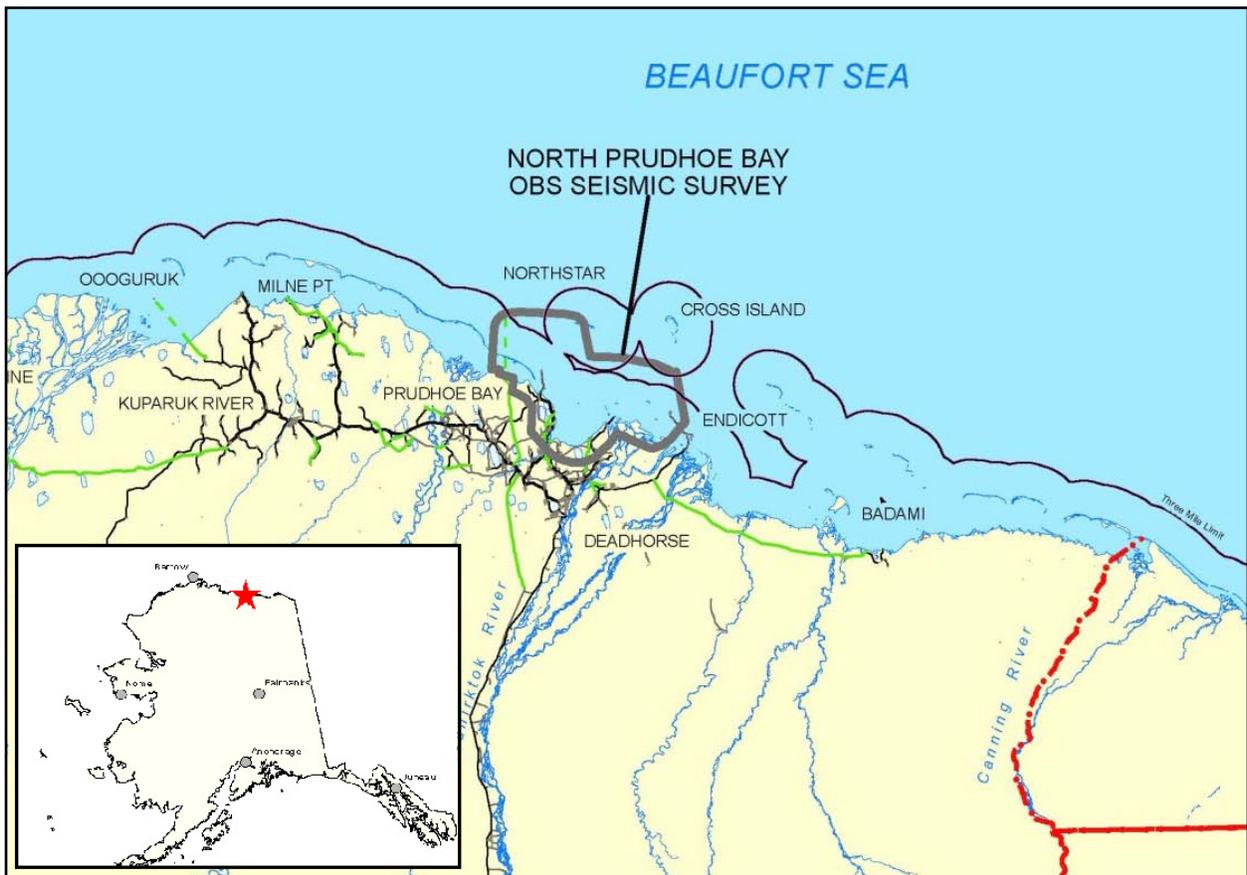




**BP Exploration (Alaska) Inc.  
North Prudhoe Bay 2014 OBS  
Geophysical Seismic Survey  
Beaufort Sea, Alaska**

**ENVIRONMENTAL ASSESSMENT**

Prepared By:  
Office of Environment  
Alaska OCS Region



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## Acronyms and Abbreviations

4MP	Marine Mammal Monitoring and Mitigation Plan
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BPXA	BP Exploration (Alaska) Inc.
CAA	Conflict Avoidance Agreement
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CWA	Clean Water Act
DM	Department of the Interior Manual
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice
EP	Exploration Plan
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
<i>FR</i>	Federal Register
G&G	Geological and Geophysical
IPCC	Intergovernmental Panel on Climate Change
LOA	Letter of Authorization
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NMML	National Marine Mammal Laboratory
NO <sub>2</sub>	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NO <sub>x</sub>	Nitrogen Oxides
NSB	North Slope Borough
OBN	Ocean Bottom Node
OBS	Ocean Bottom Sensor
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
PEA	Programmatic Environmental Assessment
POC	Plan of Cooperation
PSD	Prevention of Significant Deterioration
PSO	Protected Species Observer
SEIS	Supplemental Environmental Impact Statement
SHPO	State Historic Preservation Office
SO <sub>2</sub>	Sulfur Dioxide
U.S.	United States of America
USDOC	U.S. Department of Commerce
USDOI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile Organic Compounds

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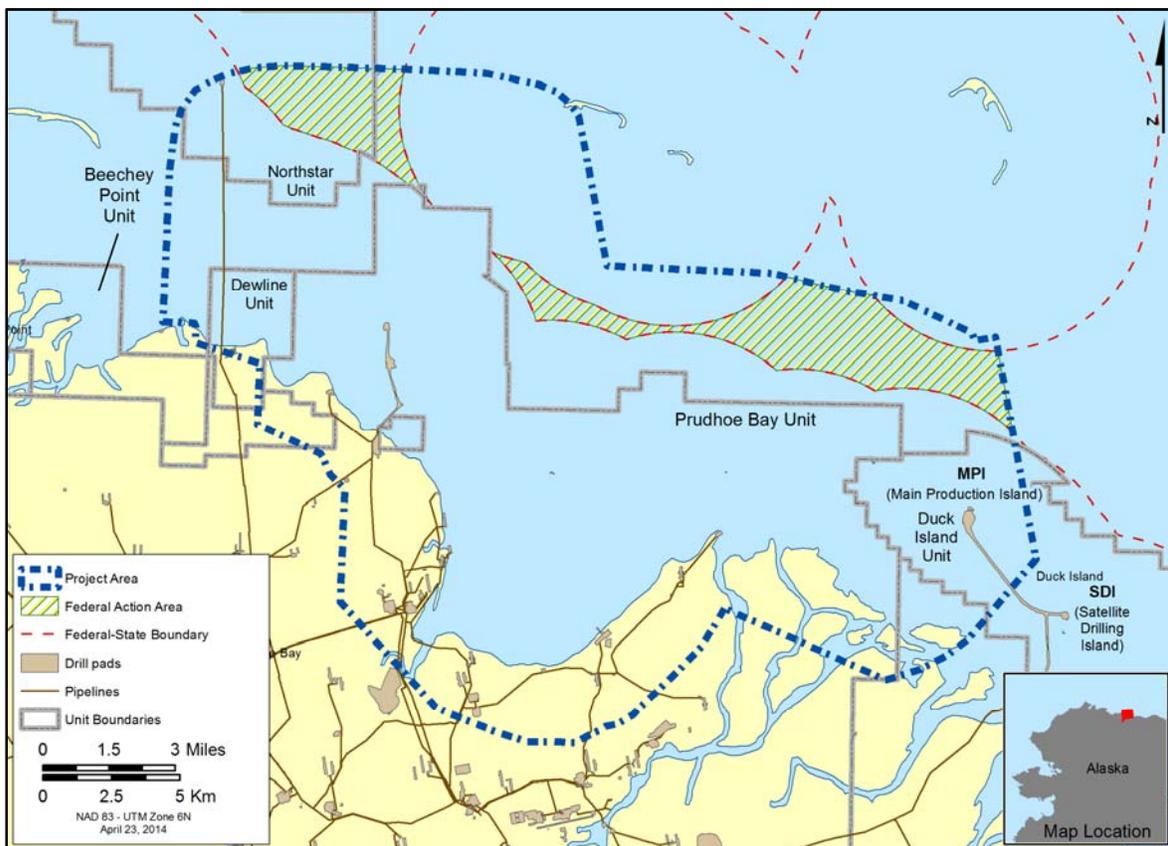
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## 1.0 PURPOSE AND NEED

BP Exploration (Alaska), Inc. (BPXA) submitted a Geological and Geophysical (G&G) permit application (BPXA, 2013a) to the Bureau of Ocean Energy Management (BOEM) on December 27, 2013 to conduct a three-dimensional (3D) ocean bottom sensor (OBS) seismic survey in the U.S. Beaufort Sea totaling 190 square miles (492 km<sup>2</sup>) (BPXA, 2013b). This proposed OBS seismic survey is referred to hereafter as the Proposed Action. Approximately 19 mi<sup>2</sup> (49.2 km<sup>2</sup>) is located in Federal OCS waters under BOEM jurisdiction. The Proposed Action would take place between June 1, 2014, and September 30, 2014.

The Proposed Action would occur offshore in the Prudhoe Bay area of the Beaufort Sea including portions of the Northstar, Dewline, and Duck Island Units as well as non-unit areas. The Proposed Action will include onshore and nearshore areas in the Sagavanirktok River Delta in both Federal and State jurisdictional areas. BOEM has jurisdiction to permit those portions of G&G surveys (30 CFR Part 551) occurring in the Federal Action Area seaward of the Federal-State Boundary (see Figure 1).



**Figure 1. Proposed Action area: North Prudhoe Bay OBS seismic survey area.** BOEM's jurisdictional area for the Proposed Action is shown in green and yellow cross-hatching.

### 1.1. Purpose of the Proposed Action

The Outer Continental Shelf Lands Act (OCSLA) (43 USC 1332) requires resources on the Outer Continental Shelf (OCS) to be made available for expeditious and orderly development, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs. The purpose of the proposed seismic program is to gather geophysical data that will be used to identify and map potential hydrocarbon-bearing formations and the geologic structures

that surround them. This information will provide critical insight into the geologic evolution, basin architecture, and depositional and structural history of the petroleum system.

BOEM has prepared this Environmental Assessment (EA) to determine whether the Proposed Action would result in significant effects to the environment, and to assist the agency in making an informed decision on the Proposed Action in accordance with the following:

- National Environmental Policy Act (NEPA) (42 USC 4231 *et seq.*).
- Council on Environmental Quality (CEQ) regulations at 40 CFR Part 1500 (specifically 1501.3(b) and 1508.27).
- Department of the Interior (DOI) regulations at 43 CFR Part 46.
- DOI policy in Section 516, Chapter 15 of the Department of the Interior Manual (DM) (516 DM 15).

Permit applications to conduct such seismic survey activities are submitted pursuant to Federal regulations for Geological and Geophysical (G&G) Explorations of the Outer Continental Shelf (OCS) at 30 CFR Part 551.

## 1.2. Previous Applicable Analyses

NEPA requires Federal agencies to use a systematic, interdisciplinary approach to protecting the human environment, which is broadly construed to include the natural and physical environment, and the relationship of people with that environment. This approach ensures the integrated use of the natural and social sciences in any planning and decision-making that may have an impact on the environment. The level of NEPA review for a particular proposed project depends on the OCSLA stage (516 DM 15), the scope of the Proposed Action, and the agency's findings on the potential effects of the Proposed Action.

BOEM has completed previous NEPA reviews of Beaufort Sea OCS activities. Documents relevant to the current analysis include, but are not limited to:

- Environmental Assessment – BP Exploration (Alaska) Three-Dimensional, Ocean-Bottom Cable, Transitional Zone Seismic Survey. March 2008 (USDOI, MMS, 2008).
- Final Programmatic Environmental Assessment, Arctic Ocean Outer Continental Shelf, Seismic Surveys – 2006 (OCS EIS/EA MMS 2006-038) June 2006 (USDOI, MMS, 2006a) (hereafter “2006 Seismic PEA”).
- Environmental Assessment - Shell Offshore, Inc., 2012 Revised Outer Continental Shelf Lease Exploration Plan, Camden Bay, Beaufort Sea, Alaska. (OCS EIS/EA BOEMRE 2011-039) (USDOI, BOEMRE, 2011a) (hereafter “2012 Shell Camden Bay EP EA”).
- Environmental Assessment – Proposed OCS Lease Sale 202, Beaufort Sea Planning Area. (OCS EIS/EA MMS 2006-001) (USDOI, MMS, 2006b).
- Environmental Assessment – Proposed OCS Lease Sale 195, Beaufort Sea Planning Area. (OCS EIS/EA MMS 2004-028) (USDOI, MMS, 2004).
- Final Environmental Impact Statement, Beaufort Sea Planning Area Oil and Gas Lease Sales 186, 195 and 202—2003 (OCS EIS/EA MMS 2003-001) February 2003 (USDOI, MMS, 2003) (hereafter “Beaufort Sea Multiple-Sale FEIS”).
- Biological Opinion and Conference Opinion for Oil and Gas Activities in the Beaufort and Chukchi Sea Planning Areas on Polar Bears (*Ursus maritimus*), Polar Bear Critical Habitat, Spectacled Eiders (*Somateria fischeri*), Spectacled Eider Critical Habitat, Steller's Eiders (*Polysticta stelleri*), Kittlitz's Murrelets (*Brachyramphus brevirostris*), and Yellow-

Billed Loons (*Gavia adamsii*). (USDOJ, FWS, 2012) May, 2012 (hereafter “USFWS 2012 Biological Opinion”).

- Endangered Species Act (ESA) Section 7(a) (2) Biological Opinion, Oil and Gas Leasing and Exploration Activities in the U.S. Beaufort and Chukchi Seas, Alaska. (NMFS, 2013) April, 2013 (hereafter “NMFS 2013 BO”).

The EA and EIS documents above, and others, are available on the BOEM Alaska OCS Region website at: <http://www.boem.gov/ak-eis-ea/>. The two Biological Opinions and others are available at: <http://www.boem.gov/About-BOEM/BOEM-Regions/Alaska-Region/Environment/Environmental-Analysis/Biological-Opinions-EPA.aspx>. Relevant sections of some of these documents are summarized and incorporated by reference in this EA. This EA builds upon these previous analyses by analyzing site- and project-specific information, and by incorporating new information from recent scientific studies.

BOEM considered and used information submitted by the project applicant, including BPXA's Environmental Evaluation Document (EED), subject to our independent evaluation of the information (40 CFR 1506.5(a)).

No comments were received during the public comment period from March 3, 2014 through midnight March 21, 2014 (EST). Further information is available at Section 5.3.

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## 2.0 PROPOSED ACTION AND ALTERNATIVES

### 2.1. Description of the Alternatives

#### 2.1.1. Alternative 1 – No Action

Under this alternative, BOEM would not approve the BPXA OBS G&G Seismic Survey Permit Application #14-03 and the proposed seismic survey would not occur in areas under jurisdiction of the Federal government. BPXA would not be able to identify and map potential hydrocarbon-bearing formations and the geologic structures that surround them, which could slow or prevent future development of these formations.

#### 2.1.2. Alternative 2 – Proposed Action

BOEM would approve the BPXA OBS G&G Seismic Survey Application #14-03 for activities in the 19 mi<sup>2</sup> area of BPXA's Proposed Action under Federal jurisdiction and located in OCS waters of the U.S. Beaufort Sea. The Proposed Action would occur during the open water season of summer 2014, beginning June 1, 2014, and concluding no later than September 30, 2014.

##### 2.1.2.1. Overview

The survey area encompasses approximately 190 square miles (mi<sup>2</sup>) (492 km<sup>2</sup>), including approximately 129 mi<sup>2</sup> (334 km<sup>2</sup>) of water depths greater than 3 feet, 28 mi<sup>2</sup> (72 km<sup>2</sup>) of water less than 3 feet, and 33 mi<sup>2</sup> (85 km<sup>2</sup>) of land. Approximately 19 mi<sup>2</sup> (49.2 km<sup>2</sup>) of the Proposed Action is located in Federal waters of the U.S. Beaufort Sea (BPXA, 2013b).

##### 2.1.2.2. Seismic Survey

Equipment for this Proposed Action will include geophysical equipment such as receivers, airguns, nodes, batteries, helicopters, tracked drills, and vessels. Vessels anticipated for use in data acquisition are shown in Table 1. A total of three source vessels (one main vessel and two smaller vessels) and a variety of associated vessels will be in operation to support seismic activities.

BPXA plans to mobilize equipment to Deadhorse in late May/early June, 2014. Mobilization, demobilization, and support activities are planned to occur at West Dock, East Dock, and Endicott. Vessels will be transported to mobilization sites by truck and prepared for launch at existing facilities in Deadhorse. A temporary flexi-float dock (170 ft (51.8 m) x 30 ft (9.1 m)) comprising sections that will be fastened on location and secured with spuds to the seafloor may be located at West Dock to provide support for vessel supply operations, personnel transfers, and refueling. A smaller temporary dock (up to 100 ft (30.5 m) x 20 ft (6.1 m)) may be used at Endicott during some of the eastern operations if needed for additional support operations.

BPXA proposes to operate 10 vessels for the duration of this Proposed Action; combined, these 10 vessels would make an estimated 11 roundtrips per day from the field operations to shore bases. Up to 13 smaller inflatable or amphibious watercraft (such as airboats) would also be employed.

The Proposed Action area is separated into three zones based upon types of receivers that will be used and method of receiver deployment and retrieval for each zone (BPXA, 2013b).

- **Offshore Zone.** The offshore zone is waters of 3 feet or deeper ( $\geq$ ). Receiver boats will be used for deployment and retrieval of receivers (marine nodes) placed in lines on the ocean bottom at 110 ft (33.5 m) spacing. Acoustic pingers will be deployed on every second node to determine exact positions of the receivers. Receivers will not be placed east of the Endicott Main Production Island (MPI), and will therefore not be placed in areas identified as part of the Boulder Patch. The offshore area of the Proposed Action under BOEM jurisdiction is 19 mi<sup>2</sup> (49.2 km<sup>2</sup>) of the 157 mi<sup>2</sup> (406.6 km<sup>2</sup>) total offshore area.

- **Surf Zone.** The surf zone includes waters up to 6 ft (1.8 m) deep along the coastline, non-vegetated tidelands, and lands within the river delta areas that are intermittently submerged with tidal, precipitation, and storm surge events. Tracked amphibious watercraft and utility type vehicles with approximate 4 in (10 cm) diameter bits will be used to drill the receivers to approximately 6 ft (1.8 m) (alternatively, the receiver holes may be created by water flushing). Small vessels will then attach autonomous nodes to the receivers. Nodes will be protected from the water by placement on either specially designed floats anchored to the bottom or on support poles or tripods. Support poles or tripods will primarily be used in water less than 18 in (45.7 cm) deep and in tidal surge areas to ensure that the nodes stay above surface waters and prevent them from becoming inundated as a result of fluctuating water levels. Installed receivers may require flushing using warm water to assist with removal. BPXA would withdraw water from the Sagavanirkok River and Beaufort Sea to use to flush and remove receivers from the riverbed and shallow water seafloor. BPXA would withdraw water from two sources: the Sagavanirkok River delta waters (approximately 375 gallons (gal) (1,420 L) per day for a total of 9,375 gallons (35,488 L)); and Beaufort Sea waters <6 ft (1.8 m) deep (approximately 375 gal (1,420 L) per day for a total of 15,175 gal (57,444 L)). Water withdrawn for flushing would be warmed (up to 100°F (37.8°C)).
- **Onshore Zone.** The onshore zone is vegetated area from the coastline inland. Autonomous nodes with geophones will be used in this area. Helicopters will be the main method used to transport land crews and equipment. Equipment will be bagged, with each bag holding several nodes, and multiple bags will be transported via sling load from the staging area to the receiver lines and temporarily cached. Bag drop zones will be 500 to 1,000 ft (152.4-304.8 m) apart and will be cleared for the presence of nesting birds prior to use. Crews on foot will walk from bag to bag and lay out equipment at surveyed locations. Vessels may also be used to transport personnel and equipment to a staging area on the beach, and vehicles may be used to transport personnel and equipment along existing road systems. Rigid-hull-inflatable (RHI) boats may be used in lakes to deploy marine nodes. Boats, nodes, and crews will be transported via helicopter to and from the lakes. Nodes will be located on the ground surface and the receiver(s) will be inserted approximately 3 ft (1.8 m) below ground surface. Receiver installation will either be by hand using a planting pole, or inserted into approximately 1.5 in (3.8 cm) diameter holes made with a hand-held drill. Support poles or tripods may be placed in lake margins and marshy areas of tundra as needed to ensure the nodes stay above surface waters and prevent them from becoming inundated as a result of fluctuating water levels. Upon completion of recording operations in a particular area, land crews will retrieve the nodes. If conditions allow, an advance crew will install receivers in the Sagavanirktok River Delta portion of the survey area in late winter for up to 30 days beginning in April, until tundra travel closure. Two tracked utility vehicles will drill in receivers with a support vehicle providing logistics. Approximately 15 people will be conducting this work in two shifts during a 24-hour period. GPS location of receivers will be recorded and survey lathe or markers be used to assist in marking the location. Receivers will be connected to recording nodes during the main OBS survey time (June – September).

