Application for the Incidental Harassment Authorization for the Taking of Marine Mammals in Conjunction with SAE's Proposed 3D Seismic Survey in the Beaufort Sea, Alaska, 2015

FINAL

January 2015

Prepared for:

SAExploration, Inc.
8240 Sandlewood Place
Anchorage, Alaska 99507

Prepared by:

Owl Ridge Natural Resource Consultants, Inc.
6407 Brayton Drive, Suite 204
Anchorage, Alaska 99507
T: 907.344.3448
F: 907.344.3445
www.owlridgenrc.com

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1. DESCRIPTION OF SPECIFIC ACTIVITY

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 2015 open water season. 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 the NMFS to fully evaluate whether the proposed actions remain incidental and unintentional. The 14 items are addressed below relative to the 2015 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 Beaufort Sea between Harrison Bay and the Sagavanirktok River delta. SAE plans to survey a maximum of 777 square kilometers (300 square miles) in 2015, although the exact location is currently unknown other than it would occur somewhere within the 4,562-square-kilometer (1,761-square-mile) box shown in Figure 1-1.

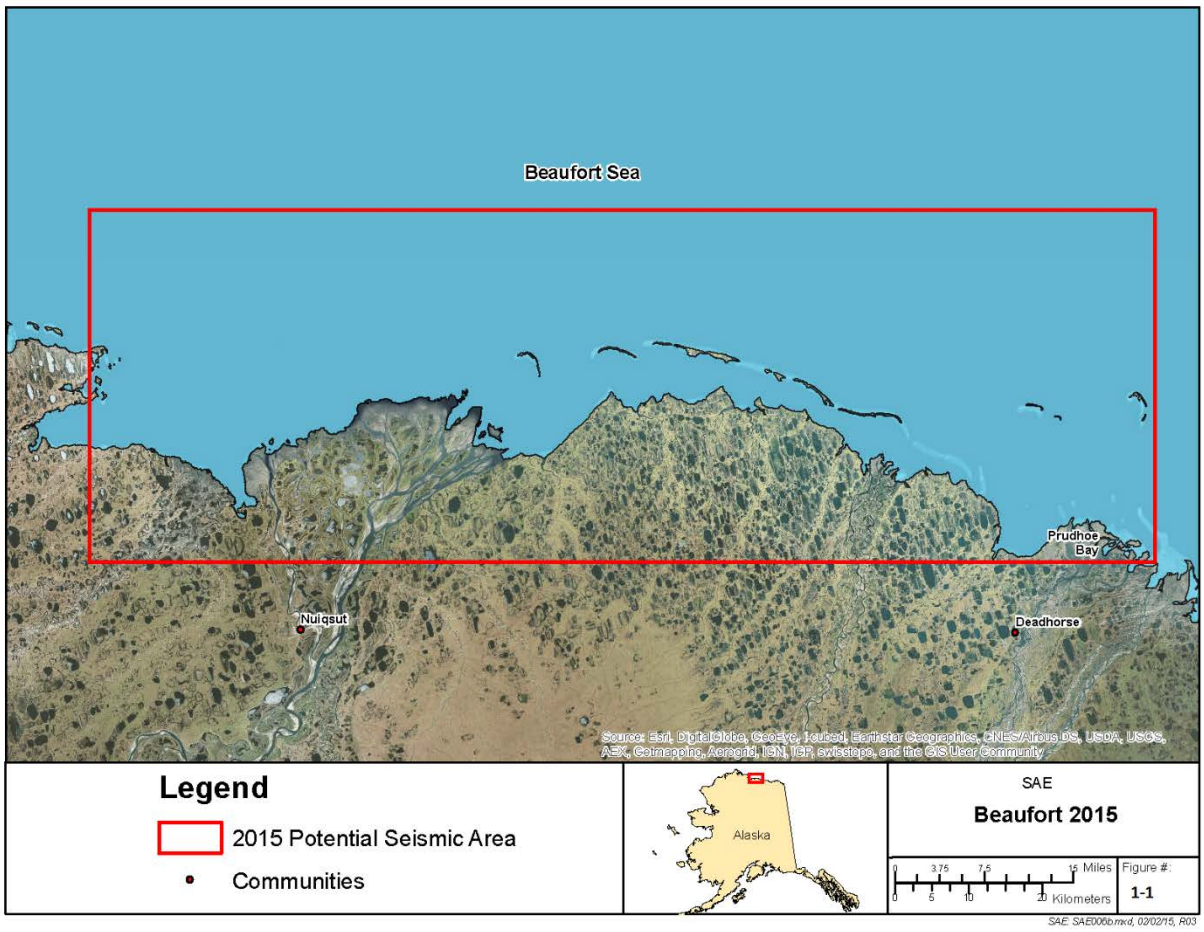

Figure 1-1 SAE's potential survey area. Only a maximum of 777 square kilometers (300 square miles) would be surveyed in 2015.

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 the 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

1.2.1. 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.

