencing with seismic survey program, SAE will contract a hydroacoustic firm to conduct passive acoustical monitoring (PAM). The exact methodology will depend on the firm selected, and the coordination that can be established with existing acoustical monitoring program in the vicinity. The purpose of the PAM will to be to record seismic noise levels and marine mammal vocalizations before, during, and after the seismic survey, and will involve strategically placing bottom-anchored receivers near the survey area.

Measures to Reduce Impacts to Subsistence Users

In-water seismic activities will follow mitigation procedures to minimize effects on the behavior of marine mammals and; therefore, opportunities for subsistence harvest by Alaska Native communities. These include:

- Inupiat Communicators and Inupiat PSOs will record marine mammal observations along with marine mammal biologists during the monitoring program and be provided annual reports.

- Fully implement the measures consistent with the CAA.
- Participate with other operators in the Communications Call Centers (Com-Center) Program. The Com-Centers will be operated 24 hours/day during the 2013 subsistence bowhead whale hunt. SAE proposes to routinely call the communications center according to the established protocol while in the Beaufort Sea.

Reporting

A final report will be submitted to NMFS within 90 days after the end of the project. The report will describe the operations that were conducted and the marine mammals that were observed. The report will include documentation of methods, results, and interpretation pertaining to all monitoring. The 90-day report will summarize the dates and locations of seismic operations, and all marine mammal sightings (dates, times, locations, activities, associated seismic survey activities, marine mammal behavior and any observed behavioral changes).

Appendix C

Plan of Cooperation

Plan of Cooperation Colville River Delta 3D Seismic Exploration

SAExploration, Inc., Anchorage, Alaska
February 2014



1.0 INTRODUCTION

SAExploration, Inc. (SAE) along with its joint venture partner, the Kuukpik Corporation, will communicate with village groups and work in cooperation concerning areas where subsistence stakeholders are present.

This Plan of Cooperation (POC) will be used by SAE to avoid and or minimize conflicts with subsistence activities by open communications and interaction with the members of affected communities. SAE believes that the understanding of issues important to the communities in which we operate are vital to solid community relations. SAExploration will do its best to accommodate the different cultures, lifestyles, heritage and preferences in these communities.

This plan contains three stages:

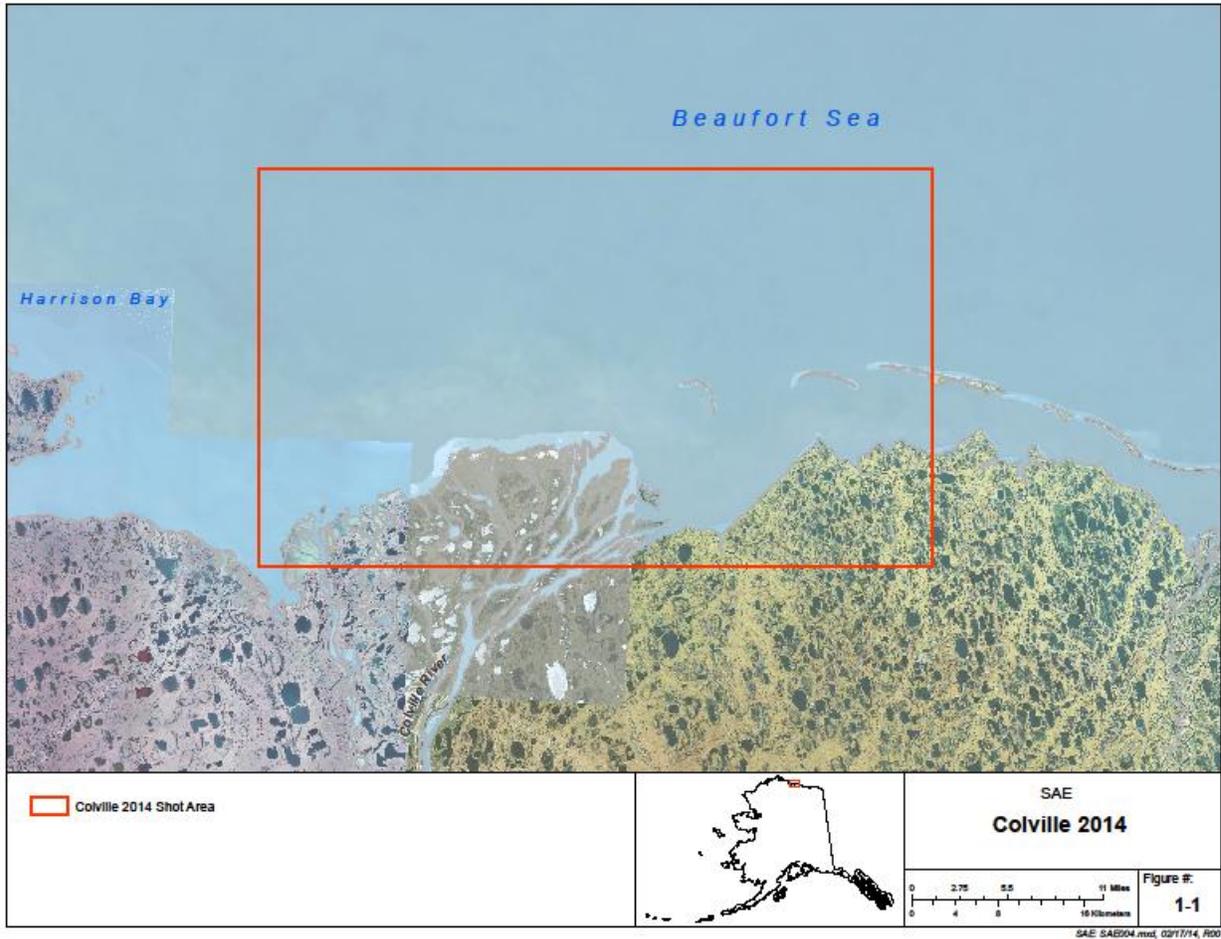
- Stage one describes initial steps to establish communication and understand subsistence timing prior to the program.
- Stage two describes how communication will happen during the program. This communication will keep SAE up to date regarding the timing and status of subsistence hunts and our liaison with the communities.
- Stage three describes what to do in the event that activities may affect subsistence activities and how to communicate with subsistence user groups.