Seismic data acquisition will occur on a 24-hour per day schedule with staggered crew changes. Receiver retrieval and demobilization of equipment and support crew will be completed by the end of September.

Smaller vessels (e.g. crew transport and support vessels) will be launched from West Dock, East Dock or Endicott. Staging of personnel, equipment, and helicopters will be based at existing facilities at Deadhorse. Personnel transportation between camps, pads, and support facilities will be by trucks

and crew transport bus via existing gravel roads. Shallow water craft such as Zodiac-type vessels and tracked amphibious watercraft will be used to transport equipment and crews to shallow water and surf zone areas of the survey area not accessible by road; tracked amphibious watercraft will not be used in vegetated areas, including tundra. Helicopters will be used to transport equipment and personnel to onshore areas (tundra and delta) where crews on foot will deploy equipment. Trucks may also be used on the existing road system to transfer survey equipment and crews to the onshore portions of the survey area accessible by road and pads.

BPXA would develop a Waste Management Plan before field work begins. Waste would be transferred for disposal at approved onshore waste treatment and disposal facilities. Typical wastes include - trash, packaging material, food waste, batteries, and aerosol cans. Waste management guidelines for segregation and disposal will be followed based on the Alaska Waste Disposal and Reuse Guide.

Approximately 220 personnel would be involved in the operation including seismic crew, management mechanics, and Protected Species Observers (PSO). Most of the crew will be accommodated at existing BPXA operated camps or Deadhorse. Some offshore crew members will be housed on vessels.

BPXA reports it would operate in accordance with the applicable conditions set forth in the EPA Vessel General Permit. Effluent volumes for domestic and sanitary discharges would vary by vessel type, size and number of personnel on board. BPXA reports that no ADEC solid waste or wastewater authorizations would be required for this Proposed Action.

Prior to commencement of the Proposed Action, surveyors would deploy up to three navigation positioning base stations (survey control) onshore or on an island and mark receiver locations in advance of the lay-out crews. Scouting of the Proposed Action area and collecting bathymetry information necessary to identify site-specific conditions such as water depth in nearshore areas will be performed prior to receiver deployment.

**Table 1. Vessels to be operated.**

Vessel Type	Number (approx..)	Dimensions (up to/approximately)	Main Activity	Frequency
<b>Offshore and Surf Zone</b>				
Source Vessel: Main	1	90 x 25 ft (27 x 7.6 m)	Seismic Data Acquisition	24-Hour Operation
Source Vessel: Small	2	70 x 16 ft (21 x 4.9 m)	Seismic Data Acquisition	24-hour Operation
Receiver Boats	4	85 x 24 ft (26 x 7.3 m) 32 x 14 ft (9.8 x 4.3 m)	Deploy and Retrieve Receivers in Offshore Zone	24-Hour Operation
Crew Transport, HSE & Support Vessels	2	45 x 14 ft (13.7 x 4.3 m)	Transport Crew and Supplies	Typically Twice Daily
Support Vessel	1	116.5 x 24 ft (35 x 7.3 m) 23 x 15 ft (7 x 4.6 m)	Crew support	24-Hour Operation
<b>Surf Zone and Onshore</b>				
Tracked Amphibious Watercraft	2	N/A	Deploy and Retrieve Receivers in Surf Zone and Non-Vegetated Onshore Areas	24-Hour Operation
Utility type vehicle/vessel*	Up to 6	N/A	Deploy and Retrieve Receivers in Surf Zone and Non-Vegetated Delta Areas Transport fuel and water for drilling	24-Hour Operation
Rigid Hull Inflatable Boats	Up to 3	N/A	Transport Crew and Supplies	24-Hour Operation

Vessel Type	Number (approx..)	Dimensions (up to/approximately)	Main Activity	Frequency
Airboats	Up to 2	N/A	Transport Crew and Supplies	24-Hour Operation
Hovercraft**	1	N/A	Transport Crew and Supplies	As Needed

Notes. In the event a specific vehicle or vessel is not available, a vehicle or vessel with similar parameters would be used.  
 Vessel and vehicle dimensions marked as N/A where size is variable and not usually provided in vehicle or vessel descriptions.  
 \* Utility type vehicles include: tracked or wheeled buggy, catamaran, airboat, or similar equipment in combination.  
 \*\* Hovercraft will be used opportunistically as needed.

### 2.1.2.3. Schedule

Site preparation activities and installation of receivers in the Sagavanirktok River Delta may occur in April, 2014. Preliminary mobilization may begin as early as late May/early June, 2014. The start of operations is dependent upon receipt of appropriate permits and authorizations. Seismic data acquisition activities are anticipated to start approximately July 15. Survey vessels would launch from existing facilities or temporary docks at West Dock, East Dock, or Endicott to the survey area as sea ice conditions allow. Open water seismic operations can only begin when the Proposed Action area has a minimal sea ice coverage (<10% ice coverage), which could be mid-late July into August. Survey activities would be conducted until subsistence whaling begins. Historically, whaling begins in the area of the Proposed Action in late August to early September. BPXA has committed to limiting airgun operations to dates agreed upon with the Nuiqsut whaling captains, which will be “captured in the CAA [conflict avoidance agreement]” (BPXA, 2013b). The CAA has historically ended airgun operations on August 25<sup>th</sup> at the start of the bowhead whale hunt. Demobilization of equipment will continue following the end of airgun operations, and is expected to be completed by the end of September.

### 2.1.2.4. Sound Generation

Three airgun arrays will be in operation. Two vessels will carry an airgun array that consists of two sub-arrays. One vessel will carry only one sub-array. The discharge volume of the sub-array will not exceed 620 in<sup>3</sup>. Each sub-array consists of eight airguns totaling 16 guns for the two subarrays with a total discharge volume of  $2 \times 620 \text{ in}^3$  (10.4 L<sup>3</sup>), or 1240 in<sup>3</sup> (20.3 L<sup>3</sup>). The 620 in<sup>3</sup> (10.4 L<sup>3</sup>) sub-array has an estimated source level of ~218 decibels referenced to 1 microPascal root mean squared (dB re 1  $\mu\text{Pa}$  rms) at 1 meter from the source. The estimated source level of the two sub-arrays combined is ~224 dB re 1  $\mu\text{Pa}$  rms. These characteristics are described below (Table 2). Each array will be towed at a distance of approximately 50 ft (15 m) from the source vessel’s stern at 3 to 6 feet (0.9 – 1.8 m) below the surface. The source vessels will travel along pre-determined lines with a speed varying from approximately 1 to 5 knots (1.85 to 9.26 km/h), mainly depending on the water depth. To limit the duration of the total survey, the source vessels will be operating in a flip-flop mode alternating their airgun discharges. This means that one vessel will discharge airguns when the other vessel is recharging. The two main source vessels will be operating with expected discharge intervals of 10 to 12 seconds, resulting in an airgun discharge every 5 to 6 seconds.

**Table 2. Proposed airgun array configuration and source signatures as predicted by the Gundalf Airgun Array model for 2 m depth.**

Array Parameter	Vessel 1: 620 in <sup>3</sup> array	Vessels 2 and 3: 1240 in <sup>3</sup> array
Number of guns	Eight 2000 psi sleeve airguns (2 x 110, 2 x 90, 2 x 70, and 2 x 40 in <sup>3</sup> ) in one array)	Sixteen 2000 psi sleeve airguns (4 x 110, 4 x 90, 4 x 70, and 4 x 40 in <sup>3</sup> ), equally divided over two sub-arrays of eight guns each
Zero to peak	6.96 bar-m (~237 dB re $\mu\text{Pa}$ @ 1 m)	13.8 bar-m (~249 dB re 1 $\mu\text{Pa}$ @ 1 m)
Peak to peak	14.9 bar-m (~243 dB re $\mu\text{Pa}$ @ 1 m)	29.8 bar-m (~243 dB re 1 $\mu\text{Pa}$ @ 1 m)

Array Parameter	Vessel 1: 620 in <sup>3</sup> array	Vessels 2 and 3: 1240 in <sup>3</sup> array
RMS pressure	0.82 bar-m (~218 dB re $\mu$ Pa @ 1 m)	1.65 bar-m (~224 dB re $\mu$ Pa @ 1 m)
Dominant frequencies	Typically less than 1 kHz	Typically less than 1 kHz

### 2.1.2.5. Monitoring and Mitigation

#### Monitoring

**Table 3. Distances (in meters) to be used for mitigation purposes for the proposed airgun arrays of the BPXA North Prudhoe Bay 2014 OBS Seismic Survey.**

Airgun Discharge Volume (In <sup>3</sup> )	Distance (In Meters)		
	160 dB RE 1 $\mu$ PA	190 dB RE 1 $\mu$ PA	180 dB RE 1 $\mu$ PA
620 – 1240 in <sup>3</sup> (10.4 L <sup>3</sup> -20.3 L <sup>3</sup> )	2,200	300	600
40 in <sup>3</sup> (0.66 L <sup>3</sup> )	1,100	70	200
10 in <sup>3</sup> (0.16 L <sup>3</sup> )	450	20	50

Source: 2014 BPXA Incidental Harassment Authorization (IHA) application section 6.2, Tables 7 and 8 (BPXA, 2013d).

#### Visual Vessel-Based Monitoring

BPXA will work with NMFS and FWS to design monitoring protocols that meet the requirements of the Marine Mammal Protection Act (MMPA). Required monitoring protocols will be established in the Incidental Harassment Authorization (IHA) and Letter of Authorization (LOA), respectively, which BPXA would obtain prior to initiating seismic survey activities. The objectives of the vessel-based monitoring would 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 Action area.

The monitoring and mitigation plan will be implemented by a team of experienced Protected Species Observers (PSOs), including both biologists and Iñupiat communicators. PSOs on board the source vessels play a key role in monitoring the 160 dB threshold area for potential Level B Harassment, and will monitor and implement mitigation measures in the 190 and 180 dB safety zones to mitigate Level A Harassment. PSOs will be stationed aboard vessels to monitor and implement mitigation measures during all seismic operations. BPXA intends to work with experienced PSOs. At least one Alaska Native resident, who is knowledgeable about Arctic marine mammals and the subsistence hunt, is expected to be included as one of the team members aboard the vessels. 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 use these distances to monitor the safety zones during the entire Proposed Action. When marine mammals are observed within, or about to enter, these designated safety zones, PSOs have the authority to call for immediate power down (or shutdown) of airgun operations as required by the situation.

BPXA plans to conduct 24-hr operations. PSOs will not be on duty during ongoing seismic operations during darkness, given the very limited effectiveness of visual observation at night (there will be no periods of darkness in the survey area until mid-August). Two PSOs will be present on each seismic source vessel.

When periods of darkness or periods of poor visibility occur after mid-August and no PSOs are on duty, BPXA's proposed IHA provisions (BPXA, 2013d, p. 48) include:

- If conditions of fog, heavy rain or snow, or darkness exist and the full 180 dB safety zone is not visible, airguns cannot commence a ramp up procedure from a full shutdown.
- If one or more airguns have been operational before the onset of poor visibility or nightfall, they can remain operational through these conditions and ramp up procedures can be initiated even though the 180 dB safety zone is not visible based on the assumption that marine mammals will be alerted by the sounds of the airgun and move away.

### **Aerial Monitoring**

Aerial monitoring will not be conducted as part of this program. The minimum distance between the two source vessels will be about 550 ft (168 m). The monitoring radius is 5 Km (3.1 mi) to the 160 dB isopleth and will be observed by PSOs aboard seismic vessels. The seismic source vessels will offer suitable platforms for marine mammal observations and during the day, PSOs utilizing reticle binoculars and the naked eye will scan the area around the vessel, making observations of marine mammals which may enter the designated safety zone. Observations will be made from locations where PSOs have the best view around the vessel. In addition, seismic operations will be suspended or airguns fully powered down if marine mammals enter the safety zone (Table 3).

### **Monitoring zones**

PSOs will establish and monitor a safety zone for marine mammals 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 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 or power down. Table 3 above shows the BPXA developed sound radii used to establish safety zones.

Pre-season distances to received sound levels of 180 and 190 dB produced by the proposed airgun arrays have been determined based on existing sound source verification measurements. PSOs will use these distances to monitor the safety zones during the entire Proposed Action. When marine mammals are observed within, or about to enter, these designated safety zones, PSOs have the authority to call for immediate power down (or shutdown) of airgun operations as required by the situation. A summary of the procedures associated with each mitigation measure is provided below. The criteria are consistent with previous NMFS IHA guidance, and included in their current application (BPXA, 2013d).

BPXA proposes to monitor safety radii zones for marine mammals before, during, and after the operation of the airguns. Monitoring will be conducted using qualified PSOs on vessels. All preliminary monitoring zones will be adjusted as needed based on existing sound source verification measurements.

The distances to received levels of 180 dB and 190 dB re 1  $\mu$ Pa (rms) are mainly relevant as safety radii to avoid Level A Harassment of marine mammals through implementation of shutdown and power down measures. When within 900 ft (270 m) of whales, vessel operators shall take every effort and precaution to avoid harassment of these animals.

### **Protected Species Observers**

Vessel-based monitoring for marine mammals will be done by trained PSOs throughout the period of seismic operations. 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.

### **Number of Observers**

BPXA intends to work with experienced PSOs. Two PSOs will be present on each seismic vessel. At least one Alaska Native resident, who is knowledgeable about Arctic marine mammals and subsistence hunting, is expected to be included as one of the team members aboard the vessels. Before the start of the seismic survey, the crew of the source vessels will be briefed on the function of the PSOs, their monitoring protocol, and mitigation measures to be implemented. On all source vessels, at least one observer will monitor for marine mammals at any time during daylight hours (there will be no periods of total darkness until mid-August) (U.S. Navy, 2014). PSOs will be on duty in shifts of a maximum of 4 hours at a time, although the exact shift schedule will be established by the lead PSO in consultation with the other PSOs.

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

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

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

### **PSO Role and Responsibilities**

The source vessels will offer suitable platforms for marine mammal observations. Observations will be made from locations where PSOs have the best view around the vessel. During daytime, the PSO(s) will scan the area around the vessel systematically with reticle binoculars and with the naked eye. The main purpose of the PSO on board the vessel is detecting marine mammals for the implementation of mitigation measures according to specific guidelines. 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.
- 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 to ensure that disturbance of marine mammals is minimized, and potential effects on marine mammals are documented. PSOs will implement the monitoring and mitigation measures specified in any NMFS issued IHA and in the Marine Mammal Monitoring and Mitigation Plan (4MP), unless the IHA and/or 4MP designate a different person to implement a given measure. The primary duties of the PSOs on board the vessels are:

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

PSOs would be stationed at the best available vantage point on the source and support vessels to observe marine mammals. 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 less experienced PSOs will be paired with experienced PSOs or field biologists to ensure consistent quality of marine mammal observations and data recording.

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, directional heading (if consistent);
- Bearing and distance from observer, apparent reaction to activities (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and behavioral pace;
- Time, location, speed, and activity of the source and mitigation vessels, sea state, ice cover, visibility, and sun glare; and positions of other vessel(s) in the vicinity.

## Mitigation

### Sound Source Verification (SSV)

BPXA does not intend to conduct sound source verification (SSV) testing during this Proposed Action. Existing sound source verification methodology has been provided to NMFS (BPXA, 2013d) and USFWS (BPXA, 2014). Based on existing SSV data, BPXA has established safety radii for 180 dB (for cetaceans and Pacific walrus) and 190 dB (for pinnipeds (except Pacific Walrus) and polar bears), which include marine mammal safety zones and the 160 dB Level B Harassment zone.

### Shut-Down Procedure

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

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

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

### Power-down Procedure

Whenever a marine mammal is detected outside the safety radius and based on its position and motion relative to the ship track is likely to enter the exclusion zone, PSOs may call for the seismic operations to implement a power-down procedure (de-energize the airgun array). A power-down procedure involves reducing the number of air guns in use such that the radius of the 180 dB (or 190 dB) zone is decreased to the extent that marine mammals are not in the exclusion zone. During a power down, a mitigation air gun (air gun of small volume such as the 10 in<sup>3</sup>) is operated. If a marine mammal is detected outside the safety radius (either injury or harassment) but is likely to enter that

zone, the air guns may be powered down before the animal is within the safety radius, as an alternative to a complete shutdown.

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

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

### **Ramp-up Procedure**

A “ramp-up” procedure gradually increases air gun volume at a specified rate using a stepped 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 immediate area and avoid any potential injury. Ramp-up is used at the start of air gun operations, including a power-down procedure, shut-down, and after any period greater than 10 minutes in duration without air gun operations. The air gun array begins operating after a specified-duration period without air gun operations. The rate of ramp-up will be no more than 6 dB per 5 minute period. Ramp-up will begin with the smallest gun in the array that is being used for all air gun array configurations.

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 safety radii are not visible for at least 30 minutes prior to ramp-up in either daylight or nighttime, and ramp-up will not commence at night unless the mitigation air gun has maintained a minimum sound source pressure level at the source during the interruption of seismic survey operations.

### **Speed or Course Alteration**

Whenever a marine mammal is detected outside the exclusion zone radius and based on its position and motion relative to the ship track is likely to enter the exclusion zone, PSOs may request that the seismic operations implement an alternative ship speed or track. If a marine mammal is detected outside the applicable safety radius and is likely to enter this area, the vessel may change speed and course when safe and practical. This change minimizes effects of seismic operations on marine mammals and can be used in conjunction with power-down procedures. The marine mammal activities and movements relative to the seismic and support vessels will be closely monitored to ensure that the marine mammal does not approach within the applicable exclusion zone. If the mammal appears likely to enter the exclusion zone, further mitigation actions will be taken; for example, either further course alterations, power-down, or shut-down of the air gun(s).

As an additional mitigation measure, vessels shall not be operated at speeds that would make collisions with marine mammals likely, regardless of whether airguns are operating. When weather conditions require, such as when visibility drops, vessels shall adjust speed accordingly to avoid the likelihood of marine mammal collisions and if in proximity of feeding whales or aggregations BPXA will reduce vessel speed to less than 10 knots (18.4 km/h) when within 900 feet (270 m) of whales and those vessels capable of steering around such groups will do so.

## 2.2. Mitigation and Monitoring of Marine and Coastal Birds

The Migratory Bird Treaty Act (MBTA) of 1918 (amended in 1936 and 1972), prohibits the taking of migratory birds, unless authorized by the Secretary of Interior. Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds) provides for the conservation of migratory birds and their habitats, and requires the evaluation of the effects of Federal actions on migratory birds, with an emphasis on species of concern. Federal agencies are required to support the intent of the migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory birds when conducting agency actions (66 Code of Federal Regulations [CFR] 3853, January 17, 2001). According to BPXA (pages 99-100, North Prudhoe Bay Unit, Ocean Bottom Sensor Seismic Survey, Environmental Impact Assessment, BP Exploration [Alaska] Inc., December 2013), the following mitigation measures have been included in the design of their survey to reduce any potential impacts to the localized avian habitats:

1. Islands with known nest colonization (Reindeer, Howe, Niakuk, and Gull) have been eliminated from the survey.
2. An extensive nest survey by avian biologists is planned to be conducted in all portions of the seismic survey area during the nesting period when active nests are anticipated. Each discovered nesting location will be identified and marked for the establishment of buffer zones. The avian biologist will transit to and from sites utilizing the road system or by boat prior to any rotary activity.
3. A buffer of 100 ft (31 m) will be established around all identified threatened, endangered, and candidate listed bird species nests for all land-based Proposed Action associated activities, to include helicopter activities.
4. Crews will be given awareness training to avoid wildlife interactions and maintain distance from wildlife. Ground-based crews that encounter flocks of flightless/molting birds will avoid blocking access to an escape route and divert around flocks.
5. Airgun ramp up, power down, and shut down procedures will be utilized.
6. Vessels and aircraft operators will maneuver to avoid high-density areas whenever possible.
7. BPXA is required to implement the following special conditions related to the USFWS 2012 BO to avoid or minimize adverse effects to ESA-listed birds (spectacled eiders, Steller's eiders, and yellow-billed loons).
  - a. BPXA will minimize the use of high-intensity work lights on their vessels, especially within the 20-m (66 ft) bathymetric contour. Exterior lights will only be used as necessary to illuminate active, on-deck work areas during periods of darkness or inclement weather; otherwise they will be turned off. Interior and navigation lights should remain on as needed for safety.
    - b. All bird encounters on BPXA vessels are to be reported within 3 days to BSEE-EED and BOEM-RE. Each report shall include the following items to be considered complete:
      - Date and Time the bird was first observed.
      - Location of vessel in decimal degrees (format: latitude XX.XXXX longitude - XXX.XXXX).
      - Species, identified to lowest possible taxonomic level using standardized AOU codes.
      - Weather (at time bird first observed): wind speed, fog, rain/snow.
      - General weather 24 hours prior to bird observation.

- Photographs of each bird (if practicable). For dead birds clear images of wing spread, top and bottom, and head views should be provided.
- Vessel operational status: at anchor/adrift or underway/in transit.
- Any indications that lighting may have factored into attracting birds to the vessel (e.g., was extra lighting on because it was dark or a specific activity was ongoing?).
- Any additional comments on bird behavior, physical description, injury or fate.