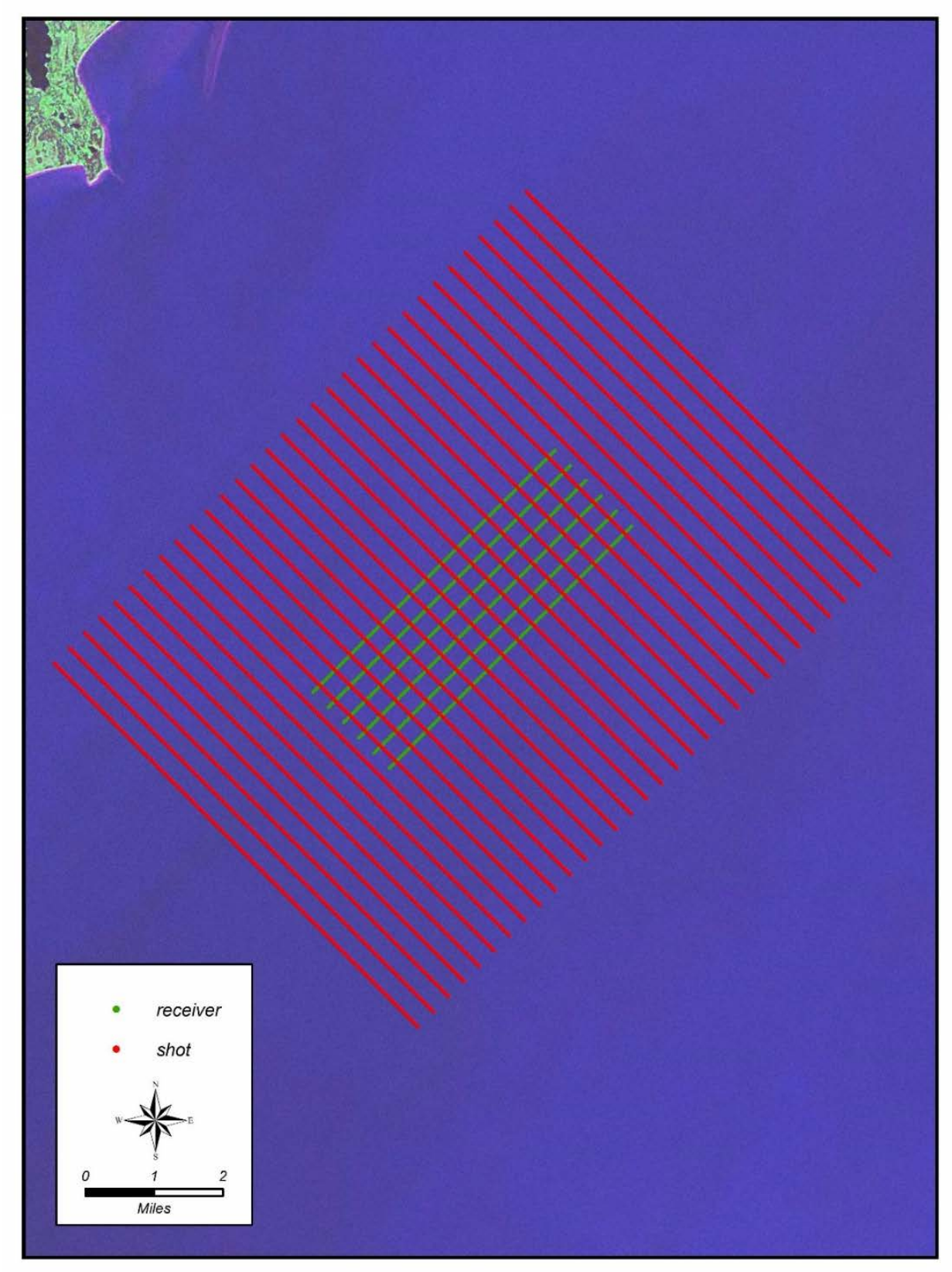

Figure 1-1. Typical patch layout.

Figure 1-2. Example nodes.

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 49 square kilometers (18.75 square miles) per day. Shot intervals along each source line will be 50 meters (165 feet). All shot areas will be wholly contained within the 4,562-square-kilometer survey box depicted in Figure 1-1, and, because of the tremendous overlap in shot area between adjacent patches, no more than 777 square kilometers (300 square miles) of actual area will be shot in 2015.

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 airgun 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.

1.2.2. 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.

1.2.2.1. Seismic Source Array

The primary seismic source for offshore recording consists of a 620-cubic-inch, 8-cluster array although a 2 x 620-cubic-inch array, totaling 1,240 cubic inches, may be used in deeper waters. For conservative purposes, exposure estimates are based on the sound pressure levels associated with the larger array. The arrays will be centered approximately 15 meters (50 feet) behind the source vessel stern, at a depth of 4 meters (12 feet), and towed along predetermined source lines at speeds between 7.4 and 9.3 kilometers per hour (4 and 5 knots). 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 16 seconds for each array resulting in an overall shot interval of 8 seconds considering the two alternating arrays. Operations are expected to occur 24 hours a day, with actual daily shooting to total about 12 hours.

Based on manufacturer specifications, the 1,240-cubic-inch array has a zero-peak estimated sound source of 249 dB (decibels) re 1 micropascals (µPa) @ 1 m (13.8 bar-m; Appendix A), with a root mean square (rms) sound source of 224 dB re 1 µPa, while for the 620-cubic-inch array the zero-peak is 237 dB re 1 µPa (rms) (6.96 bar-m; Appendix A) with an rms source level of 218 dB re 1 µPa. The manufacturer-provided source directivity plots for the 1,240- and 620-cubic-inch 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 B harassment criterion determined for this IHA request should be considered conservative.

Airgun arrays typically produce most noise energy in the 10 to 120 hertz range, with some energy extending to 1 kilohertz (Richardson *et al.* 1995). This sound energy is well within the hearing range of baleen whales (Richardson *et al.* 1995), but well below the most sensitive hearing range of pinnipeds (10 to 30 kHz; Schusterman 1981) and odontocetes (12 to ~100 kHz; Wartzok and Ketten 1999). Richardson *et al.* (1995) found little evidence of pinnipeds and odontocetes reacting to seismic pulses, suggesting pinnipeds are tolerant to these types of noise and odontocetes have difficulty hearing the low frequency energy. It is assumed, however, that SAE's airgun pulses will be audible to local pinnipeds and odontocetes (beluga whales) given the high energy involved, but would more likely elicit reaction from baleen whales, such as bowhead whales, than the high frequency species.

1.2.2.2. Mitigation Airgun

A 10-cubic-inch mitigation airgun will be used during poor visibility conditions, and is intended to (a) alert marine mammals to the presence of airgun activity, and (b) retain the option of initiating a ramp-up to full operations under poor visibility conditions. The mitigation gun will be operated at approximately one shot per minute during these periods. The manufacturer specifications indicate a 214 dB re 1 µPa zero-peak (0.5 bar-m) sound source equating to a 195 dB re 1 µPa rms source.

1.2.2.3. 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 µPa @ 1 m and operates at frequencies between 35 and 55 kilohertz. The transponder produces short pulses of 184 to 187 dB re 1 µPa @ 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; National Research Council [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 airgun 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 airgun pulses, but only when very close (a few meters) to the sources.

1.2.2.4. 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 based on previous SAE seismic surveys 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

Vessel	Operation	Size (feet)	Gross Tonnage	No. of Berths	Main Activity/Frequency	Source Levels (dB)
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

1.2.2.4.1. Source Vessels

Source vessels will have the ability to deploy two arrays off the stern using large A-frames and winches and have a draft shallow enough to operate in waters less than 1.5 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 were found to have sound source levels of 179.0 dB re 1 µPa (rms) and 165.7 dB re 1 µPa (rms).

1.2.2.4.2. 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 µPa (rms), while the smaller bow pickers produce more cavitation resulting in source levels of 171.8 dB re 1 µPa (rms).

1.2.2.4.3. 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 µPa [rms]), 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 µPa (rms), while during slower on-site movements the vessel source levels are only 166.4 dB re 1 µPa (rms) (Aerts *et al.* 2008).

1.3. Maintaining Safe Radii

The seismic airguns that will be used during SAE's Cook Inlet operation have the potential to acoustically cause short-term acoustical injury to marine mammals at close proximity. While these Level A harassments can now be authorized by IHAs, measures must be taken to avoid them as much as possible. The NMFS criteria for Level A harassments 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 zones of influence (ZOIs; the area ensonified by a specific sound level) for the 1,240-, 620-, and 10-cubic-inch airgun arrays. In 2014, Heath *et al.* (2014a) conducted a sound source verification of the very same 620-cubic-inch array SAE plans to use in 2015. They empirically determined that the distances to the 190 and 180 dB isopleths for sound pressure levels emanating from the 620-cubic-inch array was 195 and 635 meters, respectively (Table 1-2). Sound source studies have not been done for the 1,240-cubic-inch array; however, Austin and Warner (2013) conducted a sound source verification of a 1,200-cubic-inch array operated by SAE in Cook Inlet found the radius to the 190 dB isopleth to be 250 meters and to the 180 dB isopleth to be 910 meters. Heath *et al.* (2014a) also measured sound pressure levels from an active 10-cubic-inch gun during SAE's 2014 Beaufort operations and found noise levels exceeding 190 dB extended out 54 meters and exceeding 180 dB out to 188 meters. These are the distance values SAE intends to use when monitoring shutdown safety zones (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)	190 dB radius (m)	180 dB radius (m)
1,240	250	910
620	195	635
10	54	188

While the pingers and transponders that will be used to relocate nodes generate source sound levels (185 to 193 dB) exceed Level A criteria, the associated ZOIs are extremely small (radii of <1 to 6 meters) and it is highly unlikely that marine mammals would be this close to a vessel. PSOs and operators will, however, ensure that no marine mammals are in the immediate vicinity before deploying active pingers and transponders.

Housing and crew transfer vessels can produce noises exceeding 190 or 180 dB re 1 µPa when traveling at higher speeds. However, ZOIs only extend to 2 to 4 meters from the vessel; again, an area impractical to monitor.