2.0 PROJECT DESCRIPTION

The purpose of the proposed survey is to replace and augment existing datasets by providing better quality, higher resolution seismic data by using autonomous nodal seismic recording equipment.

The project is to conduct a three dimensional (3D) ocean bottom seismic survey in the Colville River Delta area of the Alaskan Beaufort Sea during the 2014 Beaufort Sea open water season. The program will be conducted over a period of approximately 60 days within the time period of July 1 to October 15, 2014. This time period includes all activities; mobilization, land and marine layout activities, marine data acquisition and demobilization of equipment and crews. Project operations will include state and federal shallow waters and the land transition zone (TZ).

2.1 Area of Activity



3.0 REGULATORY REQUIREMENTS

SAE and its contractors shall comply with all applicable federal, state and local government requirements, including U.S. Coast Guard (USCG) requirements for safety, navigation and notice. Including, “where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, the applicant must submit either a plan of cooperation or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses.” [50 CFR

216.104 (12)] SAE will also comply and sign the Conflict Avoidance Agreement (CAA) established in cooperation between industry and the Alaska Eskimo Whaling Commission (AEWC).

4.0 COMMUNICATION SYSTEM (COM CENTER)

As part of the 2013 CAA between Industry Participants, the Alaska Eskimo Whaling Commission and Village Whaling Captains' Associations, the Com Centers will facilitate communication between open-water subsistence hunters and industry vessels to minimize and avoid conflicts between subsistence hunters and industry activities.

As part of the 2013 CAA, SAE will participate as a participant to fund and to support the Beaufort Sea Com Center located in Deadhorse and the Call Center located in Kaktovik.

The Com Center (Deadhorse) will be capable of recording all communications for both Deadhorse and the Kaktovik Call Center and, as such, will remain open throughout both the Nuiqsut and Kaktovik whale hunts. Additionally, and in accordance with the 2013 CAA, telecommunications support will be provided to the Nuiqsut Cross Island whaling crews for the fall 2014 subsistence bowhead whale hunt. The Com and Call Center operators will track the locations and progress of industry activities, whalers, and other subsistence hunters as reported to them and relay information to avoid conflicts among these groups.

5.0 PLAN

5.1 Stage One

To open communications SAE attended and presented the program description to the Alaska Eskimo Whaling Commission (AEWC) during their mini-convention in December, 2013, in Anchorage. SAE also be presenting the project at the open water meeting in March 2014 at the Egan Center in Anchorage. Collaboration meetings will be held in March and April 2014 with Kuukpik Corporation leaders. Kuukpik Corporation is our joint venture partners in the project and on the North Slope of Alaska. Permits to all federal, state and local government agencies will be submitted in the spring of 2014. Ongoing discussions and meeting with these agencies have been occurring in order to meet our operational window in the project area.

Prior to offshore activities, SAE will meet and consult with nearby communities, namely the NSB planning department and the Fish and Wildlife division. SAE will also present our project during a community meeting in the villages of Nuiqsut, and Kaktovik to discuss the planned activities. The discussions will include our project description, the Plan of Cooperation, resolution of potential conflicts, and proposed operational window. These meetings will help to identify any subsistence conflicts. These meetings will allow SAE to understand community concerns, and requests for communication or mitigation. Additional communications will continue throughout the project.

Rick Trupp, General Manager 907-522-4499 (o), 907-280-9442 (m)

Protective Species Observers - TBD

Inupiat PSO/Communicators - TBD

Communication Centers

Barrow (907) 852-5057, TBD

Nuiqsut (907) TBD

Kaktovik (907) TBD