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## 3.0 AFFECTED ENVIRONMENT

This section describes the environmental conditions and resources in areas potentially affected by the Proposed Action.

### 3.1. Expected Operating Conditions

#### 3.1.1. Climate Change

The Council on Environmental Quality (CEQ), which oversees the implementation of the National Environmental Policy Act (NEPA), recognizes that there may be potential health and environmental effects associated with emissions of greenhouse gases (GHG) and climate change that may be relevant to proposed Federal actions. Therefore, the CEQ issued draft guidance in 2010 (CEQ, 2010) to advise Federal agencies to consider opportunities to reduce GHG caused by proposed Federal actions, and evaluate the relativity of the actions with respect to the effects of climate change. In the guidance, Federal agencies are asked to consider, in the context of the NEPA process, how Federal actions could contribute to the emissions of GHG and how climate change could potentially influence the natural resources affected by Federal actions. The Proposed Action is located in the Beaufort Sea OCS of the Arctic region, which is of particular importance to global climate and especially sensitive to climate change. A discussion of climate change in the Arctic, and how changes in Arctic climate may affect the natural resources evaluated in this environmental review, is in Appendix B (Sec 2.6).

#### 3.1.2. Climate and Meteorology of the Alaska North Slope

The area is characterized as having a polar tundra climate according to the Köppen classification system, which is based on the amount of annual sunshine, distribution of land and water, ocean currents, prevailing winds, synoptic weather patterns (weather patterns over a large area), mountain barriers, and altitude (Ahrens, 2013). The land area adjacent to the Beaufort Sea is affected by most of these factors, including a sea-land interface, prevailing winds that are at least partially driven by the Brooks Range, and a semi-permanent synoptic weather pattern.

##### Surface Pressure Centers

During the summer months of ice-free water, the influence of maritime polar air masses is greatest and the ocean has a moderating influence resulting in higher temperatures in the winter and lower temperatures in the summer than the inland areas of Alaska. This is due to the semi-permanent area of low pressure referred to as the Aleutian Low (Shulski and Wendler, 2007). The center is most intense in the winter, has little effect in the summer, but tends to intensify through autumn months and accounts for the drop in Prudhoe Bay's mean temperature in September (29.3°F (1.5°C)) as compared to August (36.7°F (2.6°C)).

##### Precipitation and Relative Humidity

Prudhoe Bay is 631 mi (1015 km) north of the Arctic Circle and the ground is covered by permafrost and permanently frozen hundreds of feet deep except for the near-surface layer that partially thaws during the warmest months of the summer. This will cause the surface to be marshy and muddy during the time the seismic operations are planned to occur. While the annual precipitation is relatively low (4.04 in (10.3 cm)), more than half of this amount will fall as rain over the months of July, August, and September, averaging 0.79 inches (.02 cm) per month (total of 2.37 in (6.0 cm) for the three-month period). In areas much further south, such a small amount of annual rainfall would cause desert conditions; however, the rate of evaporation is low in the cold air and there is even some vegetation, including mosses, lichens, fungi and algae, and scattered wooded vegetation. Typical weather conditions during the Proposed Action would be mostly cloudy skies and 89 percent relative humidity.

## Temperatures

Temperatures at Prudhoe Bay have risen over the last 30 years, as seen in the data recorded by the National Climatic Data Center (NCDC) and compiled by the Western Regional Climate Center (WRCC) during the period from 1981 through 2010, as compared with the same area throughout the period from 1971-2000 (WRCC, 2014a). The average mean daily high temperature in Prudhoe Bay will be 47.4°F (8.56°C) throughout the months of the survey, and the average mean daily low temperature will be above freezing, 35.2°F (1.78°C).

## Wind Velocity

A multiyear meteorological study that includes data from stations along the Beaufort Sea coastline at Barter Island, Kaktovik, Deadhorse, and Nuiqsut, Alaska, suggests the trend for wind patterns on the North Slope are influenced by the Brooks Range (Veltkamp and Wilcox, 2007). The study shows that regardless of whether the winds are from the east or west, the flow over the eastern portion of the Beaufort Sea coastline is influenced by the Brooks Range, which can affect wind direction as far as 30 miles (48.3 km) offshore along the area extending from Camden Bay to Mackenzie Bay. The incidence of wind channeling is strongest on the eastern coastline near Barter Island. Influence from the mountain range decreases to the west and shows little impact west of Barrow where wind direction in the Chukchi Sea is influenced more by surface pressure systems. Historical wind data is available for Deadhorse, Alaska, 15 miles (24.1 km) southeast of Prudhoe Bay, and was compiled by WRCC based on hourly wind data during the period from 1992 through 2002. The data indicates prevailing winds will occur from the east northeast during July, turning easterly with the approach of fall months (WRCC, 2014b). Wind speeds compiled from data collected at Barrow, Alaska, 197 miles (317 km) northwest of Prudhoe Bay, will average 12.4 mph (5.54 m/s), with occasional gusts averaging 43 mph (19.2 m/s).

## Solar Radiation

Probably the most unique climate feature of Prudhoe Bay is the extreme seasonal variations in the amount of solar radiation (Shulski and Wendler, 2007). The sun will rise in Prudhoe Bay early on the morning of May 15, 2014, and will not set again until July 29, 2014. Summer days are in constant sunlight with a low sun near the horizon. Sunlight is reflected by snow and ice making summers chilly. The seismic survey will operate in 24-hour sunlight during July, 15 to 20 hours per day of sunlight in August, and 11 to 15 hours daily in September (U.S. Navy, 2014). When considering the effect of the wind, outside temperatures may drop to uncomfortable levels in the lower to middle twenties Fahrenheit (-7 to -3.8°C). Given the occasional wind gusts detected in Barrow, wind chills could drop to around 10°F (-12.2°C).

### 3.1.3. Ice Conditions

This sea-ice description builds upon discussion in the Beaufort Sea Multiple-Sale FEIS (USDO, MMS, 2003, Section III.A.4). Salient points from this document are summarized as follows. There are three general forms of sea ice in the Proposed Action area:

- Landfast ice, which is attached to the shore, is relatively immobile, and extends to variable distances offshore;
- Stamukhi ice, which is grounded and ridged ice; and
- Pack ice, which includes first-year and multiyear ice and moves under the influence of winds and currents.

The Proposed Action is planned for the Arctic summer “melt” and “open-water” season from June to September 2014. The Proposed Action area covers portions of the landfast ice zone which generally becomes ice free from around June 22 to July 12 (Mahoney et al., 2012). Stamukhi ice is not

anticipated in the Proposed Action area; however, pack ice could be driven by wind or currents into the area at any time during the period of operations.

The concentration of Arctic sea ice reaches its northern minimum in mid- to late-September. The Arctic sea ice begins growing southward again with the onset of freezing temperatures. In the Beaufort Sea, the landfast ice begins forming in the third week of October in the lagoons and late October to early November in the nearshore region (Mahoney et al., 2012; Leidersdorf, Scott, and Vaudrey, 2012.). A weekly analysis of the National Ice Center sea ice data, from 2005 through 2012, shows great variability year to year in sea ice coverage from June through September (Figure 2). Sea ice coverage in the survey area generally increases from south to north.

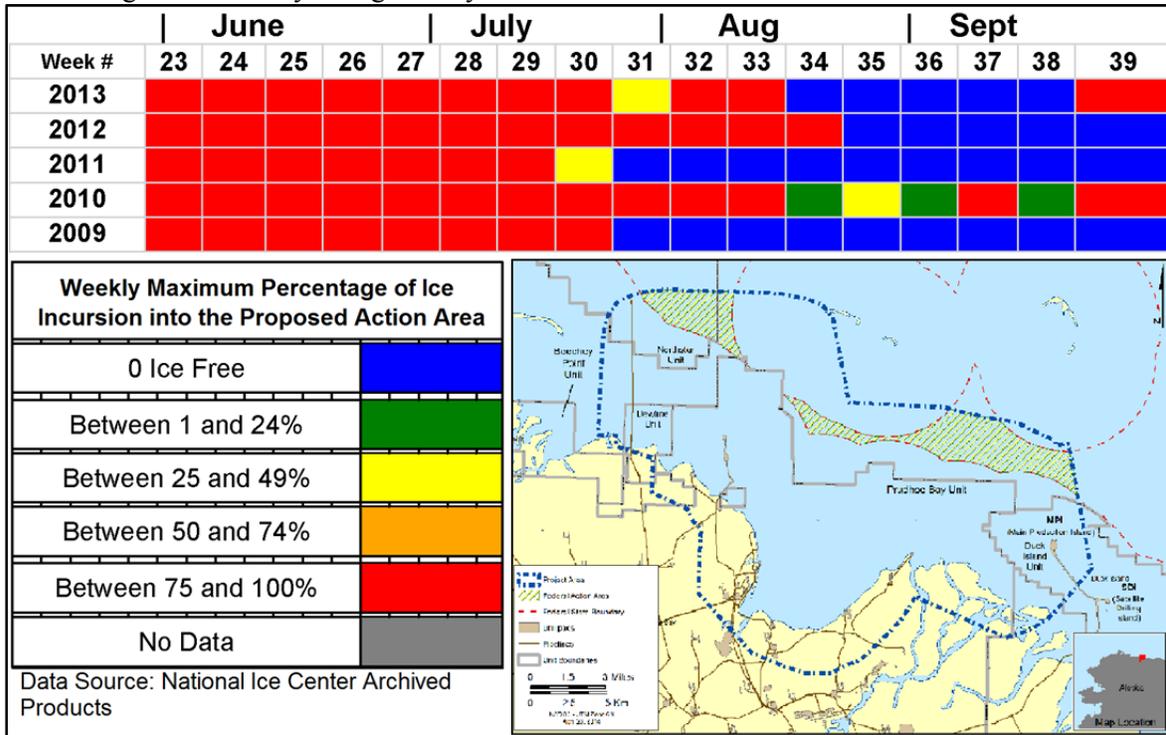


Figure 2. Weekly maximum percentage of ice incursion into the Proposed Action area.

The predominant ice stages within the Proposed Action area in October are thin first-year ice (30-70 cm (11.8 – 27.5 in)), new ice, and young ice (10-30 cm (3.9–11.8 in)) in patches and small floes; however, multiyear ice floes can be blown by wind into the Proposed Action area at any time.

**3.1.4. Sea State**

Sea state is primarily wind driven in the nearshore Beaufort Sea. Sea ice will dampen wave heights but during the open water season the higher the winds the higher the sea state will be. East northeast winds predominate in the Beaufort Sea in July–October with a frequency of 40–60% and the scalar mean wind speed ranges from 2 to 6 meters per second (m/s) (4.5–13.4 miles per hour (mph)) (Brower et al., 1988; Weinzapfel et al., 2011; Stegall and Zhang, 2012).

Stegall and Zhang (2012) noted increasing trends of areal averaged monthly mean and 95<sup>th</sup> percentile wind speeds for July through November. October had the strongest increase in the areal averaged wind speeds from 7 m/s (15.7 mph) in 1979 to 10.5 m/s (23.5 mph) in 2009. The frequency of extreme wind events shows an increasing trend during Octobers, with 8% more extreme wind events in 2009 compared to 1979 (Stegall and Zhang, 2012).

## 3.2. Resources

### 3.2.1. Air Quality

Air quality in the vicinity of the Proposed Action is largely a function of the few emission sources existing on the coastline of the North Slope and meteorological conditions, primarily wind, over the open sea. The offshore waters of the Beaufort Sea typically experience steady winds averaging 12.4 mph (5.54 m/s) and have periods of stronger winds, which have a tendency to disperse and mix air pollutants within the surrounding air. The stronger the wind, the more turbulent the air, and pollutants are diluted, which decreases pollutant concentrations and reduces the environmental impact (Ahrens, 2013). Thus, the wind conditions over the Proposed Action area together with the relatively few pollutant sources either onshore or offshore causes the quality of the air over the affected area to be consistently better than required by Federal standards (ADEC, 2010).

Operation of diesel marine engines on vessels and diesel-powered non-road surface vehicles proposed for the seismic survey would cause emissions of regulated air pollutants and greenhouse gases. The required inventory of Proposed Actioned emissions to disclose and assess the effect of additional emissions in the Proposed Action area and a thorough examination of emission sources is included in Appendix C.

### 3.2.2. Water Quality

Water quality is a term used here to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose such as protection of fish, shellfish, and wildlife. Because the water column interacts continuously with the seafloor surface sediments (e.g. deposition and suspension of particulate matter), these two aspects of overall water quality are tightly linked.

Water quality in the Beaufort Sea varies naturally throughout the year related to seasonal biological activity and naturally occurring processes, such as seasonal plankton blooms, naturally occurring hydrocarbon seeps, seasonal changes in turbidity due to terrestrial runoff, localized upwelling of cold water and formation of surface ice. Rivers and streams that flow into the Beaufort Sea contribute substantial freshwater to the marine system which affects salinity, temperature and other aspects of water quality, particularly of a band of water that runs along the seacoast.

The Sagavanirktok River Delta channels cover a broad area in the southern part of the Proposed Action area. Spring melt and floods carry river plumes under and on top of the riverine and sea ice. River plumes have been detected through constituent monitoring as far as 15-20 km (9.32-12.43 mi) from the river mouth, offshore in Prudhoe Bay (Savoie, Trefry, and Trocine, 2008; Alkire, et al., 2006; Trefry et al., 2006). Freshwater pools have been detected under ice in the Sagavanirktok River using impulse radar measurements (Kovacs and Morey, 1979).

Anthropogenic (human-generated) pollution in the Beaufort Sea is primarily related to: aerosol transport and deposition of pollutants (AMAP, 1997, 2004); pollutant transport into the region by sea ice, biota and currents (Chernyak et al., 1996); discharges from international ship traffic; and effects from increasing carbon dioxide in the atmosphere. The greatest degree of ocean acidification worldwide is predicted to occur in the Arctic Ocean. This amplified scenario in the Arctic is due to the effects of increased freshwater input from melting ice and snow and increased carbon dioxide uptake by the sea as a result of sea ice retreat (Steinacher et al, 2009).

Wind, currents and drifting sea ice play an important role in the long-range transport and redistribution of constituents and contaminants in the Beaufort Sea. Pollutants, such as polycyclic aromatic hydrocarbons (PAH) are introduced by human activities around the globe and ultimately affect the Arctic. Pollution in the Arctic is described in "Arctic Pollution Issues: A State of the Arctic Environmental Report" (AMAP, 1997).

Several important scientific studies have contributed to the knowledge of water quality and seafloor surface sediment characteristics in the U.S. Beaufort Sea outer-continental shelf waters including: Dunton et al., 2005 and 2009; Trefry et al., 2003; Trefry and Trocine, 2009; and Trefry et al., 2013.

### **Existing Regulatory Control of Discharges**

The primary regulation for controlling pollutant discharges into waters of the U.S. is the Clean Water Act (CWA) of 1972, as amended; Section 402 established the NPDES permit program. Accordingly, EPA regulates discharges incidental to the normal operation of commercial vessels (greater than 79 feet in length) through the NPDES Vessel General Permit (VGP). The current VGP was issued by EPA in March 2013.

Currently, vessel general permits are not required for discharges (except for ballast water) from vessels less than 79 feet (24.08 m) in length that are classified for commercial fishing and other non-recreational uses. A moratorium for the requirement to obtain permit coverage for these smaller vessels expires December 18, 2014. In the interim, EPA published a draft small Vessel General Permit (sVGP) in 2013 to provide for permit coverage for these vessels less than 79 feet (24.08 m).

Currently, the water quality of the Beaufort Sea is within the criteria for the protection of marine life according to CWA, Section 403 and no waterbodies are identified as impaired by the State of Alaska Department of Environmental Conservation in the Arctic Region.

The latest information on water-quality standards for the EPA is available in the current edition of 40 CFR Part 131 or at the agency's internet web site ([www.epa.gov](http://www.epa.gov)). State of Alaska water quality information is available in the most recent version of 18 AAC 70 or at the Alaska Department of Environmental Conservation, Division of Water, web page: <http://dec.alaska.gov/water/index.htm>.

### **3.2.3. Lower Trophic Levels**

Complete descriptions of the lower trophic biota are found in the Beaufort Sea Multiple-Sale FEIS (USDOJ, MMS, 2003, Section III.B.1 (pp. III 29-30)). Further information is in the 2012 Shell Camden Bay EP EA (USDOJ, BOEMRE, 2011a, Section 3.2.3 (pp. 45-46)). Therefore, following is a brief summary of the above references and new information regarding the lower trophic organisms and their environment.

The lower trophic organisms living within the Proposed Action area near Prudhoe Bay in the Beaufort Sea of the Alaska OCS consist of three diverse and abundant groups (Hopcroft et al., 2008). These are the pelagic (organisms living in the water column), the epontic (organisms living on or in ice), and the benthic (living on or in sediments at the ocean bottom) organisms. During the proposed time period of open water, the epontic organisms are not abundant and therefore will not be discussed in this document. The components of the pelagic communities are made primarily of two groups living at the surface and near-surface levels, the phytoplankton and zooplankton. Phytoplankton are the one-celled algae adapted to living in the photic zone (the upper areas where light adequate for phytoplankton penetrates the water) in the upper layers of the ocean surface (Steidinger and Garces, 2006). Phytoplankton blooms (including concurrent zooplankton organisms) tend to occur in two separate events of early and late summer, generally from July to August, with density and duration dependent upon weather conditions and nutrient fluxes (Kirchman et al, 2009). Zooplankton consist of permanent residents of the planktonic mass such as copepods, and animals exhibiting complex life cycles that include a developmental stage within the plankton blooms such as the larvae of fish, crustaceans, barnacles, polychaetes, and mollusks (Brusca and Brusca, 2002). The pelagic expanses between the surface and the benthic realms support diverse and abundant populations, including the larvaceans, pteropods, ctenophores, jellyfish, salps, squid, and other invertebrate organisms that contribute to the productivity of the region (Hopcroft et al., 2008). The final group are the benthic organisms, consisting of both those groups living within the upper sedimentary matrix (infaunal organisms) and those living on or just above the benthic surface, or strongly associated with the

benthic surface (epifaunal organisms). Offshore benthic communities can be quite diverse, but organisms commonly found in surveys include echinoderms, sipunculids, mollusks, polychaetes, copepods, and amphipods (Norcross, 2013; Dunton, Schonberg, and McTigue, 2009).

Most seafloor substrates on the Beaufort Sea OCS consist of aggregations of fine sands, muds, and silts, with percentages of substrate consisting of mud ranging from 17% to 84% (cANIMIDA, 2010; Trefry and Trocine, 2009). Limited extents of scattered cobblestone or pebbles may be found at shallower depths (Dunton, Schonberg, and McTigue, 2009). A focus on differences in communities based on physical factors is addressed in the BOEM-sponsored cANIMIDA studies on hydrocarbon chemistry and substrate composition (cANIMIDA, 2010), and the 2006 Seismic PEA. No known unique geological surface features, communities, or key reproductive sites exist in the area of the Proposed Action.

### 3.2.4. Fish

Spring melt and river runoff greatly influence the characteristics of the inshore and nearshore Beaufort Sea. This freshwater influx sets up a band (2-10 km (1.24-6.21 mi)) wide of brackish waters along the coast that then breaks down in later summer due to decreased runoff and mixing by wind. This Beaufort Sea inshore habitat and the fish that depend on the band were examined by Craig (1984). He found that Arctic cisco, least cisco and Arctic char were dominant species in the coastal Beaufort. In late summer two marine species, Arctic cod and four-hour sculpin, moved nearshore as the salinity in the band increased.

Glass (1988) examined fish species in nearshore waters of the Central Beaufort Sea, including Prudhoe Bay and the Sagavanirktok River Delta. The dominant species found were Arctic char, Arctic cisco, least cisco, broad whitefish, fourhorn sculpin, and Arctic cod. Fish dispersed from overwintering river and inshore habitats during early summer to more offshore feeding grounds, and then returned to overwintering areas in late summer. Glass concludes that fish distribution varies between and within years due to wind, mixing, coastal and river plumes, and offshore marine water characteristics.

Jarvela and Thorsteinson (1999) studied the occurrence of epipelagic fish along the eastern Beaufort Sea coast up to 30 km (18.64mi) offshore. The study area stretched from the Colville River east to the U.S.-Canada boundary, including Prudhoe Bay. The most abundant epipelagic fish caught were Arctic cod, capelin and snailfishes. Surface water temperatures and salinities varied seasonally and interannually and this influenced the spatial and temporal distribution patterns of the fish species.

In the summer of 2008, a field survey of fish and benthic invertebrates of the Beaufort Sea was conducted by NOAA, University of Washington and University of Alaska (Logerwell et al., 2010; Rand and Logerwell, 2011; Logerwell, Rand and Weingartner, 2011). They caught and identified 36 fish species. Arctic cod (*Boreogadus saida*) were the most abundant fish caught during the 2008 survey, both by weight and numbers. Fifteen species of smaller fish (eelpouts and sculpins) contributed a great number of fish to the total catch of the 2008 survey; however, they did not contribute much in terms of total biomass.