2. DATES, DURATION, AND SPECIFIC GEOGRAPHICAL REGION

The request for incidental harassment authorization is for the 2015 open water season (July 1 to October 15). 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), and no more than 777 square kilometers (300 square miles) of the total area will be shot in 2015 under this authorization. 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. SPECIES AND NUMBERS OF MARINE MAMMALS

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 extralimitally 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 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 30 percent of the potential survey box (Figure 1-1) 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 (and for that matter little of the actual lease areas where shooting would occur falls in waters greater than 15 meters deep). Also, SAE will work with the Alaska Eskimo Whaling Commission and the stipulations of the CAA to ensure effort are made to avoid the fall beluga and bowhead whale migration including completing the northernmost source lines first where possible or, if necessary, shutting down altogether during the fall bowhead whale hunt.

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

Species	Abundance	Comment
Bowhead Whale (*Balaena mysticetus*)	12,631	ESA-listed as Endangered

Species	Abundance	Comment
Gray Whale (*Eschrichtius robutus*)	19,126	Rare in Beaufort Sea
Beluga Whale (*Delphinapterus leucas*)	39,258	Beaufort Sea Stock
Beluga Whale (*Delphinapterus leucas*)	3,710	Eastern Chukchi Sea Stock
Ringed Seal (*Phoca hispida*)	249,000	ESA-listed as Threatened
Spotted Seal (*Phoca largha*)	101,568	
Bearded Seal (*Erignathus barbatus*)	155,000	ESA-listed as Threatened

Source: Boveng *et al.* (2009), Cameron *et al.* (2010), Allen and Angliss (2014), Carretta *et al.* (2014)

4. STATUS AND DISTRIBUTION OF THE AFFECTED SPECIES

4.1. Bowhead Whale (*Balaena mysticetus*)

The Western Artic 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 2014). 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 Point Barrow and Smith Bay (Green and Negri 2005, Green *et al.* 2007). Mocklin *et al.* (2012) have reported on bowheads feeding near Point 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). The NMFS's most recent estimate is 12,631 animals (Allen and Angliss 2014).

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 30 percent (1,348 square kilometers) of the potential seismic survey area (Figure 1-1) 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 under 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, no bowhead whale has been recorded in waters less than 5 meters (16 feet) deep (Clarke and Ferguson 2010). Bowhead whales were observed very close to shore in 2014, but specific information on depths has not yet been vetted (Janet Clarke, pers. comm., November 19, 2014).

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 Point Barrow) in 2005, and Green *et al.* (2007) at Smith's Bay (approximately 100 kilometers east of Point 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 Point Barrow). Their occurrence within potential seismic survey box, while possible, 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 2014). 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 2014). The current population trend is

unknown, but subsistence harvest is probably well below the potential biological removal (Allen and Angliss 2014).

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 more than 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 more than 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 more than 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 potential 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. There are a number of nearshore beluga records in the ASAMM database (http://www.afsc.noaa.gov/NMML/cetacean/bwasp/flights_2014.php), especially for the summer period (see Section 6.1).

While 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 animals migrating past during late August or September would do so well offshore of where actual seismic shooting would occur. Further, depending on location and timing, seismic activities may be temporarily suspended during 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 2014), 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 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 potential survey area, spotted seals are expected to be encountered during any survey activities occurring near the Colville River Delta. During monitoring of SAE's 2014 seismic activities conducted a few kilometers east of the Delta, Lomac-MacNair *et al.* (2014a) reported more spotted seals than any other species of marine mammal. Spotted seals appear to be much more common inside the barrier islands while ringed seals are more common in more offshore waters.

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 2014). 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. TYPE OF INCIDENTAL TAKING AUTHORIZATION REQUESTED

The incidental taking authorization requested is for both Level B noise harassment 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. The Level A criteria are noise exceeding 180 dB re 1 µPa (rms) for cetaceans and 190 dB re 1 µPa (rms) for pinnipeds, although Level A exposures are not expected with the proposed mitigation measures (see Section 1.3 and Appendix B) in place.

6. HARASSMENT ESTIMATES FOR MARINE MAMMALS

Exposure to impulsive sound levels greater than 160 dB re 1 µPa (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 the MMPA (NMFS 2005). Exposure to sound levels greater than 180 dB re 1 µPa (rms) for cetaceans and 190 dB re 1

μPa (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.

The estimate of the numbers of each species of marine mammals that could be harassed (Level B) by exposure to OBN seismic array noise levels is determined by multiplying the maximum seasonal density of each species by the total area in 2015 that will be ensonified by greater than 160 dB re 1 μPa (rms). The potential number of Level A exposures was not assessed as NMFS has not yet provided accurate methodology for estimating this "take".

6.1. Estimating Numbers of Level B Harassments

6.1.1. Ensonified Area

The acoustical footprint (total ensonified area) was determined by placing a 160-dB isopleth buffer around the area that would be surveyed (shot) during the 2015 open water season (777 square kilometers). There are no precise estimates for the 1,240-cubic-inch array. The estimated distances to the 160 dB isopleth for the 1,240-cubic-inch array is based on the sound source measurements from Heath *et al.* (2014a) for a 1,200-cubic-inch array with results showing a measured distance of 5.2 kilometers to the 160 dB threshold (Table 6-1). Placing a 5.2-kilometer buffer around the 777 square kilometer maximum shot area results in an estimated annual ZOI of 1,463 square kilometers (565 square miles), which is the ZOI value used in the exposure estimate calculations.

Table 6-1. Summary of distances to the NMFS thresholds.

Source (cubic inches)	Distance to 190 dB Isopleth (m)	Distance to 180 dB Isopleth (m)	Distance to 160 dB Isopleth (km)
1,240	250	910	5.20
620	195	635	1.82
10	54	188	1.05

Because the exact location of the 2015 shoot area is currently unknown, the distribution of marine mammal habitat within the shoot area is unknown. However, within the 4,562 square kilometer potential survey box, 18 percent (860 square kilometers) falls within the 0 to 1.5 meter depth range, 17 percent (753 square kilometers) falls within the 1.5 to 5 meter range, 36 percent (1,635 square kilometers) within the 5 to 15 meter range, and 30 percent (1,348 square kilometers) within waters greater than 15 meters deep (bowhead migration corridor). Thus, not all the area that could be surveyed in 2015 constitutes bowhead summer (>5 meters depth) or fall migrating (>15 meters depth) habitat. Further, few of the lease areas that could be shot in 2015 extend into the deeper waters of the potential survey box. The distribution of these depth ranges is found in Figure 6-1.

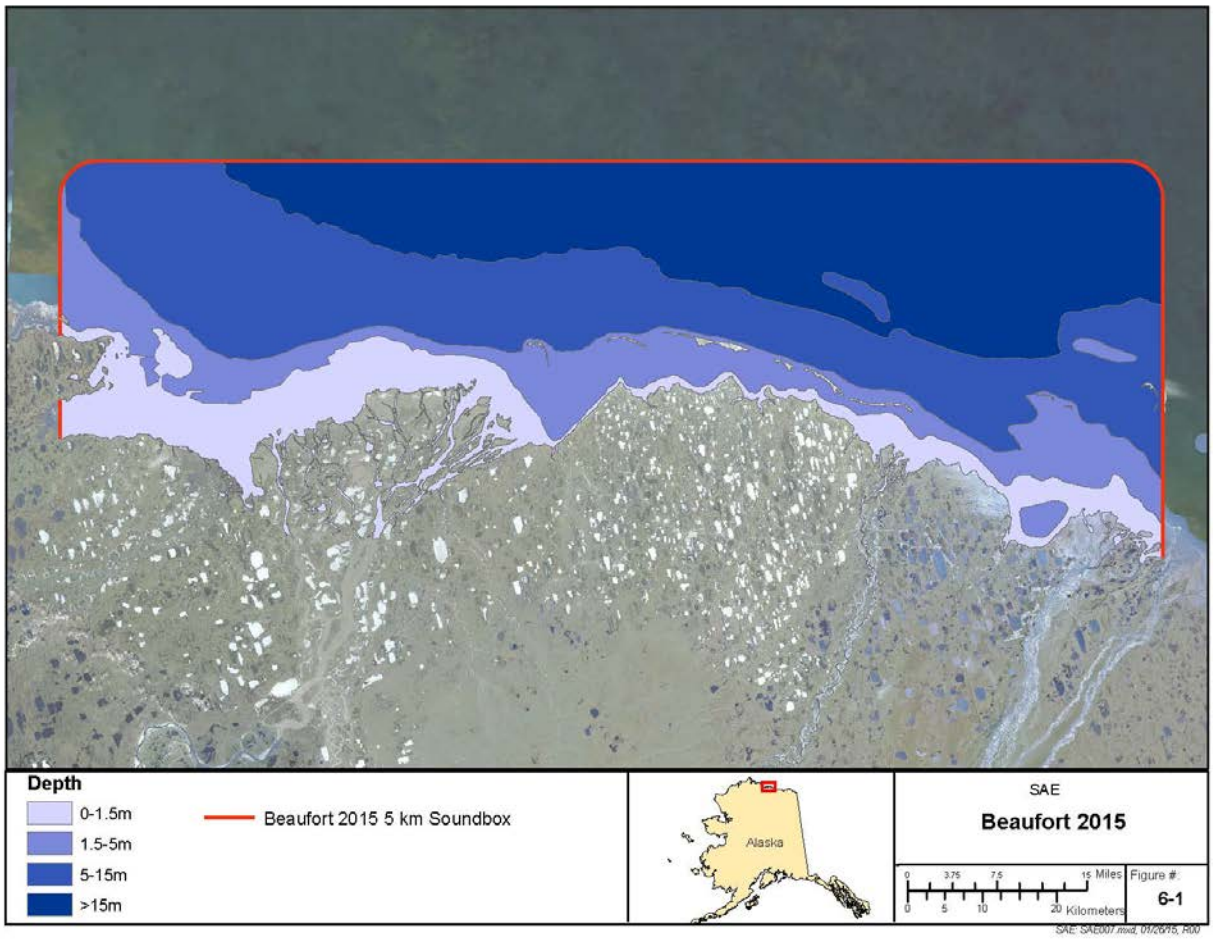

Figure 6-1. Depth contours within the potential seismic survey box.

6.1.2. 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 (#/km^2) in the Beaufort Sea.

Species	Summer	Fall
Bowhead Whale	0.0049	0.0066
Beluga Whale	0.0020	0.0057
Ringed Seal	0.3547	0.2510
Spotted Seal	0.0177	0.0125
Bearded Seal	0.0177	0.0125

6.1.2.1. 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 record 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. 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, 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 percent) 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 percent) were recorded at the eastern extreme (Blocks 4, 5, 6, and 7). During these years lesser numbers were observed in Blocks 1 and 3 where the actual 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.

ASAMM aerial survey data was collected during summer and fall 2014, and is available to view as daily reports (http://www.afsc.noaa.gov/NMML/cetacean/bwasp/flights_2014.php), but because this data has not yet been fully vetted, it is not yet appropriate for use in estimating bowhead densities in the Beaufort Sea (Janet Clarke, pers. comm., November 19, 2014). Nevertheless, the daily reports do indicate unusual nearshore concentrations of (Beaufort Sea) bowheads in both late August and late September of 2014.

6.1.2.2. Beluga Whale

There is little information on summer use by beluga whales in the Beaufort Sea. Moore *et al.* (2000) reported that only nine 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, the derived corrected density would be 0.00046 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 and 2013 ASAMM program (Clarke *et al.* 2013, 2014), six beluga whales were observed along 2,497 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 0.0024 whales per kilometer of trackline and an uncorrected density of 0.0020 assuming an ESW of 0.614.

Calculated fall beluga densities are approximately twice as high as summer. Between 2006 and 2013, 2,356 beluga were recorded along 83,631 kilometers of transect line flown during September and October, or 0.0281 beluga per kilometer of transect. Assuming an ESW of 0.614 gives an uncorrected density of 0.0229. 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, 2009-2013), only 11 of 1,605 (1 percent) 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 0.0057.

Summer and fall beluga data was also collected in 2014, but as with the bowhead data mentioned above, it has not yet been checked for accuracy and, therefore, is not yet appropriate for estimating density (Janet Clarke, pers. comm., November 19, 2014). Regardless, the data that is available from online daily reports (http://www.afsc.noaa.gov/NMML/cetacean/bwasp/flights_2014.php) indicates that a number of belugas were observed near shore in 2014, especially during the summer.

6.1.2.3. 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.

6.1.2.4. 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 haulout sites are located. Approximately 5 percent of all phocid sightings recorded by Green and Negri (2005) and Green *et al.* (2006, 2007) were spotted seals, which provide a 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. However, monitoring conducted by Lomac-MacNair *et al.* (2014a) of SAE's 2014 seismic program near the Colville River Delta showed higher than expected spotted seal use of the potential seismic survey area, probably due to repeated sightings of local spotted seals closer to the Delta haul out sites. This information was used to adjust the take requests.

6.1.2.5. 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.

6.1.3. Level B Exposure Calculations

The estimated potential harassment take of local marine mammals by the SAE's Beaufort seismic project was determined by multiplying the seasonal animal densities in Table 6-2 with the seasonal area that would be ensonified by seismic-generated noise greater than 160 dB re 1 μPa (rms). The total area that would be ensonified during 2015 is 1,463 square kilometers (565 square miles). Assuming that half this area would be ensonified in summer and half in fall, the seasonal ZOI would be half 1,463 square kilometers, or 731.5 square kilometers (282.5 square miles). The resulting exposure calculations are found in Table 6-3.

Table 6-3. The estimated number of marine mammals potentially exposed to received sound levels greater than 160 dB.

Species	Seasonal ZOI (km^2)	Summer Density	Summer Exposure	Fall Density	Fall Exposure	Total
Bowhead Whale	731.5	0.0049	4	0.0066	5	9
Beluga Whale	731.5	0.0020	1	0.0057	4	7
Ringed Seal	731.5	0.3547	259	0.2510	184	443
Spotted Seal	731.5	0.0177	13	0.0125	9	22
Bearded Seal	731.5	0.0177	13	0.0125	9	22

The requested take authorization is found in Table 6-4, and 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). The requested take authorization for ringed seals and spotted seals has also been adjusted based on observations during SAE's 2014 seismic operations immediately east of the Colville River Delta (Lomac-MacNair *et al.* 2014a). Lomac-MacNair *et al.* (2014a) only observed 5 confirmed sightings of ringed seals, none of which were observed during active seismic activity. But they also observed 40 spotted seals (4 during active seismic) and an additional 28 seals (also 4 during active seismic) that were either a ringed or spotted seal. Given only 88 square kilometers (34 square miles) were shot in 2014, this would extrapolate to about 353 spotted seals potential observed and 35 spotted seals observed during seismic activity, during the planned 777 square kilometers (300 square miles) of operation planned in 2015. If 80 percent of the ringed/spotted seal sightings were actually spotted seals, then an additional 200 spotted seals would be observed and an additional 28 observed during seismic activity. Given the nearshore location of the planned seismic activities and proximity to Colville River Delta spotted seal haulout sites, and likelihood that a number of seals that were exposed to seismic noise exceeding 160 dB were not observed, the requested take authorization for spotted seals has been increased to 500.