Based on the studies described above and other studies (Früge et al., 1989; Thorsteinson, Jarvela and Hale, 1992), Table 4 presents a list of fish species most likely to occur in the Proposed Action area.

**Table 4. Fish species most likely to occur in the Proposed Action area.**

Common Name	Taxonomic Name
Arctic cod	<i>Boreogadus saida</i>
Arctic flounder	<i>Pleuronectes glacialis</i>
Saffron cod	<i>Eleginus gracilis</i>
Capelin	<i>Mallotus villosus</i>

Common Name	Taxonomic Name
Dolly Varden	<i>Salvelinus malma malma</i>
Arctic Char	<i>Salvelinus alpinus</i>
Fourhorn sculpin	<i>Myoxocephalus quadricornis</i>
Arctic cisco	<i>Coregonus autumnalis</i>
Least cisco	<i>Coregonus sardinella</i>
Humpback whitefish	<i>Coregonus pidschian</i>
Broad Whitefish	<i>Coregonus nasus</i>
Kelp Snailfish	<i>Liparis tunicatus</i>
Ninespine Stickleback	<i>Pungitius pungitius</i>
Pink salmon	<i>Oncorhynchus gorbuscha</i>
Chum salmon	<i>Oncorhynchus keta</i>

Pacific salmon adults and juveniles occur in the Beaufort marine and estuarine Essential Fish Habitat (EFH), however, their numbers are low compared to the Bering Sea. Primarily pink and chum salmon (*Oncorhynchus gorbuscha* and *O. keta*), have been captured in the Beaufort nearshore (Craig, 1984; Craig and Haldorson, 1986; Fechhelm and Griffiths, 2001; Fechhelm et al., 2009). As climate change occurs (ice reduction, warming waters) salmon are moving further north in greater numbers (Moss et al., 2009; Kondzela et al., 2009). According to the Anadromous Waters Catalog to date, chum and pink salmon have been documented as present in the east, west and main channels of the Sagavanirktok River and pink salmon have been documented to spawn in the main and east channels.

Arctic cod is widely distributed in the U.S. Arctic in the pelagic, demersal and nearshore environments. The absolute numbers of Arctic cod and their biomass is one of the highest of any finfish in the region (Logerwell et al., 2010; Logerwell, Rand, and Weingartner, 2011; Rand and Logerwell, 2011; Frost and Lowry, 1983). The abundance, wide distribution and the role in the food web of the Arctic cod in the Beaufort Sea make this species very important in the overall ecosystem of the U.S. Arctic region. The ongoing effects of climate change in the Arctic, such as warming sea temperatures and increased acidity, affect fish in many ways including changes in lower trophic food sources and changes in ice habitat extent and qualities (Hopcroft et al., 2006).

### 3.2.5. Marine and Coastal Birds

Most marine birds that occur in the Beaufort Sea are there during the open-water season. Arrival times usually coincide with the formation of leads during spring migration to coastal breeding areas. Spring migration for most species takes place between late March and late May.

Some birds that breed on the North Slope migrate to or through the Proposed Action area (Figure 1) twice each year. Some marine and coastal birds may breed outside the Proposed Action area, but spend time in the Beaufort Sea after breeding or during their non-breeding seasons. Departure times from the Beaufort Sea for the fall and winter vary between species and often by sex within the same species, but most marine and coastal birds will have moved out of the Beaufort Sea by late October before the formation of sea ice.

Full descriptions of the most important marine and coastal bird species in the Beaufort Sea were provided in the Beaufort Sea Multiple-Sale FEIS (USDOJ, MMS, 2003) and the Final Supplemental Environmental Impact Statement, Chukchi Sea Planning Area, Oil and Gas Lease Sale 193 (USDOJ, BOEMRE, 2011b), Environmental Assessments for Lease Sales 195 and 202 (USDOJ, MMS, 2004, 2006b) and 2006 Seismic PEA (USDOJ, MMS, 2006a), and the Biological Evaluation for the U.S. Fish and Wildlife Service (USDOJ, BOEMRE, 2011c). These descriptions are summarized and updated below. Existing information is sufficient to fully evaluate the potential effects of the two alternatives.

### Descriptions of Species or Species Groups

Marine and coastal birds potentially affected by the Proposed Action can be grouped according to certain aspects of their life-history or status: ESA-listed birds or those abundant in the Proposed Action area (Table 5). The timing and specific location of the Proposed Action influences which birds could be affected. Birds listed as threatened or candidate (three species) or abundant in the Proposed Action area (five species) have the greatest potential to incur adverse effects and are described further. These eight species are carried forward to the Environmental Consequences Section 4.2.5.

**Table 5. Marine and coastal birds most likely to be affected by the Proposed Action.**

Species	Threatened or candidate species	Abundant in Proposed Action area	Carried forward under effects analysis
ESA-Listed Species			
Spectacled Eider	Yes	No	Yes
Steller's Eider	Yes	No	Yes
Yellow-billed Loon	Yes	No	Yes
Abundant Species			
Long-tailed Duck	No	Yes	Yes
Common Eider	No	Yes	Yes
King Eider	No	Yes	Yes
Northern Fulmar	No	Yes	Yes
Short-tailed Shearwater	No	Yes	Yes

Sources: USDOl, MMS, 2003, 2004, 2006a, b; USDOl, BOEMRE, 2011a, b.

### ESA-listed Birds

The distribution, abundance, and legal status of birds designated as threatened or listed as candidate species under the ESA are most recently described in the USFWS 2012 Biological Opinion (USDOl, FWS, 2012). These include the Steller's eider (*Polysticta stelleri*; threatened), the spectacled eider (*Somateria fisheri*; threatened), and the yellow-billed loon (*Gavia adamsii*; candidate species) and are often collectively referred to as ESA-listed birds. Because of their special status under ESA, the potential effects to all three species are analyzed in the Environmental Consequences section (Section 4.1.5).

**Spectacled Eider.** The North Slope spectacled eider population seems to be stable, at least since the initiation of aerial surveys of the Arctic Coastal Plain (ACP) in 1992 (Larned, Stehn, and Platte, 2009). Spectacled eiders breed in low densities across the Alaskan ACP east to about the Shaviovik River. Males leave the breeding grounds along the ACP for the ocean around mid - to late June at the onset of incubation by female eiders. Males are followed by females whose nests fail, and finally by successful breeding females and young birds in August and September. Female spectacled eiders migrate west along the Alaska coast as far as 40 km (24.85 mi) offshore. Most spectacled eiders will have migrated from the Beaufort Sea by mid-October, although small numbers of spectacled eiders could be encountered in nearshore locations of the Beaufort Sea.

**Steller's Eider.** A small number of Steller's eiders breed on the ACP of Alaska, most conspicuously near Barrow. Steller's eiders are rare east of Barrow to the Prudhoe Bay area. They are even rarer as the season progresses due to molt migration, failed breeding, etc. As with the more common spectacled eider, these birds move to nearshore coastal waters after their breeding season. Few if any Steller's eiders would likely be in the southern Beaufort Sea during or after the open-water season.

**Yellow-billed Loon.** The yellow-billed loon is relatively rare in the U.S. Arctic region (North, 1994). Dau and Bollinger (2009) reported an average of fewer than 50 yellow-billed loons during late-June surveys of the coast and barrier islands between Omalik Lagoon and the Canadian Border (2005-2009). Of the approximately 3,300 yellow-billed loons present on the breeding grounds on the North Slope, primarily between the Meade and Colville Rivers in the National Petroleum Reserve-Alaska (NPR-A), it is likely that there are fewer than 1,000 nesting pairs. Additionally, there are

approximately 1,500 yellow-billed loons (presumably juvenile nonbreeders) that remain in nearshore marine waters or in large rivers during the breeding season. In total, there are fewer than 5,000 yellow-billed loons on the Arctic coast breeding grounds and near shore marine habitat (Earnst et al., 2005). There may be approximately 1,500 yellow-billed loons, presumably non-breeding adults and immatures, in near shore marine waters or in large rivers during the breeding season. Yellow-billed loon numbers were thought to be declining (74 FR 12931, March 25, 2009), but the population is now considered stable (Stehn, Larned, and Platte, 2013).

Yellow-billed loons typically nest on low islands or narrow peninsulas on the edges of large, deep, tundra lakes. Breeding yellow-billed loons typically remain on their lakes until young are fledged.

Most yellow-billed loons from the ACP have moved into nearshore coastal waters by September. In addition, approximately 8,000 yellow-billed loons from the Canadian Arctic travel across the Chukchi Sea during spring and fall migration between Canada and wintering grounds in eastern Asia. Most loons stay very close to shore during fall migration until they reach the Lisburne Peninsula, where they head farther out to sea towards the Bering Strait (Rizzolo and Schmutz, 2010).

Low numbers, patchy distributions, and specific habitat requirements may make yellow-billed loons more susceptible disturbance, habitat alterations, and environmental disturbances and habitat alterations than species having more abundant numbers, are more widely distributed, and are able to use more diverse habitats.

## Other Birds

**Loons and Waterfowl.** The Pacific loon (*Gavia pacifica*), red-throated loon (*G. stellata*), Pacific brant (*Branta bernicla nigricans*), lesser snow goose (*Chen caerulescens caerulescens*), greater white-fronted goose (*Anser albifrons frontalis*), and tundra swan (*Cygnus columbianus*) occur in nearshore coastal waters of the Beaufort Sea and Chukchi Sea (USDOI, MMS, 2003, 2007; USDOI BOEMRE, 2011a). Waterfowl species that are more abundant and occur in more offshore areas of the Beaufort Sea include the long-tailed duck (*Clangula hyemalis*), the common eider (*Somateria mollissima*), and the king eider (*Somateria spectabilis*) and are described below.

**Long-Tailed Duck.** The long-tailed duck population has decreased considerably since 1989, but it remains a common species in the Beaufort Sea during the open-water period (Mallek, Platte, and Stehn, 2007). Many long-tailed ducks molt in the lagoons along the Beaufort Sea coast. In late June and early July, most male and nonbreeding female long-tailed ducks migrate to coastal molting areas where they are flightless for a 3- to 4-week period. Breeding females molt on freshwater lakes during the last phases of duckling development before departing the North Slope in fall. While most long-tailed ducks migrate within 45 km (28 mi) of shore, infrequent observations of long-tailed ducks in pelagic waters occur in late September (Divoky, 1987).

The molt is an energetically costly time, and long-tailed ducks have abundant food resources in the shallow water lagoons (Flint et al., 2003). During the molt, long-tailed ducks tend to stay in or near the lagoons, especially near passes between lagoons and the open ocean (Johnson, Frost, and Lowry, 1992; Johnson, Wiggins, and Wainwright, 1992; Kinney, 1985).

Molting long-tailed ducks tend to stay in or near the lagoons, feeding heavily in passes between barrier islands. Aerial surveys along coastal habitats of the entire ACP typically observe fewer than 7,500 long-tailed ducks, with about two-thirds of these associated with mainland habitats (Dau and Bollinger, 2009).

**Common Eider.** Common eiders nest on barrier islands or spits along the Beaufort Sea coast. Dau and Larned (2005) observed 1,819 common eiders along the Beaufort Sea coast with 652 on barrier islands and 1,167 on the mainland. Dau and Larned (2007) observed a total of 1,936 common eiders. Of these, 871 were along the Beaufort Sea coast with 423 along the barrier islands and 448 along the

mainland. The highest concentrations were on survey segments on both sides of Kaktovik. In 2007, total birds and indicated breeding pairs were down 37.6% and 44.0%, respectively, from 2006 counts of 3,102 birds and 1,207 pairs. Total birds and indicated breeding pairs in 2007 were down 30.0 and 27.8%, respectively, from the 1999-2006 averages of 2,766+885 (1 standard deviation, range 1,353-4,449) birds and 937+264 (1 standard deviation, range 572-1,340) pairs (Dau and Larned, 2007).

After the molt is completed, some common eiders move offshore into pelagic waters, but most eiders remain close to shore (Divoky, 1987). When traveling along the northwest coast of Alaska, these eiders tend to stay along the 20-m (66 ft) isobath, approximately 48 km (29 mi) from shore. Most males are out of the Beaufort Sea by late August or early September, and most females were gone by late October or early November. Most breeding female common eiders and their young begin to migrate to molt locations in late August and September.

The common eider population in the Beaufort Sea declined by 53% between 1976 and 1996 (Suydam et al., 2000). Common eiders were surveyed in marine waters within 100 km (62 mi) of the Beaufort Sea shoreline between Barrow and Demarcation Point by Fischer and Larned (2004) during summers in 1999-2001. In general, common eiders were concentrated in waters <10 m (<33 ft), with the highest densities occurring in segments between Oliktok Point and Prudhoe Bay and between Tigvariak Island and Brownlow Point. Common eiders were most commonly associated with barrier islands in these segments, becoming less commonly observed up to 50 km (31 mi) seaward. Common eider densities were highest in areas of low ice cover.

Fischer and Larned (2004) concluded that because eider densities did not vary between summer months, the eiders they observed near barrier islands were local breeders rather than molt or fall migrants. This is consistent with Petersen and Flint (2002), who showed that satellite-tagged common eider hens remained in shallow waters close to their breeding sites through September.

Male common eiders begin moving out of the Beaufort Sea beginning in late June. Most males are out by late August or early September, and most females were gone by late October or early November. Most common eiders migrate within 48 km (29.8 mi) of the coast when traveling west along the Beaufort Sea.

**King Eider.** Most king eiders begin to arrive in the Beaufort Sea by the middle of May. Arrival times in the Beaufort Sea are dependent upon the location and timing of offshore leads along the Chukchi Sea (Barry, 1986). Most king eiders nesting on the North Slope between Icy Cape and the western boundary of ANWR nested in three general areas: between the Colville River and Prudhoe Bay, southeast of Teshekpuk Lake and a large area near Atqasuk (Larned, Stehn, and Platte, 2009). Dau and Larned (2005, 2006, 2007, 2008) surveyed the Chukchi Sea and Beaufort Sea coastlines and found 810, 3,048, 1,621, and 2,227 king eiders in 2005, 2006, 2007, and 2008, respectively.

The king eider population in the Beaufort Sea appeared to remain stable between 1953 and 1976 but declined by 56% between 1976 and 1996 (Suydam et al., 2000). Fischer and Larned (2004) surveyed king eiders in marine waters within 100 km of the Beaufort Sea shoreline between Barrow and Demarcation Point during summers in 1999 and 2001. King eiders were the second most abundant species counted during the survey periods. King eider densities varied according to water depth, offshore distance, and percent of ice cover. Large flocks of king eiders concentrated in the mid-depth (10-20 m (33-66 ft)) zone offshore of Barrow and Oliktok Point. In 1999 and 2000, these flocks were in waters >10 m (>33 ft) deep but were found in the shallow (<10 m (<33 ft)) and mid-depth zone in July 2001. King eiders were unique among species surveyed by occurring in higher densities in low (31%) and moderate (31-60%) ice cover (Fischer and Larned, 2004).

Satellite telemetry was used to determine that most king eiders spent more than two weeks staging offshore in the Beaufort Sea prior to fall migration (Phillips, 2005; Powell et al., 2005). Female king eiders may need to remain in the Beaufort Sea longer than males to replenish fat stores depleted

during egg laying and incubation (Powell et al., 2005). Prior to molt migration, king eiders in the Beaufort Sea usually were found about 13 km (8 mi) offshore; however, during migration to molting areas, king eiders occupied a wide area ranging from shoreline to >50 km (>31 mi) offshore (Phillips, 2005).

## Seabirds

The common murre (*Uria aalge*), thick-billed murre (*U. lomvia*), tufted puffin (*Fratercula cirrhata*), horned puffin (*F. corniculata*), black-legged kittiwake (*Rissa tridactyla*), black guillemot (*Cepphus grylle*), Ross' gull (*Rhodostethia rosea*), ivory gull (*Pagophila eburnea*), Arctic tern (*Sterna paradisaea*), pomarine jaeger (*S. pomarinus*), parasitic jaeger (*S. parasiticus*), long-tailed jaeger (*S. longicaudus*), and glaucous gull (*Larus hyperboreus*) occur in the Chukchi Sea and Beaufort Sea (USDOI MMS (2003, 2007); USDOI, BOEMRE (2011a). Species that nest at Cape Lisburne (i.e., murre, puffins, kittiwakes) are more concentrated in that area of the Chukchi during the open water season. Seabird species that are more abundant and occur in the Beaufort Sea include the northern fulmar (*Fulmarus glacialis*) and the short-tailed shearwater (*Puffinus tenuirostris*) and are described below.

**Northern Fulmar.** Fulmars do not breed in the Arctic region, and those observed during the summer are nonbreeders or failed breeders from southern areas. Fulmars are most numerous from late August to mid-September. Divoky (1987) estimated 45,000 northern fulmars in pelagic waters of the southern Chukchi Sea during late August to mid-September. Flocks totaling in the low hundreds were observed during the late summer and early fall around the Klondike and Burger prospects during seabird surveys in 2008-2011 (Gall and Day, 2012). Similar distributions are anticipated to occur in the adjacent Beaufort Sea.

**Short-Tailed Shearwater.** Shearwaters do not breed in the Arctic region. These birds breed in the Southern Hemisphere. At northern latitudes, short-tailed shearwaters likely forage at highly productive patches of euphausiids and amphipods. Divoky (1987) reported short-tailed shearwaters north of Barrow and into Arctic Canada, depending on the presence of sea ice. In certain years, an estimated 100,000 short-tailed shearwaters passed Point Barrow in one day in mid-September (Divoky, 1987).

Gall and Day (2012) suggested that the shearwaters can rapidly respond to changes in oceanic conditions and exploit food resources when and where they are available. For example, Kuletz (2011) reported a single flock numbering over 15,000 short-tailed shearwaters in the western Beaufort Sea in late August–early September, 2011. Kuletz (2011) reported over 4,000 shearwaters during a seabird survey in the Chukchi Sea in late August – early September 2011 (the most abundant species reported), with many flocks numbering between 150-300 birds. These observations were consistent with those of Bankert (2012). Similarly, flocks totaling in the low hundreds were observed during the early fall around the Klondike, Burger, and Statoil prospects during seabird surveys in 2008-2011 (Gall and Day, 2012); however, during the early fall period in 2009, almost 12,000 short-tailed shearwaters were observed near the Klondike Prospect. Similar distributions are anticipated to occur in the adjacent Beaufort Sea.

### 3.2.6. Marine Mammals

Full descriptions of marine mammals in the Beaufort Sea are provided in the Beaufort Sea Multiple-Sale FEIS (USDOI, MMS, 2003: sections III.B.6 (pages III-54 through III- 58) and III.B.4 (pages III-39 through III 49)).

Bowhead whales, beluga whales, ringed seals, bearded seals, and spotted seals occur in the Proposed Action area during the open water season; gray whales, polar bears, and Pacific walrus may also occur in the Proposed Action area but not in large numbers. Other marine mammal species are

typically absent from the Central Beaufort Sea and documented observations of these species are rare or non-existent, and therefore will not be covered in this analysis.

All marine mammals are protected by the Marine Mammal Protection Act (MMPA). Whales and seals are managed by NMFS, while Pacific walrus and polar bear are managed by the USFWS. Marine mammals protected by the ESA include bowhead whales, which are listed as endangered; polar bears, ringed seals, and bearded seals, which are listed as threatened; and Pacific walruses, which are a candidate species.

### **Bowhead Whale**

The Western Arctic stock of bowhead whales inhabit the Beaufort Sea during the open water season. The current population estimate is 10,314, and an estimated 3.2% annual rate of increase (Allen and Angliss, 2013). During summer, bowhead whales concentrate near nutrient-rich upwellings around Barrow Canyon and the Mackenzie Shelf to feed on marine invertebrates, and small fish (Sheffield and George 2014; Moore, Clarke, and Ljungblad, 1989; Moore and Reeves, 1993; Moore, DeMaster, and Dayton, 2000; Moore et al., 2002). Individuals and smaller groups, particularly juveniles and postnatal females with calves, may be observed feeding in sub-optimal habitat throughout the Beaufort Sea (Clarke et al., 2014). Most bowheads migrate from the Beaufort Sea to the Chukchi Sea during September (Moore et al., 1995). The Proposed Action area is in shallow waters where some bowhead whales are likely to feed, but south of the main fall bowhead whale migration route in the Beaufort Sea. Bowhead whales in the Western Arctic stock are listed as endangered under the ESA.

### **Beluga Whale**

Portions of both the Beaufort Sea (BSS) and the Eastern Chukchi Sea (ECS) stocks of beluga whales occur in the Beaufort Sea. Both stocks overwinter in the Bering Sea and summer in the Beaufort Sea, using spring lead systems to migrate around western and northern Alaska during April and May (Richard, Martin, and Orr, 2001; Allen and Angliss, 2013). These stocks, collectively, number over 36,000 with stable or possibly downward trending population trajectories (Allen and Angliss, 2013). Moore (2000) and Moore, DeMaster, and Dayton (2000) suggest belugas select deeper water near the continental shelf break to feed on fish, independent of ice cover. Few are likely to be encountered near the Proposed Action area.