Table 6-4. The estimated Level B harassments and requested take of marine mammals.

Species	Estimate Exposures	Take Authorization Request 2015
Bowhead Whale	9	15

Beluga Whale	7	15
Ringed Seal	443	500
Spotted Seal	22	500
Bearded Seal	22	25
Humpback Whale	0	2
Gray Whale	0	2
Narwhal	0	2
Ribbon Seal	0	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 that much of the survey would occur in shallow waters where bowhead whales rarely occur. 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*). Finally, the number of marine mammals potentially exposed during SAE's 2014 seismic survey were well below the take authorization request for all species.

The estimated take as a percentage of the marine mammal stock is 0.5 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 0.5 percent represents a worst-case scenario. The estimated take of 0.1 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. Level B take request as percentage of stock.

Species	Abundance	Requested Take	Percent Population
Bowhead Whale	12,631	15	0.1%
Beluga Whale (Beaufort Stock)	39,258	15	0.1%
Beluga Whale (E. Chukchi Stock)	3,710	15	0.4%
Ringed Seal	249,000	500	0.2%
Spotted Seal	101,568	500	0.5%
Bearded Seal	155,000	25	0.1%
Humpback Whale (West. North Pac.)	938	2	0.0%
Gray Whale	19,126	2	0.0%
Narwhal (Baffin Bay)	45,000	2	0.0%
Ribbon Seal	49,000	2	0.0%

Abundance sources: COSEWIC (2004), Boveng *et al.* (2009), Cameron *et al.* (2010), Allen and Angliss (2014), Carretta *et al.* (2014)

6.2. Estimating Level A Harassments

By current NMFS criteria, Level A acoustical harassment occurs when a pinniped is exposed to sound pressure levels exceeding 190 dB re 1 μPa (rms) or a cetacean to levels exceeding 180 dB re 1 μPa (rms). The standard mitigation measure for avoiding Level A harassment is to monitor for marine mammals approaching the 190 and 180 dB isopleths, and shutting down noise sources before these animals reach these isopleths. Presumably, without mitigation, some marine mammals could be exposed to noise levels deemed harmful, at least temporarily.

NMFS has recently requested that applicants estimate the potential Level A exposures that could occur without mitigation to better understand the potential for SAEs seismic project to cause temporary hearing impairment in local marine mammals. There is no one method for estimating potential Level A exposures, and different methods can provide very different results. Actual observations in the field tend to show very little marine mammal activity near the seismic vessels, probably because the marine mammals move away from the seismic noise rather than approach it. For example, the mitigation measure of operating a 10-cubic-inch mitigation gun during poor visibility conditions assumes that marine mammals will hear the small airgun and move away from the sound source before being exposed to louder noise levels from the full array. Level B harassment noise levels may actually mitigate for Level A harassment where marine mammals move away from the source before noise levels exceed Level A criteria.

To estimate the number of potential Level A exposures, without mitigation, two methods were employed illustrating in a range of results. Each is presented below.

6.2.1. Method 1 – Previous Observations

Lomac-MacNair *et al.* (2014a, b) conducted marine mammal monitoring for both of SAE's 2014 seismic survey activities (Colville River Delta and Prudhoe Bay) in the Beaufort Sea. The draft 90-day reports for these efforts do not provide specific information on the number of marine mammals exposed to Level A noise levels, but they do provide number of shut down events that occurred, when provides a fair estimate of the number of marine mammal groups at least that could potentially have been exposed without mitigation. During SAE's 456-square-kilometer (176-square-mile) shoot in Prudhoe Bay, the airguns were shut down or powered down on 31 occasions, all for pinnipeds. During the much smaller 88-square-kilometer (34-square-mile) seismic survey just east of the Colville River Delta, four shutdown events occurred, three for pinnipeds and one for a single beluga whale. Consequently, 35 events occurred over 544 square kilometers (210 square miles) of survey effort. For the planned 777-square-kilometer (300-square-mile) program in 2015, this extrapolates to approximately 50 shutdown events, with the vast majority associated with either spotted or ringed seals. (Lomac-MacNair *et al.* [2014a, b] did not provide distances to all the marine mammals initiating shut down events, and not all pinnipeds were identified to species.)

In a nearly identical seismic survey conducted in the Chukchi Sea in 2013, Cate *et al.* (2014) produced a sightability curve for all marine mammals observed within 360 m of the seismic vessel. Given that the great majority of sightings were for pinnipeds, the curve indicated that while pinnipeds were observed to distances out to 1.5 km, the detection probability was 50 percent at about 120 m. Thus, for a distance out to 250 m, it is expected that about half the pinnipeds present might not have been detected. Applying this

as a correction factor of 2x to the estimated 50 shut down events, approximately 100 marine mammals, almost entirely seals, might be exposed to Level A seismic noise levels.

6.2.2. Method 2 – Seasonal ZOI

This method is the same used to estimate Level B exposures in that the total amount of area that could be seasonally ensonified by noise levels exceeding 190 and 180 dB is multiplied by density of each species. Because the radii to both the 190 dB (250 m) and 180 dB (910 m) are essentially equal to or larger than the mid-point (250 m) between the seismic source lines, the entire 777-km^2 seismic maximum source area would be ensonified, plus buffers of 250 m and 910 m around the source area. Thus, the 190 dB ZOI relative to pinnipeds would be 805 km^2, or 402.5 km^2 for each the summer and fall season, while the 180 dB ZOI would be 883 km^2, or 441.5 km^2 each season. Multiplying these values by the animal densities provides the Level A exposure estimates shown in Table 6-6.

Table 6-6 The estimated number of marine mammals potentially exposed to received sound levels greater than 190 dB (pinnipeds) and 180 dB (cetaceans).

Species	Seasonal ZOI (km^2)	Summer Density	Summer Exposure	Fall Density	Fall Exposure	Total
Bowhead Whale	441.5	0.0049	2	0.0066	3	5
Beluga Whale	441.5	0.0020	1	0.0057	3	4
Ringed Seal	405.5	0.3547	144	0.2510	102	246
Spotted Seal	405.5	0.0177	7	0.0125	5	12
Bearded Seal	405.5	0.0177	7	0.0125	5	12

The estimated number of marine mammals that could potentially be exposed to Level A harassment noise, without mitigation, using this method is nearly three times higher than the estimate developed using data from actual shut downs (Method 1). This might be because the marine mammal density estimates are high, or it could mean that during seismic activity, few marine mammals approach to distance close to the seismic vessels. In a sense, while seismic operations can expose a large number of marine mammals to Level B harassment, this noise may allow marine mammals to avoid Level A harassment by moving away from the source before Level A sound pressure levels are received.

6.2.3. Level A Take Request

SAE is not requesting authorization for Level A take. SAE will employ a suite of mitigation measured identified in the Marine Mammal Monitoring and Mitigation Plan to avoid Level A take. Also, there is no indication from similar surveys conducted by SAE that any Level A exposure has actually resulted in a harm rising to the level of "take".

7. ANTICIPATED IMPACT OF THE ACTIVITY ON THE SPECIES OR STOCK

7.1. Introduction

The primary impact of the proposed ocean-bottom cable (OBC) seismic survey to local marine mammals is acoustical harassment from the 620 and 1,240 cubic inch airgun operations. Noise generated from the airguns could disrupt normal behaviors of marine mammals where received levels exceed 160 dB re 1 μPa. What is known about behavioral responses to noise stimuli by the marine mammals that inhabit the OBN seismic survey area are discussed below. Acoustical injury is possible where received sound levels exceed 180 dB re 1 μPa (cetaceans) or 190 dB re 1 μPa (pinnipeds), but this potential impact will largely be mitigated by ramping up of airguns and establishing a shutdown safety zone (see Section 1.2 and Appendix B).