### **Gray Whale**

The most recent estimate of abundance of the Eastern Pacific Stock of gray whales, from the 2006/2007 southbound survey, is 19,126 whales. They feed on benthic and pelagic invertebrates, small fish, and are most common in coastal and shoal waters having little sea ice, in larger bays and near Barrow Canyon (Carretta et al., 2012; Clarke et al., 2014). Gray whales are seasonal migrants to the Chukchi and Beaufort Seas, arriving in late spring after bowhead whales have migrated and most sea ice has receded. Small numbers of gray whales have been documented in the Beaufort Sea and few gray whales should occur near the Proposed Action area.

### **Bearded Seal**

Bearded seals in the Beaufort Sea are part of the Beringian Distinct Population Segment (BDPS) of the circumpolar bearded seal population. Allen and Angliss (2013) provide a rough population estimate of 155,000 for the BDPS of bearded seals as explained in Cameron et al. (2010). Though most BDPS bearded seals summer in the Chukchi Sea, a smaller number occupy the Beaufort Sea, feeding on benthic invertebrates and some fishes (Burns, 1970; Stirling, Kingsley and Calvert, 1982; Stirling, 1997). The diving abilities restrict bearded seals to continental shelf waters  $\leq 200$  meters deep. They are commonly observed during oil and gas exploration in the Chukchi Sea during the open water season, but less so in the Beaufort Sea; a small number would occur near the Proposed Action area.

## Ringed Seal

During summer the resident ringed seal population is supplemented by migrants from the Bering and Chukchi Seas. The Arctic subspecies of ringed seal is the most abundant seal species in the Beaufort Sea and conservative population estimates exceed 1,000,000. Ringed seals have an estimated annual maximum theoretical net productivity rate of 12% (Kelly et al., 2010). They are dispersed in the open-water season, preferring water depths >20 m (66 ft) where they forage on fishes and pelagic invertebrates (Lowry et al., 1980; Reeves, 1998; Moulton et al., 2002; Clarke et al., 2014). Ringed seals are the most commonly encountered marine mammal species in the Arctic and will be present in the Proposed Action area.

## Spotted Seal

The Alaskan spotted seal stock inhabits the Bering, Chukchi, and Beaufort Seas. Recent estimates place spotted seal numbers at 141,479 in the eastern and central Bering Sea during winter and NMFS theorizes the population's net productivity rate is about 12% (Allen and Angliss 2013). More spotted seals occur in the Chukchi Sea than in the Beaufort Sea, where small numbers haul out in Harrison Bay, Smith Bay, and a few other coastal areas. Spotted seals use haulouts for resting, molting, and whelping. Due to comparatively low numbers of spotted seals in the Beaufort Sea few should occur within the Proposed Action area.

## Pacific Walrus

Pacific walrus primarily inhabit the Bering and Chukchi Seas, moving south and north with the advance and retreat of the sea ice. Walrus are an ice obligate species. Pacific walrus occur during the open water season in very low numbers in the Beaufort Sea. Most sightings are west of Cape Halkett; walrus have rarely been observed as far east as Kaktovik (USDOI, MMS, 2003). The most recent population estimate for walrus is approximately 129,000 (Speckman et al., 2011). The USGS and the FWS are in the process of developing a new population estimate based on a genetic mark-recapture methodology.

## Polar Bear

Polar bears occur throughout the continental shelf of the Beaufort Sea. The Chukchi/ Bering Sea and the Southern Beaufort Sea populations of polar bears may occur within the Proposed Action area. For management purposes, the USFWS assumes that most bears found east of the Barrow area are from the Southern Beaufort Sea population; there are currently believed to be about 1,500 bears in this population (Regehr, Amstrup, and Stirling 2006). During the open water season, a portion of the polar bear population remains onshore along the coastline or on the barrier islands. Some bears may be observed swimming between offshore ice and the shoreline or barrier islands.

### 3.2.7. Terrestrial Mammals

Terrestrial mammal species occurring in Beaufort Sea coastal areas include caribou, muskox, grizzly bears, and arctic foxes. Terrestrial mammal populations are managed by Alaska Department of Fish & Game. State of Alaska lands are managed by the Alaska Department of Natural Resources.

#### Caribou

The Central Arctic Caribou Herd (CAH) uses the coastal area near the Proposed Action for insect relief from late June into August. The CAH population numbers 67,000, and continues to grow (ADF&G, 2014; ADNR, 2009). Up to several thousand caribou could be encountered at any given time onshore and along the coast; numbers on islands could be less than 20 individuals in a group. Caribou are mobile and would be found along the Arctic coastal plain when the Proposed Action would occur.

## Muskox

Muskox occur in Beaufort Sea coastal areas where they feed on sedges and willows during summer. Herd sizes are small and consist of family groups dispersed over small areas. Muskox are mostly sedentary, with herds moving more during snow-free months. Subadults may disperse over greater distances. Small numbers of muskoxen, likely numbering in groups of 10 or less, could be encountered during the Proposed Action (ADF&G, 2014; ADNR, 2009).

## Grizzly Bear

Grizzly bears are widely dispersed across the North Slope, but in low numbers because of the low biological productivity of the Arctic, where a larger area is required to nutritionally support each animal. Because of the low grizzly bear population density on the Arctic coastal plain, the Proposed Action would be likely to affect only small numbers of bears (ADF&G, 2014; ADNR, 2009).

## Arctic Fox

Arctic foxes are common in the Proposed Action area, particularly around industrial developments which can make ideal denning sites. They sometimes swim between the coast and barrier islands to scavenge, raid bird nests, and cache food for later consumption, but remain most common on the mainland. Arctic foxes are prolific, ubiquitous, and likely to be encountered during onshore operations (ADF&G, 2014; ADNR, 2009).

### 3.2.8. Subsistence Activities, Environmental Justice, Public Health and Economics



**Figure 3. North Slope villages nearest the Proposed Action area. Nuiqsut and Kaktovik are the villages potentially affected by the Proposed Action.**

## Subsistence Activities

Iñupiat of the North Slope place high cultural and social value on subsistence activities, which provide a sense of identity. Alaska Natives consider subsistence not just as important cultural activity, but as the culture itself (Wheeler and Thornton, 2005). Because subsistence is so culturally and socially important, reduced (even perceptually reduced) subsistence food availability impacts food security and contributes to social pathologies such as crime, mental health issues, and increasing social disorganization. (Wernham, 2007). North Slope Borough (NSB) communities have an annual

subsistence harvest of between 153.2 to 665.3 pounds (lbs) (69.6 to 301.8 kg) per person (AHDR, 2004). Bowhead whales are a paramount subsistence resource to North Slope Communities. The importance of subsistence hunting and resources dominates subsistence discourse in North Slope Inupiat Eskimo communities (USDOI, BOEMRE, 2011a). Subsistence harvests provide dietary variety and meet long-term, sustainable nutritional needs even when few or no bowhead whales are taken during the hunting season (USDOI, BOEMRE, 2011a). Nuiqsut and Kaktovik subsistence resources, harvest periods, and affected resource descriptions follow.

### ***Subsistence Communities of Nuiqsut and Kaktovik***

#### **Nuiqsut**

Nuiqsut (Figure 3) is a coastal community 17 miles inland from the Beaufort Sea coast along the western shore of the Colville River. Thetis Island and Cross Island, from which Nuiqsut hunters base seal, eider, and bowhead whaling activities, are located to the northeast. The Proposed Action would occur 73 miles (118 km) west of Nuiqsut from July through September 2014. Nuiqsut's subsistence harvest areas are depicted in detail in SRB&A (2010), Subsistence Mapping of Nuiqsut, Kaktovik, and Barrow (Maps 131-136). Subsistence resources taken throughout the year are relied on to provide an important portion of the Nuiqsut subsistence diet (SRB&A, 2010).

Nuiqsut residents harvest subsistence resources in marine and terrestrial environments. Subsistence resources extend over a large area between Barrow and Atqasuk to the west, Kaktovik to the east, and have over occurred offshore 50 miles (80 km) (SRB&A, 2010). Summer subsistence hunts begin in July, with some hunts as early as May, increasing in June, and continuing through September (SRB&A, 2010).

Camps and cabins are located along the Colville River Delta. Use of these camps and cabins are important in allowing residents access when conducting subsistence activities. There are many camps or cabins located on Cross Island and used for resource harvesting (SRB&A, 2010).

#### **Kaktovik**

Kaktovik (Figure 3) is located on Barter Island just off the Beaufort Sea coast approximately 120 miles (193 km) east of Prudhoe Bay and 90 miles (145 km) west of the Canadian border just north of the Arctic National Wildlife Refuge (ANWR). Kaktovik residents utilize both marine and terrestrial subsistence resources throughout the year and these resources comprise a substantial portion of the Kaktovik subsistence diet (SRB&A, 2010). The Proposed Action area is more than 90 miles (145 km) west of Kaktovik. Kaktovik's subsistence harvest areas are depicted in detail in SRB&A (2010), Subsistence Mapping of Nuiqsut, Kaktovik, and Barrow (SRB&A, 2010: Maps 131-136).

### ***Subsistence Resources of Nuiqsut and Kaktovik***

#### **Bowhead Whale (*aġviq*)**

Bowhead whaling in Nuiqsut occurs around late August through mid-October. In 2008 Cross Island bowhead whale hunting began earlier in the season with the first crew arriving on August 29 and since this time the season has continued to begin earlier. Monitoring of bowhead whales and related harvesting activities from 2001-2008 indicates the majority of bowhead whales harvested by Nuiqsut have been in the northeast quadrant off Cross Island (Applied Sociocultural Research, 2012; USDOI, BOEMRE, 2011a; SRB&A, 2010: Maps 113 and 114).

Kaktovik bowhead whale hunters travel between Camden Bay to the west, Nuvagapak Lagoon to the east, and up to approximately 50 miles (80 km) from Kaktovik in search of bowhead whales July through October. Primary harvest is during September, when the ocean is ice-free (SRB&A, 2010). Bowhead whale hunting occurs up to approximately 25 miles (40 km) from shore, between Arey Island and Tapkaurak Lagoon. Hunters generally stay within 15 and 30 miles (24 – 38 km) from shore, traveling farther only when bowhead whales are not available closer to shore or when ice

conditions or the presence of supply or drilling ships force hunters farther from shore (SRB&A, 2010).

### **Ringed Seal (*natchiq*) and Bearded Seal (*ugruk*)**

Nuiqsut hunters harvest ringed and bearded seal in the Beaufort Sea during summer months. Subsistence use areas for ringed seal are located from Cape Halkett to the west, Camden Bay to the east, and up to approximately 20-25 miles (32-40 km) from shore with some hunters traveling up to 40 miles (64 km) offshore near Thetis Island (SRB&A, 2010: 284). Ringed seal hunting, which peaks in July and August, occurs in open water as seals follow the ice pack June - September, though hunting has been reported in May and October.

Kaktovik residents hunt for ringed seal while hunting for bearded seal. Hunts occur offshore between Prudhoe Bay to the west, Demarcation Bay to the east, and up to approximately 30 miles (48 km) from shore with periodic harvesting of ringed seal occurring inside lagoons close to Barter Island.

Nuiqsut bearded seal hunting occurs between Harrison Bay and Flaxman Island with a high number of hunts occurring between the mouth of Fish Creek and Thetis Island. Hunting occurs offshore up to 20 miles (32 km) extending as far west as Cape Halkett, as far east as Camden Bay, and offshore up to 40 miles (64 km).

In recent years, bearded seal hunting for Kaktovik residents is more common than ringed seal hunting. Bearded seal hunting occurs along the coast as far west as Prudhoe Bay and as far east as the United States/Canada border approximately 30 miles (48 km) from shore. Many hunters will generally hunt within five miles (8 km) of shore (SBR&A, 2010). Hunting activities for Kaktovik begin in March, peak in July and August, and conclude in September.

### **Fish: Arctic Cisco (*qaaktaq*), Arctic Char/Dolly Varden (*paiktuk/iqalukpik*), Broad Whitefish (*aanaagæiq*), and Burbot (*Tittaaliq*)**

The Colville River plays an important role in the life cycle of the fish placing Nuiqsut in a unique location for harvesting this resource. Arctic cisco is an important subsistence resource for the residents of Nuiqsut and is a major source of food in the community. Harvest occurs in October and November with some harvests in December or as early as August and September (SRB&A, 2010). Generally, harvesting of Arctic char/Dolly Varden is conducted separately from Arctic cisco harvests in August and September. Harvesting also occurs in May through July and in October through and November along the Colville River. Harvest occurs between the delta and beyond the Chandler River, along the Anaktuvuk River, in Fish Creek south of Nuiqsut, and along the Colville River. Broad whitefish harvests occurs June through August with most fishing done in July along the Colville River between the mouth and the Sentinel Hill area, Fish Creek, Itkillik River, Chipp River, and in some area lakes. Fishing for burbot between October and April is a common winter time activity for Nuiqsut residents. (SRB&A, 2010).

Kaktovik residents harvest Arctic Cisco during the summer, traveling as far west as Sagavanirktok River and as far east as the Mackenzie River Delta. Residents fish off Barter Island, along barrier islands near Barter Island, such as Arey Island and Bernard Spit. Fishing areas may include distant locations such as Camden Bay, specifically Collinson Point, Griffin Point, and Demarcation Bay. Kaktovik fishes for Arctic char using coastal and inland locations between Mikkelsen Bay to the west, Shingle Point (in Canada) to the east, and inland along Sagavanirktok, Shaviovik, Canning, Hulahula, Kongakut, Mackenzie, and Big Fish Rivers. Kaktovik residents harvest Arctic char throughout the year July and August (SRB&A, 2010). Broad whitefish is a less common harvest in Kaktovik than that of Arctic Cisco or Arctic Char; they are harvested primarily along the coast, in river mouths between Mikkelsen Bay and Shingle Point, and inland at Lake Schrader (SRB&A, 2010). Harvesting occurs in July through September. Burbot is the least common fish harvested by Kaktovik and are not highly desired nor widely available near Kaktovik. Harvest areas are along the

coast, in the mouths of rivers between Mikkelsen Bay and Angun Point, and at two coastal locations (Shingle Point and Komakuk Beach) in Canada between June and October (SRB&A, 2010)

### **Geese, Swans, and Eider**

Nuiqsut and Kaktovik residents harvest several species of geese: Greater white-fronted goose (*kigiyuk niâlivailuk*), Canada goose (*iqsragutilik*), Brant (*Niâlinâaq*) and snow geese (*Kayûq*).

Nuiqsut goose hunting occurs around the Colville River near Ocean Point and the mouth of Itkillik River, along Nigliq Channel, and in a large area around Fish and Judy creeks during the spring. During May and June, hunters move closer to the coast to harvest waterfowl (SRB&A, 2010). Between May and September, harvests for king eiders (*Qiyalik*) and common eiders (*Qaugak*) are often combined with offshore seal hunts in the Colville River Delta. Hunting occurs in the Beaufort Sea between Atigaru Point and the mouth of the Kuparuk River, along the Colville River Delta, and eastward to the area where fall whaling occurs. Hunters may travel offshore over 30 miles to hunt waterfowl and have reported using Thetis Island as a base for hunting activities.

Kaktovik goose hunting occurs in May to June and August to September as far west as Prudhoe Bay and as far east as the Mackenzie Delta, between as far west as Collinson Point and as far east as Pokok Lagoon (SRB&A, 2010). Hunting also occurs inland along Hulahula, Okpilak, and Jago Rivers and across from Barter Island. Hunting occurs during May and June and in August and September (SRB&A, 2010). Eider hunting is less frequent and more opportunistic. Eider harvests occur along the coast as far west as Sagavanirktok River, as far east as the Mackenzie Delta, and inland along Okpilak and Jago Rivers during May through September. Some residents harvest eiders as early as April and as late as October (SRB&A, 2010).

### **Caribou (Tuttu)**

Caribou is an important subsistence food for the residents of Nuiqsut (SRB&A, 2010). Caribou hunting occurs year-round with summer and fall months a time of group hunting and extended camping trips. In early summer caribou are hunted by boat, along the coastline or shores of barrier islands where caribou congregate for relief from insects and heat. The coastal area used most frequently by hunters is the delta of the Colville River. The area of secondary importance for hunters includes all of Harrison Bay to Smith Bay. (SRB&A, 2010: Map 111). Most residents hunt caribou June through September, and hunting peaks in July and August (SRB&A, 2010).

For Kaktovik residents, caribou hunting is a key terrestrial subsistence activity. Residents report traveling substantial distances from their community to hunt for caribou. Hunting areas are located as far west as Ikpikpuk River and eastward beyond the Mackenzie River Delta in Canada. (SRB&A, 2010). Hunting caribou occurs along the coast during the summer months, traveling inland during the winter months (usually starting in October) by snowmachine and along the coast by snowmachine hunting west or east of Barter Island along the coastline.

### **Environmental Justice**

Executive Order 12898 (EO), “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” requires that each Federal agency:

- Consider environmental justice to be part of its mission.
- Provide an evaluation in an EIS or EA as to whether the Proposed Action would have “disproportionately high adverse human health and environmental effects on minority populations and low income populations.”

The intent of EO 12898 is to promote the fair treatment of people of all races and income brackets, so no person or group of people bears a disproportionate share of the negative effects from Federal agency decisions.

According to the 2010 Census, demographics of the Nuiqsut and Kaktovik communities indicate they meet the 50% population threshold of an affected area.

- Nuiqsut - 88.2% of the population (402 residents) are Alaska Native (specifically Iñupiat) American Indian.
- Kaktovik - 88.7% of the population (239 residents) of Kaktovik are Alaska Native or American Indian.

For centuries, survival in the Arctic has centered on of subsistence foods and materials and knowledge needed to harvest these resources. Iñupiat culture has depended upon passing on traditional knowledge and beliefs about subsistence resources including:

- Observations of game behavior to successfully locate and harvest game.
- Hunter and family behaviors to ensure successful harvests in the future (Spencer, 1976).

Although there have been substantial social, economic, and technological changes in Iñupiat lifestyle, subsistence continues to be the central organizing value of Iñupiat sociocultural systems. Iñupiat continue to be socially, economically, and ideologically loyal to their subsistence heritage with substantial amounts of subsistence food sharing within and between communities, compromising important kin ties (Heinrich, 1963).

Disruption of subsistence harvest patterns could alter these cultural values, affect community social structure and, consequently, resulting in disproportionately high adverse effects on this minority population.

## Public Health

Good health is essential to cultural sustainability and socio-economic development and is a prerequisite to human productivity and development (Basavanthappa, 2008). Communities develop their own healthy or unhealthy patterns of interaction resulting from the interrelationships between many systems (social and organizational) within each community. Individual status, roles, and positions function together in an attempt to achieve goals of these systems. This is demonstrated by the relationships between subsistence hunting of bowhead whales and whaling crew structures in Iñupiat society. Subsistence food gathering is not only central to Iñupiat culture, but also to survival and good health (GAO, 2003).

Good health comes from socio-cultural identities incorporating their traditions, values, and norms that are accepted and reinforced, placing priorities on prevailing attitudes and values about health and illness, and about utilizing traditional medicines such as food to maintain a community's health.

Fuel and shipping costs to get food and supplies to Villages varies across Alaska and is dictated by region. These high costs create higher food prices, directly impacting community health. Any real or perceived decrease in subsistence harvests coupled with higher food prices results in the availability of less nutritious foods and resulting "food deserts." Further, lack of accessibility to a variety of reasonably priced nutritious and fresh foods or subsistence harvest foods can be an obstacle to achieving the recommended daily diet (Block and Kouba, 2005). Research shows that people in low income communities pay proportionately more for food than people living in higher income communities and in the NSB this issue, along with others plays a role in environmental justice, public health, and economic sustainability. Research shows there is an association between under-nutrition, malnutrition, high obesity rates, and (ii) decreased economic and social resources (Black and Macinko, 2008).

## Economy

The NSB is a mixed economy, characterized by a traditional cash economy and subsistence economy and has high unemployment and underemployment.

Outer Continental Shelf oil and gas activities generate economic benefits for the NSB in the form of direct and indirect employment, increasing personal income, and various types of revenues to the local government. NSB receives revenues primarily from property taxes from high value onshore oil and gas infrastructure. For a more detailed description of the structure and composition of the NSB economy, see the BOEM study on the “North Slope Economy, 1965 to 2005” (USDOI, MMS, 2006c).

### **3.2.9. Archaeological Resources**

BOEM conducted a review of potential effects on historic properties associated with this Proposed Action. The offshore seismic activities do not constitute an undertaking, as they do not have the potential to affect historic properties. The Alaska State Historic Preservation Office (SHPO), on January 23, 2013, concurred through formal correspondence with BPXA that the on-land component of the seismic work would also have no effect on historic properties. BPXA obtained the SHPO's concurrence well in advance of their permit application to BOEM. This finding is still in effect. Therefore, archaeological and historic resources will not be further analyzed in this document.