7.2. Behavioral Response

7.2.1. 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 μPa (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 μPa (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 μPa (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).

7.2.2. 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 Osmek 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 playbacked 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.

7.2.3. 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. Lomac-MacNair *et al.* (2014a) monitored SAE's 2014 seismic program in the Colville River Delta and observed 8 times more spotted seals during non-seismic monitoring than during seismic monitoring even though the monitoring efforts were similar. It is probable that the mitigation airgun used to alert marine mammals of pending seismic noise allowing time for animals to vacate the immediate vicinity was effective. However, Lomac-MacNair *et al.* (2014b) actually observed more seals during seismic effort than during an equal amount of non-seismic effort while monitoring SAE's 2014 operations in Prudhoe Bay.

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). PTS is a result of long-term continuous exposure, which is of little relevance to impulsive seismic noise or animals migrating past the noise source. The only continuous noise source associated with the seismic program, vessel propeller noise, does not occur for long durations or within a set location.

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, 2004) exposed captive beluga whales to typical seismic airgun noises, and initially (Romano et al. 2001) found no changes in hormonal or immune response levels, while later experiments (Romano et al. 2004) did show elevated hormone levels with increasing impulsive noise levels. Still, chronic exposure to elevated seismic noise is not expected with this seismic program given the whales' migration patterns.

8. ANTICIPATED IMPACTS ON 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. In the past, bowhead whales were harvested all along the barrier islands, but 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) annually to 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 about three.

Cross Island is located inside the potential survey box, but seismic activities are unlikely to affect Cross Island based whaling as the conditions of the Conflict Avoidance Agreement will require that SAE mitigate their operations during the fall bowhead whale hunt, including the possibility of temporarily shutting down.

Although Nuiqsut whalers my incidentally harvest beluga whales while hunting bowheads, these whales are rarely seen and are not actively pursued. Any harvest would most likely occur 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 µPa (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. ANTICIPATED IMPACTS ON HABITAT

The OBN 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 small 620- and 1,240-cubic-inch airgun arrays 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. ANTICIPATED EFFECTS OF HABITAT IMPACTS ON MARINE MAMMALS

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. MITIGATION MEASURES

The primary means of minimizing potential impacts to marine mammals include 1) using relative small seismic arrays (1,240 and 620 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 acoustical 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. PLAN OF COOPERATION

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. Although Nuiqsut's Cross Island whaling camp occurs within the potential survey box, all seismic activities will cease during the annual fall bowhead whale hunt.

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. MONITORING AND REPORTING

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. SUGGESTED MEANS OF COORDINATION

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 mitigation measures. Opportunity to further evaluate seismic effects on marine mammals is largely not available as seismic operations will be conducted in a manner specifically to avoid marine mammal encounters. However, all observations of marine mammals, including any observed reactions to the seismic operations will be recorded and reported to the NMFS and the North Slope Borough.

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APPENDIX A

The 620 and 1,240 cui Array Parameters and Directivity Plots

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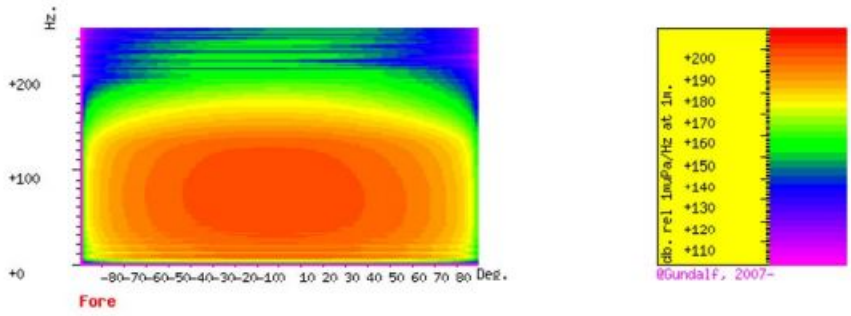
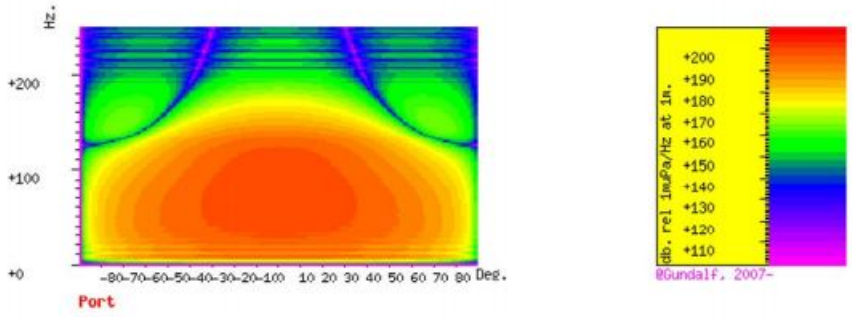
Array parameter	Array value
Number of guns	16
Total volume (cu.in).	1240.0 (20.3 litres)
Peak to peak in bar-m.	29.8 +/- 0.375 (2.98 +/- 0.0375 MPa, ~ 249 db re 1 muPa. at 1m.)
Zero to peak in bar-m.	13.8 (1.38 MPa, 243 db re 1 muPa. at 1m.)
RMS pressure in bar-m.	1.65 (0.165 MPa, 224 db re 1 muPa. at 1m.)
Primary to bubble (peak to peak)	25.3 +/- 2.68
Bubble period to first peak (s.)	0.095 +/- 0.0246
Maximum spectral ripple (dB): 10.0 - 50.0 Hz.	11.4
Maximum spectral value (dB): 10.0 - 50.0 Hz.	198
Average spectral value (dB): 10.0 - 50.0 Hz.	195
Total acoustic energy (Joules)	62028.3
Total acoustic efficiency (%)	22.1

Inline directivity, bearing = 0 degrees

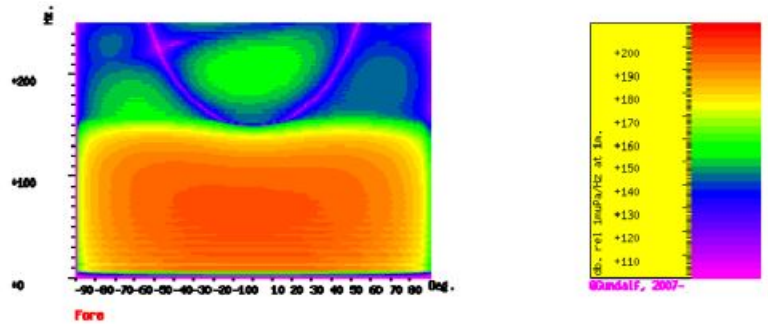


Crossline directivity, bearing = 90 degrees



Array parameter	Array value
Number of guns	6
Total volume (cu.in).	620.0 (10.2 litres)
Peak to peak in bar-m.	21.3 +/- 0.439 (2.13 +/- 0.0439 MPa, ~ 247 db re 1 muPa. at 1m.)
Zero to peak in bar-m.	9.1 (0.91 MPa, 239 db re 1 muPa. at 1m.)
RMS pressure in bar-m.	1.33 (0.133 MPa, 222 db re 1 muPa. at 1m.)
Primary to bubble (peak to peak)	10.9 +/- 1.07
Bubble period to first peak (s.)	0.0345 +/- 0.00546
Maximum spectral ripple (dB): 10.0 - 50.0 Hz.	9.87
Maximum spectral value (dB): 10.0 - 50.0 Hz.	198
Average spectral value (dB): 10.0 - 50.0 Hz.	196
Total acoustic energy (Joules)	25692.3
Total acoustic efficiency (%)	18.3