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## 4.0 ENVIRONMENTAL CONSEQUENCES

**Refueling.** This EA considers the impacts of up to one accidental refueling spill. Initial fueling will occur in Deadhorse, West Dock, or East Dock (BPXA, 2013b, p.4). Up to 10,000 gallons (37,854 L) of fuel (mostly ultra-low sulfur Diesel (ULSD) and small quantities of gasoline) may be temporarily stored on existing pads to support survey activities both onshore and offshore. Fuel may be transported to locations to refuel equipment. The vehicle transporting fuel (helicopter, boat, tracked buggy, or truck) to locations off pads will supply the necessary quantity of fuel at the time of transfer. All fueling will occur in accordance with applicable regulations and BPXA spill prevention practices. Spill prevention practices include Fuel Transfer plans, which designate fluid off-loaders and receivers, spill prevention equipment, secondary containment and drip liners.

Fuel transfers will be conducted in accordance with applicable regulatory requirements and meet BPXA's Fluid Transfer Procedure requirements. A temporary flexi-float dock may be located at West Dock to provide support for vessel supply operations, personnel transfers, and refueling. Vessels will either be fueled from a shore based location, or offshore by contractor supplied or contracted vessels. Offshore fueling will be limited to the extent practicable. Weather, sea states and vessel function will be the determining factors to decide on which method is used. The seismic contractor's Spill Prevention Control and Countermeasures (SPCC) regulated equipment (including fuel storage tanks) will be managed in accordance with their own SPCC plan(s). Oil spill response activities are covered by BPXA's approved Greater Prudhoe Bay and Endicott Oil Discharge Prevention and Contingency Plans (BPXA, 2013e).

For purposes of analysis, a seismic vessel transfer spill during refueling was estimated to have a volume range from <1-13 barrels (bbl) (USDOJ, BOEMRE, 2010a, b) for Alternative 2. The <1 bbl minimum volume represents a fuel spill where dry quick disconnect and positive pressure hoses function properly. The 13 bbl maximum spill volume represents a spill where spill prevention measures fail and fuel lines rupture. For Alternative 2, fuel spills could range from zero bbl if no fuel spills occur to <1 bbl-13 bbl if there is a spill during refueling, and spill prevention equipment functions properly (<1 bbl) or fails completely (13 bbl). Previous NEPA analyses, such as those for Statoil, ION 2010, ION 2012 and TGS (USDOJ, BOEMRE, 2010a, b; USDOJ, BOEM, 2012; USDOJ, BOEM, 2013), concluded a <1-13 bbl spill would be localized and temporary. A <1 bbl fuel spill could persist for up to 30 hours in open water and up to 5 days in broken ice; a 13 bbl fuel spill could persist for up to 2 days in open water and up to 10 days in broken ice. Although BPXA is not planning on operating in ice, ice blowing into the Proposed Action area or oil spreading into ice was considered for estimates of fuel oil persistence.

### 4.1.1. Air Quality

#### 4.1.1.1. Direct and Indirect Effects

##### Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to air quality.

##### Alternative 2 – Proposed Action

The emissions would occur primarily from operation of the main and auxiliary engines aboard the seismic ship and other proposed vessels, with lesser emissions from the operation of vehicles onshore. The survey is proposed to use equipment that is mobile, non-stationary, and is not expected to be used in one specific area for a long period of time. The engines are proposed to meet the engine emissions regulations established by the Environmental Protection Agency (EPA) at 40 CFR Part 86 for on-road engines, and 40 CFR Parts 89 and 90 for non-road engines. The engines and all equipment will be

operated according to the manufacturer's recommended specifications. In addition, the engines will be fueled using Ultra Low-Sulfur Diesel (ULSD) fuel in the diesel engines, which will greatly reduce emissions of sulfur oxides.

The emission inventory analysis shows that the combination of emissions from vessels would cause emissions of nitrogen oxides to exceed the established threshold of 100 tons per year, indicating a minor air quality effect. However, emissions of the other regulated pollutants are all expected to be less than 100 tons per year, indicating a negligible effect. Persistent moderate winds and episodes of strong winds, which are typically found over the open waters of the Beaufort Sea, have a tendency to disperse and mix air pollutants within the surrounding air. The stronger winds cause greater turbulence in the air and greater dilution of pollutants which decreases pollutant concentrations and reduces the environmental impact (Ahrens, 2013). Likewise, the transitory and mobile nature of the emission sources proposed for the survey would assist in dispersing pollutants, not allowing concentrations of pollutants to building up in a confined area. Thus, when also considering the wind conditions over the Proposed Action area, the relative lack of onshore sources, together with the relatively low emissions caused by the Proposed Action, the quality of the air over the affected area would remain better than required by Federal standards (ADEC, 2010). As such, the potential impact to air quality conditions would be negligible to minor.

#### **4.1.1.2. Cumulative Effects**

##### **Alternative 1 – No Action**

Selection of the No Action Alternative would add no incremental effects on air quality to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

##### **Alternative 2 – Proposed Action**

Any additional activities occurring during the same time period and in the same general area requiring the use of marine vessels may contribute to the air emissions from the Proposed Action. A thorough description of cumulative operations on the Beaufort Sea OCS is provided in Appendix B Cumulative Effects Scenario, Section B-3 Impact Sources.

The 2011 Alaska Department of Environmental Conservation (ADEC) report, *Emissions, Meteorological Data, and Air Pollutant Monitoring for Alaska's North Slope* (Section 6, Ambient Monitoring on the North Slope) (ADEC, 2011), provides results from the most recent air quality monitoring on the North Slope using equipment installed by industrial sources. Monitors sponsored by the Environmental Protection Agency (EPA) detect and record concentrations of pollutants at Prudhoe Bay, and have been since 2010. A monitor sponsored by Shell is operating at Badami oil field, 35 miles (56 km) east of Prudhoe Bay; and a monitor used by BPXA and Exxon Mobile is located at Endicott Island 2.5 miles (4 km) offshore and 15 miles (24 km) from Prudhoe Bay. Other monitors are located at Point Thomson, 60 miles (97 km) east of Prudhoe Bay, and Nuiqsut, a village south-southeast of Harrison Bay. The data collected from the Shell and BPXA/Exxon Mobile monitors, and data from Point Thomson and Nuiqsut are included in the ADEC database in the 2011 report. The monitors would detect and record impacts from onshore sources of emissions, as well as impacts from vessel traffic, if present, for the pollutants and averaging periods reported by each monitor.

The monitored data reporting during the period from 2001 to 2005 at Nuiqsut showed ambient concentrations below the National Ambient Air Quality Standards (NAAQS). More recent data is provided from the Badami, Edicott, and Pt. Thomson sites for 2009 and 2010. The pollutant most commonly linked to vessel traffic and other combustion sources is nitrogen dioxide (NO<sub>2</sub>). The Nuiqsut monitor shows average one hour average concentrations of NO<sub>2</sub> to be 76.0 micrograms per cubic meter (µg/m<sup>3</sup>), 40.0 percent of the NAAQS, which is established at 188 µg/m<sup>3</sup>. The recorded data at the Badami and Endicott sites show an average concentration of 83.7 µg/m<sup>3</sup>, or 44.5 percent of

the NAAQS for the one hour concentration of NO<sub>2</sub>; no data for the one-hour concentration of NO<sub>2</sub> was recorded.

The 24-hour average concentration of coarse particulate matter (PM<sub>10</sub>) is 57.0 µg/m<sup>3</sup> at Nuiqsut, 38.0 percent of the NAAQS set at 150 µg/m<sup>3</sup>. Badami and Edicott monitors report average 24-hour PM<sub>10</sub> concentrations average 7.9 µg/m<sup>3</sup>, just 5.3 percent of the NAAQS. The ozone monitor at Pt. Thomson indicates the concentration is 39.1 percent of the NAAQS standard of 235 µg/m<sup>3</sup>. Concentrations of carbon monoxide are less than 10 percent of the average eight-hour NAAQS and the other pollutants show even lower percentages. Consequently, when considering the wind conditions over the open sea and the transitory and mobile nature of the emission sources associated with the Proposed Action, additional emissions from other operations in the Beaufort Sea and onshore appear to be well diluted and dispersed. Thus, based on the information currently available concerning the recent past, present, and foreseeable future projects in the Beaufort Sea, and considering the negligible to minor air quality effect of the Proposed Action, only negligible to minor cumulative air quality impacts would be expected.

## **4.1.2. Water Quality**

### **4.1.2.1. Direct and Indirect Effects**

#### **Alternative 1 – No Action**

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to water quality.

#### **Alternative 2 – Proposed Action**

The Proposed Action would occur in the Sagavanirktok River Delta, the Prudhoe Bay coastal area, and the nearshore and offshore marine environments.

The Proposed Action could affect water quality through:

- Deployment and burying of nodes on the seafloor.
  - Drilling (hand-held tool) approximately 5,400 holes (1.5 in (3.8 cm) diameter) in the onshore to insert receivers.
  - Drilling approximately 4,650 holes (4 in (10 cm) diameter) in the surfzone to insert receivers.
- Water withdrawal from the Sagavanirktok River (approximately 375 gal (1,420 L) /day) and from Beaufort Sea nearshore (approximately 375 gal (1,420 L)/day) for flush and retrieve nodes.
- Removal of nodes from the surfzone using warm water pressure jets with water heated to 100°F (38°C).
- Onshore dock construction and camp construction.
- Activities of project personnel at camps.
- Shallow watercraft use and landings (e.g. airboat, buggy, jon boat, etc).
- Vessel discharges from ten vessels (permitted by vessel permit).
- Vessel re-fueling.

The potential direct and indirect effects from the Proposed Action on water quality include:

- Placing Nodes: temporary water quality degradation at localized riverine delta and estuarine seafloor sampling sites for digging holes to place nodes.

- Removing nodes: temporary water quality degradation at localized riverine delta and estuarine seafloor sampling sites from warm water jet use for dislodging nodes.
- Vessel Discharge: Temporary water quality degradation at localized sites due to contaminants from seismic vessel discharge and deck runoff.
- Non-point Runoff: Temporary water quality degradation at localized sites due to physical disturbance and sediment runoff from construction activities (dock, camps), shallow craft use and landings.
- Accidental Fuel Spill: Temporary water quality degradation due to fuel spills from accident in refueling vessels at sea (the maximum estimated spill of 13 bbl spill would disperse and evaporate within 48 hours).

The Proposed Action would cause temporary, negligible effects on water quality.

#### **4.1.2.2. Cumulative Effects:**

##### **Alternative 1 – No Action**

Selection of the No Action Alternative would add no incremental effects on water quality to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

##### **Alternative 2 – Proposed Action**

The Proposed Action would cause temporary, negligible effects on water quality. Depending on the specific activity, the effects would be localized (e.g. individual seafloor diggings and dislodging of nodes) or dispersed (e.g., non-point runoff from construction and maintenance onshore).

Past activities in the region include exploration drilling, seismic surveys, and shipping traffic. Activities that are known to likely occur in the reasonably foreseeable future include additional seismic surveys, geological surveys, and scientific research surveys (Appendix B). Overall, the cumulative effects of the proposed activities on water quality from past, current and reasonably foreseeable future activities would be minor when considering the effects on the scale of the southern Beaufort Sea off the coast of Alaska.

#### **4.1.3. Lower Trophic Resources**

##### **4.1.3.1. Direct and Indirect Effects**

###### **Alternative 1 – No Action**

Under the No Action Alternative, there would be no anthropogenic impacts to lower trophic organisms in the waters off Prudhoe Bay in the Proposed Action area.

###### **Alternative 2 – Proposed Action**

##### **4.1.3.2. Direct and Indirect Effects**

Due to small number of nodes to be deployed and recovered in the Proposed Action area under BOEM jurisdiction (19 mi<sup>2</sup> (49.7 km) no adverse effects on lower trophic organisms are anticipated.

#### **Cumulative Effects**

If the Proposed Action occurs, no additional effects would be added to the effects associated with ongoing or reasonably foreseeable future activities off Prudhoe Bay in the Proposed Action area.

#### 4.1.4. Fish

##### 4.1.4.1. Direct and Indirect Effects

The Proposed Action would occur in the Sagavanirktok River Delta, the Prudhoe Bay coastal area, and the nearshore and offshore marine environments.

The Proposed Action could affect fish through:

- Discharging airgun shots throughout the marine Proposed Action area.
- Drilling approximately 4,650 holes (4" diameter) holes in the riverine and estuarine surfzone to insert receivers.
- Water withdrawal from the Sagavanirktok River (approximately 375 gal (1,420 L)/day, a total of 9,375 gal (35,488.2 L)); and from Beaufort Sea shallow marine (approximately 375 gal (1,420 L)/day, a total of 15,175 gal (57,444 L)).
- Removal of nodes from surf zone using warm water pressure jets.
- Dock construction.
- Shallow watercraft (e.g. airboat, buggy, jon boat, etc.) use and landings onshore.
- Proposed Action personnel activity on and near shore.
- Vessel discharges from ten vessels (permitted by vessel permit).
- Vessel re-fueling.

Effects stemming from these listed events include:

**Airgun Discharge.** Noise from ships and airgun shots could affect fish through interference with sensory orientation and navigation, decreased feeding efficiency, scattering of fish away from a food source and redistribution of fish schools and shoals (Fay, 2009; Radford et al., 2010; Simpson, 2010; Slabbekoorn, et al., 2010; Purser and Radford, 2011).

Pelagic species, such as adult Arctic cod, adult salmon, cisco, capelin, and similar species could startle and scatter as noise continues and, in theory, receive reduced levels of sound. Sedentary, burrowing, territorial, benthic-obligated fish, shallower near-shore fish, fish eggs and fish larvae in the immediate area of airgun operations would be exposed to higher noise levels due to their limited swimming behaviors, obligate life history characteristics, behavioral traits or spatial limitations (e.g. sculpin species and flatfish species). Foraging and reproduction behaviors of these benthic-obligate fish could be affected negatively by noise from the Proposed Action.

**Drilling and Placing Nodes.** Temporary water quality degradation and noise at localized riverine delta and estuarine seafloor sampling sites for drilling or flushing holes to place nodes in shallow waters. This activity would cause physical disturbance of seafloor habitat used by fish in shallow water (or in the shoreline flats used by fish at high tide) and temporary water quality degradation at seafloor sampling sites.

**Flushing and Removing Nodes.** Withdrawal of water for flushing from riverine and estuarine pools and marine water (< 6 ft deep) would cause morbidity or mortality to early pelagic life stages of fish entrained (e.g., Arctic cod, Arctic flounder).

**Vessel Discharge.** Vessel discharges and deck runoff (limited by permit specifications) from ten vessels would cause temporary water quality degradation at localized sites and which could reduce visibility.

**Non-point Runoff.** Temporary water quality degradation could occur at localized sites due to physical disturbance and sediment runoff from construction activities (dock, camps), shallow craft

use and landings. Fish would be affected by potential for increase in suspended sediment (which could reduce visibility) and constituents in runoff which may contain contaminants.

**Accidental Fuel Spill.** Temporary water quality degradation could occur from accidental fuel spills during vessel refueling at sea, the river delta, or at landing sites. The maximum estimated spill of 13 bbl would disperse and evaporate within 48 hours (Section 4.0). Toxicity effects on fish (particularly early life stages) could occur in the immediate area of a spill.

### **Summary of Effects on Fish**

All effects would be localized (e.g. individual seafloor drillings for node placement and flushing to dislodge nodes) or dispersed (e.g. airgun discharges over the entire Proposed Action area). Therefore, the Proposed Action would cause temporary, negligible effects on fish.

#### **4.1.4.2. Cumulative Effects**

Past activities in the region include exploration drilling, seismic surveys, and shipping traffic. Reasonably foreseeable future activities include additional seismic surveys, geological surveys, and scientific research surveys (Summarized in Appendix B). Overall, the cumulative effects of the Noticed Activities on fish from past, current and reasonably foreseeable activities would be minor in a regional context.

#### **4.1.5. Marine and Coastal Birds**

##### **4.1.5.1. Direct and Indirect Effects**

###### **Alternative 1 – No Action**

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to marine and coastal birds.

###### **Alternative 2 – Proposed Action**

Potential effects of the Proposed Action on coastal and marine birds are summarized in categories of:

- Disturbance from the physical presence of vessels and field crews.
- Disturbance from noise by vessels or seismic airguns.
- Birds encountering vessels.
- Mortality from fuel spills from vessels.

Field crews could disturb nesting birds. Mitigation measures described in BPXA permit application documents will minimize or attempt to avoid adverse effects to marine and coastal birds. These mitigation measures, which rely on prompt reporting of bird strikes, would minimize adverse effects to marine and coastal birds to a negligible level of effect. Bird strike reporting is difficult to monitor; to improve compliance with this measure, BOEM reiterates the measures described in Section 2.2 of this EA.

Vessel activity could disturb birds. Flocks of migrating or flightless birds would generally move away from vessel activity. There is an energetic cost to repeatedly moving away from vessel disturbances as well as a cost in terms of lost foraging opportunities or displacement to an area of lower prey availability. Seismic survey activity is expected to have localized disturbance effects on certain marine bird species that are distributed across the Proposed Action area. The more abundant species (long-tailed ducks, common and king eiders) would be affected more than ESA-listed species that are less common in the Proposed Action area. Migrating birds would likely experience temporary impacts as they moved through the Proposed Action area. Molting birds could be disturbed repeatedly

if they were unable to relocate (i.e., flightless) to another area when seismic operations were occurring.

During the course of normal feeding or escape behavior, some birds could conceivably be near enough to an airgun to be injured by a pulse. The reactions of birds to airgun noise suggest that a bird would have to be very close to the airgun to receive a pulse strong enough to cause injury, if that were possible at all. Injury to birds in offshore waters is expected to result in a negligible level of effect because birds are most likely to move away from slow-moving seismic vessels well in advance of the towed seismic-airgun array. Flightless birds at sea remain capable of slowly moving away from disturbances.

Seabirds attracted to lights and vessels in nearshore waters could collide with a vessel and be injured or killed. Marine and coastal birds could be disoriented by storms or collide with vessels during inclement weather (e.g., fog, rain) or darkness. Vessels operating in marine environments often encounter passerines and shorebirds species when the birds are migrating. In 2012, Shell Gulf of Mexico, Inc. and Shell Offshore, Inc. (collectively referred to as Shell) conducted an exploration drilling program in the Chukchi and Beaufort Seas (USDOI, BOEMRE, 2011a; USDOI, BOEM, 2011). Shell reported that at least 131 birds were observed on their drilling units and support vessels, 83 (63%) of which were dead. In some cases, it appeared that some birds sought refuge on a vessel in inclement weather and used it to rest and continue migration. In other cases, exhausted birds alighted on a vessel, but did not survive. The injuries and mortalities, however, strongly indicated birds collided with vessel structures and died or later succumbed to injuries. Industry reported 18 bird:vessel encounters during the 2013 open-water season, with a much reduced number of vessels in operation.

Using the 2012 Shell bird encounter reports, BPXA could experience up to 70 (10 vessels, 7 encounters per vessel per season) bird encounters over their operational period; this is a conservative estimate and not all encounters would be expected to be fatal. On average, shearwaters, auklets and passerines would be the most frequent species groups anticipated to be reported, but as BPXA vessels would operate much closer to shore than the Shell fleet did, especially later in the open-water season, a larger proportion of seaducks and passerines would be expected. The number of bird:vessel encounters/strikes affecting a broad diversity of species over a season would not be expected to affect any particular bird population. The level of bird mortality from vessel collisions for most species would be considered a minor level of effect.

While no ESA-listed eiders or yellow-billed loons were documented by Shell to interact with their vessels, king and common eiders and a grebe were reported. These reports suggest that it is possible listed spectacled or Steller's eiders or a loon could be involved in future vessel encounters. BPXA proposes to work primarily in areas nearer to shore where ESA-listed bird densities are typically higher. While unlikely and not reasonably expected to occur, an eider or yellow-billed loon killed striking a BPXA vessel would not be considered a significant effect because these species populations appear stable and the loss of an eider or loon could be recovered in a generation.

Should a fuel spill of the magnitude defined in the Section 4.0 fuel spill scenario occur during refueling, a small number of birds in the immediate vicinity of the vessel could be affected, depending on current and wind patterns. Few birds are likely to be in the area during refueling and in the unlikely occurrence of a fuel spill, a limited amount of individual bird mortality (and all birds contacted by spilled fuel are assumed to die), which could result in a minor level of effect; however, spill prevention and response measures would minimize adverse effects to marine and coastal bird populations.

Field crews would conduct land-based operations during the nesting season. These activities are considered a connected action to the Proposed Action. BPXA proposes to mitigate disturbance impacts to nesting marine and coastal birds. However, individual nests may be disturbed repeatedly

by field crew activity and helicopters. When disturbed, the female tends to flush from the nest. These nests may be abandoned and the eggs or young could die or be eaten by predators. This potential mortality would be considered a moderate level of effect. Overall, the Proposed Action is expected to have a moderate level of effect on marine and coastal birds.