Inline directivity, bearing = 0 degrees



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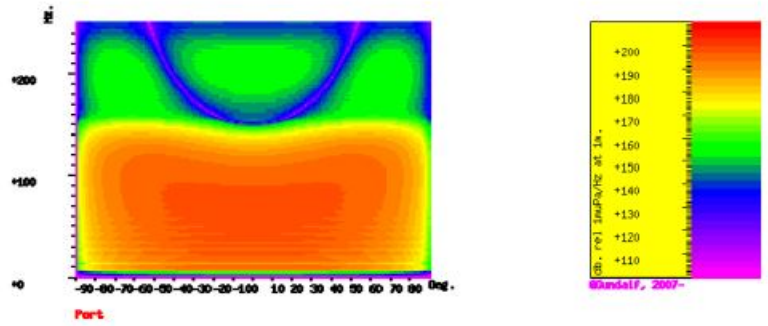

APPENDIX B

Marine Mammal Monitoring and Mitigation Plan

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Marine Mammal Monitoring and Mitigation Plan

SAExploration Colville 3D Seismic Survey Operation 2015

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 conduct safety and harassment monitoring from both seismic vessels.

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.

Monitoring zones for the 190, 180, and 160 dB with the various airgun configurations were measured during SAE seismic operations in 2014. 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.

Table 1. Summary of distances to the NMFS sound level thresholds.

Array (cubic inches)	Distance to 190 dB Isopleth (m)	Distance to 180 dB Isopleth (m)	Distance to 160 dB Isopleth (km)
1,240	250	910	5.20
620	195	635	1.82
10	54	188	1.05

Sound Source Verification

Sound source verification (SSV) testing of the airgun arrays was conducted in 2012 (Austin and Warner 2013) and 2014 (Heath *et al.* 2014) and the vessels were measured in 2008 (Aerts *et al.* 2008). Results of

these measurement are the basis of the safety and harassment zones that will be monitored. No additional SSV tests are planned for 2015.

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 both source vessels to monitor and implement mitigation measures during all daytime seismic operations. A lead PSO will be designated on each source 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 airgun operations. To better observe the exclusion zone, a lead PSO, one or two PSOs, and an Inupiaq communicator will be on primary source vessel and two PSOs will be stationed aboard the secondary source vessel. (The total number of observers is limited by available berthing space aboard the vessels.) The three to four total observers aboard the primary source vessel will allow two observers simultaneously on watch during daylight hours (as requested by the peer review committee). When marine mammals are about to enter or are sighted within designated exclusion zones, airgun 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 airgun 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 airgun(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 platforms 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 standard reticle binoculars or long-range big-eye binoculars. 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 airgun 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 airgun activity is suspended. The operating airgun(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 airgun 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 airgun array). A power down procedure involves reducing the number of airguns 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 airgun activity is suspended. During a power down, a mitigation airgun (airgun of small volume

such as the 10 cubic inch) is operated. If a marine mammal is detected outside the safety radius (either injury or harassment) but is likely to enter that zone, the airguns 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, airgun activity will not resume until the marine mammal has cleared the applicable exclusion zone.

Ramp Up Procedure

A “ramp up” procedure gradually increases airgun 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 airgun operations, including a power down, shut down, and after any period greater than 10 minutes in duration without airgun operations. The airgun array begins operating after a specified-duration period without airgun 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 airgun array configurations. During the ramp up, the applicable exclusion zone for the full airgun 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

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 airgun(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 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.

PSO teams will consist of Inupiat observers and experienced field biologists. An experienced field crew leader and an Inupiat observer will be onboard each source 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 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:

- observe and record sensitive wildlife species;
- ensure mitigation procedures are followed accordingly; and
- 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 zone 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; and
- time, location, speed, and activity of the source vessels; sea state, ice cover, visibility, and sun glare; and positions of other vessel(s) in the vicinity.

Spotted Seal Haulout Monitoring

As requested during the 2014 peer review, SAE monitored spotted seal haulout sites located at the Colville River Delta during the SAE's 2014 seismic program. The boat-based monitoring program was largely ineffective for the following reasons: 1) spotted seal haul out use was largely confined to the river channels (where the seals feed on migrating channels) based both on the surveys and interviews with Nuiqsut hunters, 2) weather conditions precluded some survey attempts and actual seal use of the marine haulouts, 3) not enough is known about seal haulout use at the delta to separate the influence of environmental patterns from industrial activities, 4) SAE was specifically asked not to conduct an aerial-based monitoring program to avoid disturbance of village activities, 5) a separate (aerial-based) spotted seal monitoring program was simultaneously being conducted by an another party, and 6) actual 2015 seismic activities came no closer than 5 kilometers of a marine haulout site. SAE does not plan to conduct a spotted seal monitoring program in 2015, but will consult with NMFS regarding a monitoring program if the final actual 2015 seismic activities occur in the immediate vicinity of known marine haulout sites.

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; and
- participate with other operators in the Communications Call Centers (Com-Center) Program. The Com-Centers will be operated 24 hours/day during the 2015 subsistence bowhead whale hunt.

SAE proposes to routinely call the communications center according to the established protocol while in the Beaufort Sea.

Reporting

Weekly Reports

Weekly reports will be submitted to NMFS no later than the close of business (Alaska Time) each Thursday during the weeks when in-water G&G activities take place. The field reports will summarize species detected, in-water activity occurring at the time of the sighting, behavioral reactions to in-water activities, and the number of marine mammals exposed to harassment level noise.

Monthly Reports

Monthly reports will be submitted to NMFS for all months during which in-water G&G activities take place. The monthly report will contain and summarize the following information:

Dates, times, locations, heading, speed, weather, sea conditions (including Beaufort Sea state and wind force), and associated activities during the G&G Program and marine mammal sightings.

- Species, number, location, distance from the vessel, and behavior of any sighted marine mammals, as well as associated G&G activity (number of shutdowns), observed throughout all monitoring activities.
- An estimate of the number (by species) of: (i) pinnipeds that have been exposed to the geophysical activity (based on visual observation) at received levels greater than or equal to 160 dB re 1 µPa (rms) and/or 190 dB re 1 µPa (rms) with a discussion of any specific behaviors those individuals exhibited; and (ii) cetaceans that have been exposed to the geophysical activity (based on visual observation) at received levels greater than or equal to 160 dB re 1 µPa (rms) and/or 180 dB re 1 µPa (rms) with a discussion of any specific behaviors those individuals exhibited.
- An estimate of the number (by species) of pinnipeds and cetaceans that have been exposed to the geotechnical activity (based on visual observation) at received levels greater than or equal to 120 dB re 1 µPa (rms) with a discussion of any specific behaviors those individuals exhibited.
- A description of the implementation and effectiveness of the: (i) terms and conditions of the Biological Opinion's Incidental Take Statement; and (ii) mitigation measures of the IHA. For the Biological Opinion, the report shall confirm the implementation of each Term and Condition, as well as any conservation recommendations, and describe their effectiveness, for minimizing the adverse effects of the action on ESA-listed marine mammals.

90-Day Technical Report

A report will be submitted to NMFS within 90 days after the end of the project or at least 60 days before the request for another Incidental Take Authorization for the next open water season to enable NMFS to incorporate observation data into the next Authorization. The report will summarize all activities and monitoring results (*i.e.*, vessel-based visual monitoring) conducted during in-water G&G surveys. The Technical Report will include the following:

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

- Analyses of the effects of various factors influencing detectability of marine mammals (*e.g.*, sea state, number of observers, and fog/glare).
- Species composition, occurrence, and distribution of marine mammal sightings, including date, water depth, numbers, age/size/gender categories (if determinable), group sizes, and ice cover.
- Analyses of the effects of survey operations.
- Sighting rates of marine mammals during periods with and without G&G survey activities (and other variables that could affect detectability), such as: (i) initial sighting distances versus survey activity state; (ii) closest point of approach versus survey activity state; (iii) observed behaviors and types of movements versus survey activity state; (iv) numbers of sightings/individuals seen versus survey activity state; (v) distribution around the source vessels versus survey activity state; and (vi) estimates of Level B harassment based on presence in the 120 or 160 dB harassment zone.