#### **4.1.5.2. Cumulative Effects**

##### **Alternative 1 – No Action**

Selection of the No Action Alternative would add no incremental effects on marine and coastal birds to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

##### **Alternative 2 – Proposed Action**

The level of effects for the Proposed Action with respect to marine and coastal birds is moderate. When considered in combination with other past, present, and reasonably foreseeable actions (Appendix B, Cumulative Effects Scenario), effects on marine and coastal birds would be moderate. Past projects include seismic surveys and exploration drilling, but the effects of these actions were temporary and no longer impact marine and coastal birds. BPXA plans to conduct ancillary activities east of the Endicott Causeway, but these activities would not overlap in space with the Proposed Action. These activities would not combine to appreciably increase the level of effect on marine and coastal birds because the impact of the Proposed Action is relatively small.

#### **4.1.6. Marine Mammals**

##### **4.1.6.1. Direct and Indirect Effects**

##### **Alternative 1 – No Action**

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to marine mammals.

##### **Alternative 2 – Proposed Action**

The potential effects from geophysical and geologic surveys on marine mammals in the Beaufort Sea were evaluated in the 2006 Seismic PEA (USDOI, MMS, 2006a) and the NMFS 2013 BO (NMFS, 2013).

Potential effects of the Proposed Action on marine mammals include:

- Disturbance from the physical presence of vessels and human activity.
- Disturbance from vessel and seismic airgun noise.
- Vessels striking marine mammals.
- Animal entanglement in lines or cables.

**Physical Presence of Vessels.** Generally, walruses, polar bears, and ice seals enter the water if approached too closely by vessels. PSOs and vessel crew would watch for marine mammals on ice or in the water and stop or change course to avoid disturbing them with close approaches, which will minimize impacts to marine mammals from vessel presence.

**Vessel and Airgun Noise.** Vessels are a transient presence which limits effects on marine mammals because marine mammals can detect and avoid them (Richardson et al., 1995a; Richardson et al., 1995b). Vessels produce continuous low frequency sounds, frequently around 160 dB, that are perceptible to marine mammals; these noise levels quickly attenuate in the marine environment, so vessel noise should have negligible effects on marine mammals.

The area of effects from an operating airgun arrays likely extends to 12 mi (19 km), as evidenced by bowhead whale behavior in the vicinity of operating airguns (Richardson et al. 1995b). Therefore it is likely that operating airguns would act to divert most marine mammals away from an active seismic survey long before the less intense vessel noise becomes a concern. The mitigations and protocols prescribed by USFWS in the 2013 LOA 13-12, and by BPXA in their 2014 North Prudhoe Bay IHA application (BPXA 2013d), would act to reduce impacts to negligible levels of effect.

In the case of marine mammals that do not avoid approaching vessels and their various sound sources, operation procedures would reduce or eliminate any potential effect on marine mammals: If PSOs observe a marine mammal entering the species specific exclusion zone, the airgun arrays would be powered down or shut down.

**Collisions.** The absence of collisions involving industry vessels and marine mammals in the Arctic despite decades of spatial and temporal overlap suggests collision probabilities are low (NMFS, 2013) and a collision between a seismic vessel and a slow-moving whale would be unlikely. Seismic surveys move at speeds of around 5 knots (9.3 km/h), change direction slowly, and are directed in the BOs, IHAs, and LOAs to avoid close approaches to marine mammals. Walruses and seals are quick and agile in the water and unlikely to be injured by large slow-moving vessels. No vessel/marine mammal collisions would be expected to occur because of the Proposed Action.

**Entanglement.** Entanglements of certain species (dolphin, ray, and sea turtle) have occurred in the Gulf of Mexico (GOM) as a result of OB surveys. None of these species occurs in Alaskan waters, and no entanglements with lines or cables during ocean bottom surveys have been recorded offshore in Alaska. There are low numbers of mammals likely to be present in the Proposed Action area, and these animals would tend to avoid noise and activity associated with the survey (as described in section 4.1.6). In addition, the weighted lines used in this survey are designed to lie on the ocean bottom rather than float. Furthermore, NMFS and FWS were made aware of the entanglements in GOM; they did not deem entanglement to be an issue in Alaska. USFWS has issued an LOA and NMFS has a draft IHA up for public comment (April-May 2014). No entanglements are anticipated to occur as a result of the Proposed Action.

### **Species-Specific Effects**

The eight marine mammal species most likely to be present in the Proposed Action area during all or part of the July through September survey period are bowhead whales, gray whales, beluga whales, bearded seals, ringed seals, spotted seals, walruses, and polar bears.

#### **Bowhead Whale**

The Proposed Action would begin before most bowheads have migrated into the Beaufort Sea. Bowhead whales are responsive to noise in their environment, and their primary response to seismic surveys has been avoidance, though responses have varied. Unless whales are engaged in actions that require undivided attention, they avoid vessel noise and related noise from seismic surveys. Studies of bowhead whale response to airgun noise indicates most bowhead whales divert from seismic activity by about 12 mi (19 km), unless feeding or engaging in social behaviors. This diversion of 12 mi (19 km) keeps bowhead whales away from the Proposed Action. Bowhead whales are capable of detecting and avoiding slow moving vessels.

Monitoring and operational procedures as identified in the NMFS 2013 BO and BPXA 2014 IHA application (BPXA, 2013d) would reduce the potential for adverse impacts, including disturbance from vessel presence, vessel or airgun sounds, or collisions to a negligible level of effect on bowhead whales.

**Gray Whale**

Gray whales feed widely across the continental shelf waters but are most often observed in shallow and nearshore areas where they feed on benthic species. Few gray whales are expected to use the Beaufort Sea since primary concentration areas occur near the Chukchi Sea, particularly in protected waters and bays, and near the Barrow Canyon upwelling.

If present, gray whales are anticipated to be affected in a manner consistent with what has been described for bowhead whales. Monitoring and operational procedures as identified in the IHA application would reduce adverse impacts, including disturbance from vessel presence, vessel or airgun sounds, or collisions to a negligible level of effect on gray whales.

**Beluga Whale**

The main fall migration corridor for beluga whales occurs north of coastal areas so interactions with migrating beluga whales remain unlikely. During spring, summer, and early fall belugas mostly remain near the ice front feeding on fish. The Proposed Action would avoid operations in sea ice and remains far away from most beluga whales.

Research has shown that beluga whales may be displaced by seismic noise (Erbe and Farmer, 2000), which could result in increased energetic costs. Belugas in the vicinity of survey activities would be affected in a manner similar to bowhead or gray whales. However, monitoring and operational procedures identified in the IHA application would reduce impacts, including disturbance from vessel presence, vessel or airgun sounds, or collisions to a negligible level of effect on beluga whales.

**Bearded Seal**

Bearded seals occur throughout the Proposed Action area and some bearded seals could be encountered by the Proposed Action. Past observations indicate effects from the Proposed Action would amount to temporarily disturbing or displacing a few individual bearded seals. Industry surveys have noted bearded seal often respond to seismic surveys by spy-hopping as vessels pass by (Funk et al. 2010, Bles et al. 2010; Brueggeman, 2009). NMFS uses the 160dB and 190 dB sound source level standards to assess Level B and Level A harassment, respectively, to ice seals. NMFS (2013) suggested bearded seals mostly remain unaffected by sounds up to 189 dB in intensity, implying injuries could only occur when noise levels equal or exceed 190 db (up to 180 - 600 m (590 – 1968 ft) from the airguns).

Monitoring and mitigations outlined in the BO and IHA are expected to reduce adverse impacts, including disturbance from vessel presence, vessel or airgun sounds, or collisions to a negligible level of effect on bearded seals.

**Ringed Seal**

Ringed seals should be the most commonly encountered marine mammal during the Proposed Action. Impacts to ringed seals should amount to brief disturbance or displacement, consistent with those described for bearded seals. Standard monitoring and mitigations outlined in the BO and IHA are anticipated to reduce adverse impacts, including disturbance from vessel presence, vessel or airgun sounds, or collisions to a negligible level of effect on ringed seals.

**Spotted Seal**

Spotted seals may be encountered during the Proposed Action, though much less often than bearded and ringed seals. Impacts to spotted seals would be consistent with those described for bearded seals and ringed seals. Standard monitoring and mitigations outlined in the IHA application are expected to reduce adverse impacts, including disturbance from vessel presence, vessel or airgun sounds, or collisions to a negligible level of effect to spotted seals.

### **Pacific Walrus**

Small numbers of Pacific walrus are occasionally observed within the Proposed Action area, however they are not regularly observed there. It is unlikely that walrus will be within the Proposed Action area during the survey, but should small numbers of walrus be present, the most likely impacts from the proposed OBS survey would be disturbance from vessel traffic or air guns. Very small numbers of walrus could be displaced from the area by the ongoing activities during the survey. The proposed OBS survey would result in a negligible level of effect to Pacific walrus.

### **Polar Bear**

Individual polar bears or small family groups (adult females with attendant cubs) may be moving through the survey area in small numbers during the proposed survey period. Polar bears may be curious and approach vessels or land based personnel, or they may avoid the ongoing activities. Polar bears may flee from vessels or helicopters by running away on land or entering the water and swimming away. Running onshore may overheat bears, and both running and swimming have energetic costs. In this case, such flight behavior is expected to be short term and to have no noteworthy impact upon the health of the bear. BPXA applied for an LOA from the USFWS on March 17, 2014 (BPXA, 2014), and intends to conduct the surveying activities pursuant to the LOA's terms. Typical mitigation measures of the LOA include avoidance of bears by a proscribed distance and specific measures to limit bear attractants such as garbage, and to limit the likelihood of human-bear interactions. A few bears could be temporarily displaced by the proposed OBS survey. The proposed OBS survey would result in a negligible level of effect to polar bears.

### **Summary of Effects**

Eight marine mammal species are present in the Beaufort Sea when the Proposed Action is planned (June – Sept. 2014). Though there are relative differences to the numbers of each species that could be affected by the OBS survey and related sound sources during the Proposed Action, potential adverse interactions for all species are reduced by monitoring and operational procedures as identified in the IHA and LOA. These are mitigations to reduce adverse impacts, including disturbance from vessel presence, vessel or airgun sounds, or collisions to a negligible level of effect for all marine mammals.

#### **4.1.6.2. Cumulative Effects**

##### **Alternative 1 – No Action**

Selection of the No Action Alternative would add no incremental effects on marine mammals that would be additive to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

##### **Alternative 2 – Proposed Action**

Appendix B, Cumulative Effects Scenario, identifies other activities that could overlap in space and time with the Proposed Action. The small number of vessels associated with the Proposed Action would be insufficient to measurably add to the existing impacts of vessel traffic on marine mammals in the Beaufort Sea.

Vessel traffic and vessel noise levels would have a negligible cumulative effect on marine mammals in the Beaufort Sea because the impacts from the Proposed Action will be temporary and transient, and will not have an additive effect combined with any other seismic activity in the Proposed Action area.

Vessel collisions or entanglements with marine mammals have not been documented.

Effects of climate change in the U.S. Beaufort Sea include loss of habitat for resting and foraging for polar bears, walrus, and ice seals. The Proposed Action has no clear causal connection to climate change.

The Proposed Action is not anticipated to appreciably add to the cumulative effect of vessel traffic or noise, collision risk, entanglement, or climate change to marine mammals in the Beaufort Sea.

#### **4.1.7. Terrestrial Mammals**

The state of Alaska permits onshore and coastal geophysical exploration with a land use permit issued by Alaska Department of Natural Resources (ADNR), Division of Oil & Gas under 11 AAC 96.010. Alaska Department of Fish and Game (ADF&G) manages terrestrial mammal populations in Alaska and sets mitigation measures for these species. The State of Alaska has issued permits that will mitigate impacts to terrestrial mammals.

The Proposed Action requires the use of helicopters, foot traffic, and vehicle support when road access is possible, which has the potential to affect terrestrial mammals. Airgun, seismic noise, and vessel noise should have no effect on terrestrial mammals in the area, but the presence of aircraft, watercraft, and other vehicles could affect terrestrial mammal species. Foot traffic and vehicle traffic would disturb larger mammals if they are approached too closely.

**Aircraft Operations.** Helicopters will be the main method used to transport land crews and equipment, which will be bagged, with each bag holding several nodes. Multiple bags of nodes will be transported via sling load from the staging area to the receiver lines and temporarily cached at drop zones spaced 500 to 1,000 ft (152-305 m) apart. Inflatable boats may be used to deploy marine nodes in large lakes, and boats, nodes, and crews would be transported via helicopter. Aircraft operators will maneuver to avoid high density or concentration areas of wildlife whenever possible (BPXA, 2013c, p. 103).

**Foot Traffic.** Crews on foot will lay out the equipment at each surveyed location. Segments of the Proposed Action requiring travel afoot would require crew awareness training to avoid wildlife interactions and maintain distance from wildlife. Ground based crews that encounter terrestrial mammals will avoid blocking access to an escape route (BPXA, 2013c, p. 103).

**Vehicular Traffic.** Vehicles may be used to transport personnel and equipment along the road system when possible and will not drive on unimproved surfaces.

##### **4.1.7.1. Direct and Indirect Effects**

#### **Alternative 1 – No Action**

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to terrestrial mammals.

#### **Alternative 2 – Proposed Action**

##### **Caribou**

Caribou commonly occur in coastal areas along the Beaufort Sea coast during summer, and would likely be encountered by the Proposed Action. Air or boat traffic associated with offshore surveys could disturb caribou using coastlines, river bars, or islands (MMS, 1987; ADNR, 2009: p. 8-18).

ADNR (2009) found motor vehicle and aircraft traffic can disturb caribou, particularly those with calves. Aircraft flying under 1,000 ft (305 m) have been known to frighten caribou, scattering herds and individuals, separating cows from calves, and possibly causing individuals to injure themselves in an escape attempt. Vehicle operations can elicit similar responses from caribou.

ADNR (2009) encourages lessees to maintain aircraft altitudes > 1,500 feet (457 m), or lateral distances > 1 mile (1.6 km) from caribou, excluding takeoffs and landings, and to incorporate recommendations from the final report to the Alaska Caribou Steering Committee in operational planning (Cronin et al. 1994). If aircraft remain at altitudes over 1,500 ft (457 m), significant impacts on caribou will be mitigated. Furthermore, the mitigations included in the State of Alaska permits for onshore operations require workers and vehicles to maintain a suitable distance away from caribou. A negligible level of affect is anticipated.

### **Muskox**

Muskoxen regularly occur in coastal areas along the Beaufort Sea coast during summer, and could be encountered during the Proposed Action.

ADNR (2009) found motor vehicle and aircraft traffic can disturb ungulates, particularly those with calves. Aircraft flying under 1,000 ft (305 m) have been known to frighten muskoxen, scattering herds and individuals, separating cows from calves, and possibly causing individuals to injure themselves. The type and magnitude of reactions depend upon distance from the disturbance; aircraft speed and direction of approach; aircraft altitude; frequency of disturbances; habituation to disturbances; animal physical condition; herd demographics and size; season; terrain; and weather.

ADNR (2009) encourages lessees to maintain aircraft altitudes > 1,500 feet (457 m), or lateral distances > 1 mile (1.6 km) from muskox, excluding takeoffs and landings, and to incorporate recommendations from the final report to the Alaska Caribou Steering Committee (Cronin et al., 1994) in operational planning. If aircraft remain at altitudes over 1,500 ft (457 m), significant impacts on musk ox will be mitigated. Furthermore, the mitigations included in the State of Alaska permits for onshore operations require workers and vehicles to maintain a suitable distance away from musk ox. A negligible level of affect is anticipated.

### **Grizzly Bears**

Grizzly bears are territorial and require large home ranges, particularly in the Arctic and few bears are expected to occur within the Proposed Action area, likely less than 5-10 individuals.

Grizzly bears tend to flee low-flying aircraft, which has the potential to separate a sow from her cubs. Vehicles may also to similar flight responses (Stokowski and LaPoint, 2000). The low bear population keeps the probability of encountering a grizzly low, however during summer some grizzlies visit the lower Sagavanirktok River for salmon and scavenging. The mitigations for onshore operations would prevent foot and vehicle traffic from having adverse effects on grizzly bears by requiring workers and vehicles to maintain a suitable distance away from them (BPXA, 2013c). Furthermore BPXA recently conducted surveys in an effort to detect polar bear dens in suitable onshore denning habitat, surveys that could also have detected grizzly bear dens, and none were found. Mitigations included in the State of Alaska permits for onshore operations State of Alaska would reduce the level of effects from the Proposed Action to negligible.

### **Arctic Foxes**

Arctic foxes occur throughout Arctic Alaska, including coastal areas and barrier islands. Arctic foxes are naturally curious and habituate to aircraft, vessel, and vehicle traffic unless conditioned otherwise. Consequently, the Proposed Action should have negligible direct effects on Arctic foxes. If birds and bird nests are disturbed there could be an adverse effect on the ability of Arctic foxes to accumulate and cache food, or to hunt some bird species. However such an impact would only affect a few individuals of the Arctic fox population. Arctic foxes are characterized as having a high fecundity and turnover rate when compared to other mammal species in the Arctic (ADNR, 2009, p. 4-29), and adverse secondary or indirect effects of the Proposed Action would have no effect on the population, and a negligible level of effects on individual foxes.

#### **4.1.7.2. Cumulative Effects**

##### **Alternative 1 – No Action**

Selection of the No Action Alternative would add no incremental effects on terrestrial mammals that would be additive to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

##### **Alternative 2 – Proposed Action**

Appendix B identifies other activities that could overlap in space and time with the Proposed Action. The Proposed Action would measurably add to the existing impacts of vehicle, vessel, and aircraft traffic on terrestrial mammals in the Proposed Action area.

Vehicle, vessel, and aircraft traffic would have a negligible effect on terrestrial mammals in the Beaufort Sea because the impacts from this Proposed Action will be temporary and transient and appropriate mitigation measures have been established by the State of Alaska.

The Proposed Action is not anticipated to increase the cumulative effects associated with ongoing or reasonably foreseeable activities above a negligible level of effect to terrestrial mammals in the North Prudhoe Bay area.

#### **4.1.8. Subsistence Activities, Environmental Justice, Public Health and Economy**

##### **4.1.8.1. Direct and Indirect Effects**

##### **Alternative 1 – No Action**

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to Subsistence Activities, Environmental Justice, Public Health or Economy.

##### **Alternative 2–Proposed Action**

The Proposed Action has the potential to affect marine and terrestrial subsistence harvests due to the location and time of the Proposed Action. The Proposed Action will take place between July and September 2014 in the Prudhoe Bay area of the Beaufort Sea. Seismic data acquisition will occur in July and August and mobilization is scheduled to begin in late May/early June from existing facilities in Deadhorse. Approximately 200 people will be involved in the operation. These individuals will be housed at existing BPXA facilities and on offshore vessels.

Vessels, equipment, and personnel operating in the Proposed Action area have the potential to produce a disturbance of offshore and terrestrial subsistence activities under state and Federal jurisdiction.

BPXA's plan of operation includes mitigation measures to minimize disturbances, including:

- Use of PSOs.
- Implementing airgun ramp-up procedures.
- Airgun power-down procedures.
- Airgun shutdown procedures.
- Limiting airgun use as historically specified in the annually developed conflict avoidance agreement (CAA) and plan of cooperation (POC) (traditionally ending airgun use for seismic surveys on August 25<sup>th</sup>).
- Surveys of onshore and surf zone work areas, and onshore surveys of nesting areas to reduce effects on subsistence resources.

- A commitment to hold meetings in the Village of Nuiqsut with the Alaska Eskimo Whaling Commission (AEWC).

The Proposed Action will have negligible to minor effects on subsistence resources due to its timing and location. Marine and terrestrial subsistence hunts undertaken by Nuiqsut and Kaktovik hunters will be able to continue and the Proposed Action will be located away from Cross Island whale hunts. The largest source of conflict will be from noise associated with the number of vessels working in the area, the use of airguns, helicopter transport of crews and equipment during fly-in-fly-out crew exchanges, human movement, and human voices.

### ***Subsistence Activities***

Areas of subsistence and resources harvested by Nuiqsut and Kaktovik are discussed in Section 3.2.8. Based on the timing (July-September) and location (Prudhoe Bay area of the Beaufort Sea) of the Proposed Action, subsistence hunting for marine mammals, birds, fish and terrestrial animals is anticipated and falls within the proposed schedule.

Subsistence activities in the area of the Proposed Action will target bowhead whales, ringed and bearded seal, fish, geese, eider and caribou. Cross Island, located approximately 3 miles north of the Proposed Action area, is the primary location for bowhead whale hunting by Nuiqsut hunters. Bowhead whale harvesting occurs north of the Proposed Action area in water depths of 50 ft (15 m). The Sagavanirktok River Delta is utilized by Kaktovik for subsistence harvests and is located in the Proposed Action area. Resources are harvested in the Sagavanirktok River Delta region during the months of July-September.

The Proposed Action has potential effects on Nuiqsut and Kaktovik marine and terrestrial subsistence hunts. Mitigation required by typical NMFS' IHAs, USFWS LOAs, CAA, and the POC should protect subsistence harvests. Effects from this Proposed Action should not be long-term, but limited to the season in which the seismic work is conducted: July through September, 2014. There will be negligible to minor effects on subsistence activities from the Proposed Action.