Notification of Injured or Dead Marine Mammals

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by the IHA (if issued), such as an injury (Level A harassment), serious injury or mortality (*e.g.*, ship-strike, gear interaction, and/or entanglement), the Applicant would immediately cease the specified activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the Alaska Regional Stranding Coordinators. The report would include the following information:

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

Activities would not resume until NMFS is able to review the circumstances of the prohibited take. NMFS would work with the Applicant to determine what is necessary to minimize the likelihood of

further prohibited take and ensure MMPA compliance. The G&G Program would not be able to resume activities until notified by NMFS via letter, email, or telephone.

In the event that the G&G Program discovers an injured or dead marine mammal, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (*i.e.*, in less than a moderate state of decomposition as described in the next paragraph), the Applicant would immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinators. The report would include the same information identified in the paragraph above. Activities would be able to continue while NMFS reviews the circumstances of the incident. NMFS would work with the Applicant to determine if modifications in the activities are appropriate.

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

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APPENDIX C

Plan of Cooperation

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Plan of Cooperation
Colville River Delta 3D Seismic Exploration

SAExploration, Inc., Anchorage, Alaska
November 2015

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.

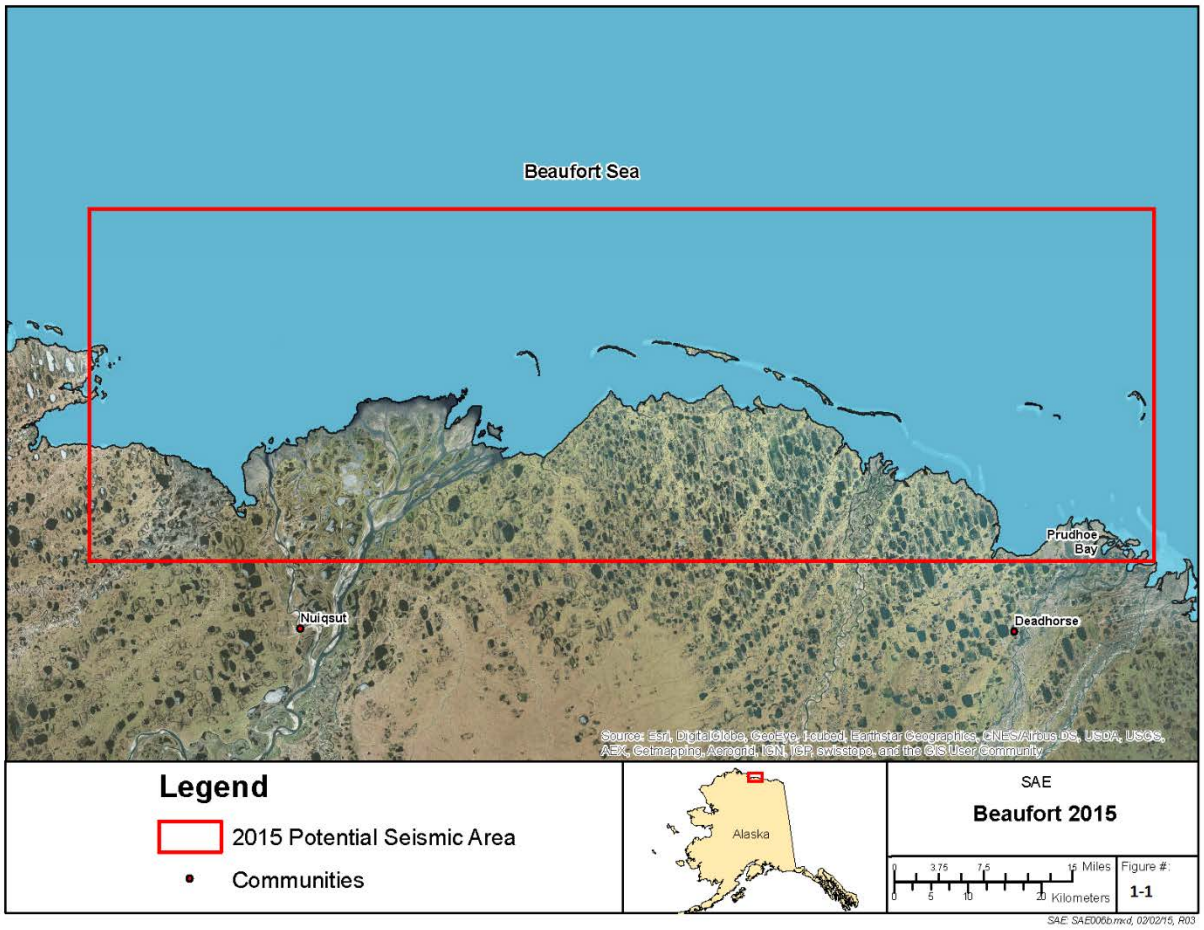
This plan contains three stages:

- 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 2015 Beaufort Sea open water season. The program will be conducted over a period of approximately 70 days within the time period of July 1 to October 15, 2015. 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).



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 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, a Communication Center (Com Center) will be established to facilitate communication between open-water subsistence hunters and industry vessels to minimize and avoid conflicts between subsistence hunters and industry activities. 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 2015 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 will present the program description to the AEWC during their quarterly meeting in December, 2014. SAE will also be presenting the project at the open water meeting in March 2015 in Anchorage. Collaboration meetings will be held in March and April 2015 with Kuukpik Corporation leaders. Kuukpik Corporation is a joint venture partner in the project. Permits to all federal, state and local government agencies will be submitted in the spring of 2015. 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 North Slope Borough (NSB) planning department and the NSB 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.

5.2 Proposed Schedule for Meetings

AEWC	December 11 and 12, 2014
Barrow (NSB)	TBD
Nuiqsut	TBD
Open Water	March, 2014
Kaktovik	TBD

5.3 Stage Two

SAE will document results of all meetings and incorporate to mitigate concerns into the POC. There shall be a review of permit stipulations and a permit matrix developed for the crews. The means of communications and contacts list will be developed and implemented into operations. The use of scientific and Inupiat PSOs/Communicators on board the vessels will ensure that appropriate precautions are taken to avoid harassment of marine mammals, including whales, seals, walruses, or polar bears. SAE

will coordinate the timing and location of operations with the Com-Centers in Deadhorse and Kaktovik to minimize impact to the subsistence activities or the Nuiqsut/Kaktovik bowhead whale hunt.

5.4 Stage Three

If a conflict does occur with project activities and subsistence hunting, the SAs will immediately contact the project manager and the Com Center. If avoidance is not possible, the project manager will initiate communication with a representative from the impacted subsistence hunter group(s) to resolve the issue and to plan an alternative course of action (which may include ceasing operations during the whale hunt).

6.0 EMPLOYMENT OPPORTUNITIES

SAE and its contractors work with local villages to identify qualified individuals that are interested in working on our program.

7.0 COMMUNICATION

The following contact information is provided to facilitate communication.

SAExploration	
Rick Stolz, Operations Supervisor	907-330-9662
Sue Simonds, Permits and Regulatory Coordinator	907-331-8140
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