### ***Environmental Justice***

Environmental Justice issues for the NSB during the Proposed Action have a greater potential to affect subsistence hunting than any other overarching issue and therefore carry the highest priority when considering this Proposed Action. The Proposed Action may cause slight disruption to the health and well-being of Nuiqsut and Kaktovik due to slight disruptions in hunting. However, BPXA's plan of operation has identified mitigation measures regarding potential impacts on subsistence activities. Environmental justice impacts will be negligible to minor.

### ***Public Health***

There will be continued subsistence harvests sufficient to maintain nutritional status, BPXA crews will be accommodated in existing camps and on vessels, and since BPXA is cooperating with NSB Communities, the Proposed Action will have negligible effects on public health.

### ***Economy***

The Proposed Action is short term, temporary, involves low levels of new employment and associated income, and no new property tax revenues will be realized by the NSB or State of Alaska. The Proposed Action is expected to have a negligible effect on employment, income, and revenue levels of the NSB.

## **4.1.8.2. Cumulative Effects**

### **Alternative 1 – No Action**

Selection of the No Action Alternative would add no incremental effects on Subsistence Activities, Environmental Justice, Public Health or the Economy to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

## **Alternative 2 – Proposed Action**

### ***Subsistence***

The level of effects for the Proposed Action with respect to subsistence resources is minor. When considered in combination with other past, present, and reasonably foreseeable actions, effects on subsistence resources remain minor. Past projects include seismic surveys and exploration drilling, but the effects of these actions were temporary and no longer impact subsistence resources. Shallow water geohazard ancillary activities survey #AA005 (Appendix B, Section 2.5) is ongoing in the same sea as the Proposed Action. While seismic and exploration projects do have potential effects on subsistence resources, the impacts of the BPXA seismic survey are likely to be negligible because BPXA has committed to appropriate mitigation measures in their IHA and LOA applications, and the duration of the Proposed Action is limited; therefore, projects occurring concurrently in the Beaufort Sea may have negligible to minor additive effects on subsistence resources.

### ***Environmental Justice***

There will be no disproportionate additive adverse human health or environmental effects resulting from the Proposed Action. Cumulative impacts to environmental justice will be negligible and have no additive effect on other projects occurring concurrently in time or space with the Proposed Action.

### ***Public Health***

The Proposed Action is short-term and will have no measurable effects on NSB routines or community functions related to health. There will be no long-term consequences for health and well-being from this action. Cumulative impacts to public health will be negligible and have no additive effect on other projects occurring concurrently in time or space with the Proposed Action.

### ***Economy***

The Proposed Action is temporary, involving low levels of new employment and no generation of property tax revenues accruing to the NSB or State of Alaska. Cumulative impacts on employment, income, and revenue levels of the NSB will be negligible and have no additive effect on other actions occurring concurrently in time or space with the Proposed Action.

## **5.0 CONSULTATION AND COORDINATION**

### **5.1. Endangered Species Act Consultation**

Section 7(a)(2) of the ESA requires Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the adverse modification of designated critical habitat. BOEM fulfilled ESA obligations for the Proposed Action. No further consultation is required for ESA listed species. Consultations and conferences required by ESA between BOEM, USFWS and NMFS for ESA protected species have been accomplished through Programmatic Biological Opinions on the effects of oil and gas leasing and exploration activities in the U.S. Beaufort and Chukchi Seas (NMFS, 2013; USDO, FWS, 2012). Specifically, the effects of certain pre-developmental activities were considered and addressed in the programmatic Biological Opinions.

#### **5.1.1. USFWS Administered ESA-Listed Species**

BOEM has determined BPXA's Proposed Action is within the scope of activities analyzed in the USFWS programmatic Biological Opinion (USFWS 2012 BO) issued to BOEM for oil and gas leasing and exploration activities in the U.S. Beaufort and Chukchi Seas on May 8, 2012 (USDO, FWS 2012). To avoid and minimize impacts to ESA listed birds, BOEM shall require BPXA to conduct the Proposed Action in accordance with appropriate Reasonable and Prudent Measures/Terms and Conditions of the USFWS 2012 Biological Opinion (USDO, FWS, 2012) and discussed in the Measures to Reduce Impacts to Marine and Coastal Birds, specific Mitigation Measures in Section 2.2. A small number of ESA listed polar bears may be present in the area of the Proposed Action. On March 17, 2014, BPXA made application for a Letter of Authorization (LOA) from USFWS (BPXA, 2014) for incidental take of small numbers of polar bear under the Marine Mammal Protection Act (MMPA). The LOA, if granted, will also constitute incidental take authorization for BOEM under the ESA.

Pacific walrus, a candidate species, was not included in the 2012 USFWS BO (USDO, FWS, 2012) and consultation is not required by law. ESA only requires Federal agencies to conference on actions likely to jeopardize the continued existence of a proposed species. The USFWS LOA to BPXA would also constitute authorization for incidental take of small numbers of Pacific walrus under MMPA, since a small number of Pacific walrus may be present in the area of the Proposed Action.

#### **5.1.2. NMFS Administered ESA-Listed Species**

BOEM determined BPXA's proposal is within the scope of activities analyzed in the 2013 BO (NMFS, 2013). NMFS issued a programmatic Biological Opinion (NMFS 2013 BO) to BOEM for oil and gas leasing and exploration activities for ESA-listed whales and seals (Section 3.2.6) on April 2, 2013 (NMFS, 2013). Whales and seals may be present in areas of the Proposed Action. BPXA requested an Incidental Harassment Authorization (IHA) on December 30, 2013, from NMFS for non-lethal harassment under the Marine Mammal Protection Act (MMPA). If the IHA is issued, it would also constitute incidental take authorization for BOEM under the ESA.

### **5.2. Essential Fish Habitat Consultation**

The Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801-1884) mandated the identification of Essential Fish Habitat (EFH) for managed species and requires that Federal agencies consult with NMFS on actions that may adversely affect EFH. BOEM has prepared an EFH assessment in a separate document for this Proposed Action and is currently in consultation with NMFS.

### 5.3. Public Involvement

BOEM notified the public of its receipt of the BPXA G&G Seismic Survey Application #14-03 and later issued a public notice that BOEM would prepare an EA. On March 3, 2014, BOEM posted a request for public input on preparation of an Environmental Assessment for the BPXA (Alaska), Inc. 2014 Geophysical 3D Ocean Bottom Node Seismic Survey in the Beaufort Sea. Comments were accepted at <http://www.regulations.gov> through midnight March 21, 2014. The request, which closed on March 21, 2014, without receiving any public comment, is available to view at: <http://www.regulations.gov#!docketDetail;D=BOEM-2014-0025>.

### 5.4. Reviewers and Preparers

The persons responsible for the review of BPXA G&G Seismic Survey Application #14-03 and supporting information and analysis, and preparation of this EA are listed below:

Name	Title	Contribution
Gene Augustine	Biologist	ESA consultation
Scott Blackburn	Supervisory Environmental Protection Specialist	Project Manager
Jerry Brian	Socioeconomic Specialist	Economics
Chris Campbell	Socioeconomic Specialist	Archaeological Resources
Mary Cody	Wildlife Biologist	Marine Mammals-Polar Bear and Walrus
Christopher Crews	Wildlife Biologist	Terrestrial and Marine Mammals
Nancy Deschu	Fishery Biologist	Water Quality, Fish and Essential Fish Habitat
Dan Holiday	Wildlife Biologist	Lower Trophic Levels, Cumulative Effects
Virginia Raps	Meteorologist	Air Quality and Climate Change
Mark Schroeder	Wildlife Biologist	Marine and Coastal Birds
Caryn Smith	Oceanographer	Oil / Fuel Spills, Sea Ice and Sea State
William Swears,	Technical Writer / Editor	Technical Editor
Jennifer Youngblood	Socioeconomic Specialist	NEPA Project Coordinator, Sociocultural, Public Health and Environmental Justice

## Glossary

**Airgun:** An airgun is a device that releases compressed air into the water column, creating an acoustical energy pulse with the purpose of penetrating the seafloor.

**Exclusion Zone:** Also synonymously referred to as a safety zone within the BPXA source material, the exclusion zones are the areas around the seismic-survey-sound source within designated sound-level isopleths wherein marine mammals may be exposed to sounds that are considered a Level A take by NMFS. The exclusion zones are based on sound levels of 180 dB (for cetaceans and walrus) and 190 dB (for ice seals and polar bears). Exclusion zones for Pacific walrus and polar bear are established by the USFWS. The exclusion zones must be clear of marine mammals prior to survey commencement, and must remain free of marine mammals during survey operations.

**Harrassment:** The MMPA defines “harrassment” as “any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B Harassment].”

**Isopleth:** A line on a map connecting points at which a given variable has a specified constant value. For seismic surveying, isopleths connect points of equal sound level (e.g. 160 dB, 180 dB, 190 dB).

**Power-down Procedure:** Reduction of the sound output of the airgun array to a level that would avoid exposing any marine mammal to the 180 or 190 dB (depending upon the species) exclusion zone.

**Protected Species Observer (PSO):** Formerly Marine Mammal Observer (MMO). PSOs are trained observers whose responsibilities are to observe, record, and inform the vessel crew of any sighted protected species. PSO vessel duties include watching for and identifying marine mammals; recording their numbers, distances, and reactions to the survey operations; and documenting “take by harassment” as defined by NMFS and/or USFWS.

**Ramp-up Procedure:** Ramp-up of an airgun array consists of a gradual increase in sound level and a step-wise increase in the number and total volume of airguns firing until the full volume is achieved. The intent of ramp-up is to “warn” marine mammals in the vicinity of the airguns and to allow sufficient time for those animals to leave the area and avoid any potential injury or impairment of their hearing. Under normal conditions, animals sensitive to these activities are expected to move out of the area. Seismic surveys, including airgun testing or tuning, use the ramp-up procedures described below to allow whales and other marine mammals to depart the exclusion zone before seismic surveying begins.

Ramp-up procedures during seismic survey operations are as follows.

- Visually monitor the entire full array exclusion zone and adjacent waters for the absence of marine mammals for at least 30 min before initiating ramp-up procedures. If no marine mammals are detected, (15 min for ice seals and polar bears or 30 min for baleen whales and Pacific walrus), ramp-up procedures may be initiated.
- Initiate ramp-up by firing a single airgun, preferably the smallest in terms of energy output (dB) and volume.
- Continue ramp-up by gradually activating additional airguns over a period of at least 20 min, but no longer than 40 min, until the desired operating level of the airgun array is obtained.

**Safety Zone:** see Exclusion Zone.

**Shut-down Procedure:** Airgun operations may not be conducted when marine mammals are present within the exclusion zone. If a marine mammal is seen swimming toward the exclusion zone, the airguns may first be powered down to avoid exposing the marine mammal to the 180/190 dB level, depending on species. If the animal reaches the single airgun exclusion zone, the array must be shut down. Likewise, if a marine mammal surfaces within single airgun exclusion zone, the seismic survey must be shut down. If the airgun array is shut-down for any reason during darkness or poor weather, it may not be re-energized until conditions allow for the exclusion zone to be effectively monitored.

**Start-up Procedure:** Start-up is the initiation of airgun activity preparatory to ramp-up (either initial operation in the survey area, or subsequent to a shut-down). Start-up of airgun operations may not commence unless the 180 dB exclusion zone has been visible for at least 30 min prior to start-up, and no marine mammals are observed within the exclusion zone for 15 min (ice seals and polar bears) or 30 min (baleen whales and Pacific walrus). If the array is shut-down pursuant to observation of a marine mammal, airgun operations may resume after the mammal has been observed to clear the exclusion zone for single airgun actuation or no marine mammals are observed within the exclusion zone for 15 min (ice seals and polar bears) or 30 min (baleen whales and Pacific walrus).

**Take/Taking:** The term “take” under the MMPA means “to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal” (MMPA, Section 3(13). Take, as defined by the ESA, means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (ESA Section 3(19)).

Under the MMPA, the ‘taking’ of marine mammals, incidental or otherwise, without a permit or exemption is prohibited, with a few exceptions. One such exception (as stated in Sections 101(a)(5)(A) and (D)) is for the incidental, but not intentional, “taking,” by U.S. citizens, while engaging in an activity (other than commercial fishing) of small numbers of marine mammals of a species or population stock provided that the taking will have a negligible impact on such species or stock, will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses, and the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting are set forth. Additionally, pursuant to Section 101(a)(5)(D) of the MMPA monitoring plans are required to be independently peer reviewed where the project may affect the availability of a species or stock for taking for subsistence uses.

In the 1982 amendments to the ESA, the "incidental take permit" process was established under section 10(a)(1)(B) of the ESA to allow for the "incidental take" of endangered and threatened species of wildlife by non-Federal entities. Incidental take is defined by the ESA as take that is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity."

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**APPENDIX A**  
**LEVEL OF EFFECTS DEFINITIONS**

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## A-1. Introduction

This appendix defines and explains the levels of effect used in the BPXA OBS G&G Seismic Survey Application #14-03 EA to evaluate potential environmental impacts. Impacts are described in terms of frequency, duration, general scope, and/or size and intensity. Each level considers such factors as the nature of the impact, the spatial extent, recovery times, and the effects of mitigation. The terms negligible, minor, moderate, and major are used to describe the relative degree or anticipated level of effect of an action on a specific resource. Following each term listed below for a specified resource are the general characteristics used to determine the anticipated level of effect. For each term, best professional judgment was used to evaluate the best available data concerning the affected resource.

For each resource, a “significance threshold” is also provided. Adverse impacts that do not meet the significance threshold are considered “not significant.” Required mitigation measures may reduce otherwise “significant” impacts to a level of “not significant.”

The absence of a significant effect does not equate to “no effect.” As shown in the four-category scale, and in the numerous environmental analyses that BOEM has undertaken, effects from activities can be adverse and noticeable before they reach the significance threshold. Furthermore, in the cumulative effects analysis, BOEM analyzes the combined effects of projected activities with other actions, because BOEM recognizes that effects that individually do not reach this significance threshold may exceed that significance threshold when considered collectively.

## A-2. Levels of Effect

### 2.1 Air Quality

The levels of effect applied to the air quality analysis are based on the results of two levels of analyses, the emission inventory, and if required, the more rigorous ambient air analysis based on computer dispersion modeling.

#### 2.1.1 Significance Threshold

A significant effect on air quality is determined when:

1. Project-related emissions cause an increase in pollutant concentrations over the nearest onshore area of at least 20 square kilometers that
  - a. exceeds half of any of the National Ambient Air Quality Standards (NAAQS) (except for ozone); or
  - b. exceeds half of the maximum allowable increase for any pollutant for the Prevention of Significant Deterioration (PSD) for a Class II area under 40 CFR 52.21(c) or 18 AAC 50.020(b); or
  - c. is expected to exceed half the ozone NAAQS based on an analysis of the potential increase in the ozone precursor emissions of volatile organic compounds (VOC) and nitrogen oxides (NOX); or
2. Design concentrations violate the NAAQS or if applicable, the Alaska Ambient Air Quality Standards (AAQS).

#### 2.1.2 Level of Effects

##### Negligible

- Emission rates would be less than 100 tons per year for VOCs and all pollutants regulated under the NAAQS, and, if applicable, the Alaska AAQS.

**Minor**

- Emission rates would be equal to or greater than 100 tons per year for VOCs and all pollutants regulated under the NAAQS, and, if applicable, the Alaska AAQS.

**Moderate**

- Project-related emissions cause pollutant concentrations of at least one pollutant to exceed one-half of the PSD maximum allowable increases; or
- Project-related emissions cause pollutant concentrations of at least one pollutant to exceed one-half of the NAAQS, and, if applicable, the Alaska AAQS; or
- Increases in emissions of NO<sub>x</sub> and VOC would result in the formation of ozone to a level that would be expected to exceed one-half the ozone NAAQS.

**Major**

- Design concentrations of at least one pollutant would equal or exceed one-half the NAAQS, and, if applicable, one-half the Alaska AAQS; or
- Increases in emissions of NO<sub>x</sub> and VOC would result in the formation of ozone to a level that would be expected to equal or exceed the ozone NAAQS.

## 2.2 Water Quality

The levels of effect applied to water quality analysis consider the context and intensity of impacts, EPA's NPDES permitting program, and criteria under 40 CFR 125.122:

1. The quantities, composition and potential for bioaccumulation or persistence of the pollutants to be discharged;
2. The potential transport of such pollutants by biological, physical or chemical processes;
3. The composition and vulnerability of the biological communities which may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain;
4. The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism.
5. The existence of special aquatic sites including, but not limited to marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas and coral reefs;
6. The potential impacts on human health through direct and indirect pathways;
7. Existing or potential recreational and commercial fishing, including finfishing and shellfishing;
8. Any applicable requirements of an approved Coastal Zone Management plan;
9. Such other factors relating to the effects of the discharge as may be appropriate;
10. Marine water quality criteria developed pursuant to section 304(a)(1).

### 2.2.1 Significance Threshold

Significant effect on water quality is determined by any of the following: (1) the action is likely to violate its National Pollution Discharge Elimination System permit; (2) in the event of an accidental spill of crude oil or refined oil, total aromatic hydrocarbon or total aqueous hydrocarbon criteria for the Alaska marine or fresh-water quality standards are exceeded; or (3) the action is otherwise likely to introduce changes in the physical, chemical, or biological characteristics of a waterbody which

case an unreasonable degradation of the marine environment as defined at 40 CFR 125.121 and determined in accordance with 40 CFR 125.122.

## 2.2.2 Level of Effects

### Negligible:

- Temporary and localized impacts to water quality that do not cause an unreasonable degradation under 40 CFR 125.122.

### Minor:

- Long-term and/or widespread impacts to water quality that do not cause an “unreasonable degradation” under 40 CFR 125.122.

### Moderate:

- Impacts to water quality that exceed NPDES permit criteria or cause a temporary or localized “unreasonable degradation” under 40 CFR 125.122.

### Major:

- Impacts to water quality that cause long-term and widespread “unreasonable degradation” under 40 CFR 125.122.

## 2.3 Lower Trophic Organisms

### 2.3.1 Significance Threshold

An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status.

### 2.3.2 Level of Effects

#### Negligible:

- No measurable impacts. Population-level effects are not detectable.
- Localized, short-term disturbance or habitat effect experienced during one season that is not anticipated to accumulate across multiple seasons.
- No population level impacts to reproductive success or recruitment are anticipated.
- Mitigation measures are implemented fully and effectively or are not necessary.

#### Minor:

- Population-level effects are not detectable.
- Widespread annual or chronic disturbances or habitat effects not anticipated to accumulate across 1 year, or localized effects that are anticipated to persist for more than 1 year.
- Mitigation measures may be implemented on some, but not all, impacting activities, indicating that some adverse effects are avoidable.
- Unmitigatable or unavoidable adverse effects are short term and localized.

#### Moderate:

- Disturbances could occur, but not on a scale resulting in population-level effects.
- Widespread annual or chronic disturbances or habitat effects could persist for more than one year and up to a decade.

- Widespread implementation of mitigation measures for similar activities may be effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are short term and widespread, or long term and localized.

**Major**

- Disturbances occur that result in measurable population-level effects.
- Widespread seasonal, chronic, or effects from subsequent seasons are cumulative and are likely to persist for more than 1 decade.
- Mitigation measures are implemented only for a small portion of similar impacting activities, but more widespread implementation for similar activities could be more effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are widespread and long lasting.

**2.4 Fish****2.4.1 Significance Threshold**

An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status.

**2.4.2 Level of Effects****Negligible:**

- No measurable impacts. Population-level effects are not detectable.
- Localized, short-term disturbance or habitat effect experienced during one season that is not anticipated to accumulate across multiple seasons.
- No mortality or impacts to reproductive success or recruitment are anticipated.
- Mitigation measures are implemented fully and effectively or are not necessary.

**Minor:**

- Population-level effects are not detectable. Temporary, nonlethal adverse effects to some individuals.
- Widespread annual or chronic disturbances or habitat effects not anticipated to accumulate across 1 year, or localized effects that are anticipated to persist for more than 1 year.
- Low mortality levels may occur, measurable in terms of individuals or <1% of the local post-breeding fish populations.
- Mitigation measures may be implemented on some, but not all, impacting activities, indicating that some adverse effects are avoidable.
- Unmitigatable or unavoidable adverse effects are short term and localized.

**Moderate:**

- Mortalities or disturbances could occur, but not on a scale resulting in population-level effects.
- Widespread annual or chronic disturbances or habitat effects could persist for more than 1 year and up to a decade.
- Some mortality could occur but remains limited to a number of individuals insufficient to produce population-level effects.

- Widespread implementation of mitigation measures for similar activities may be effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are short term and widespread, or long term and localized.

### Major

- Mortalities or disturbances occur that have measureable and thus significant population-level effects.
- For fishes, the anticipated mortality is estimated or measured in terms of tens of thousands of individuals or >20% of a local breeding population and/or >5% of a regional population, which may produce short-term, localized, population-level effects.
- Widespread seasonal, chronic, or effects from subsequent seasons are cumulative and are likely to persist for more than 1 decade.
- Mitigation measures are implemented only for a small portion of similar impacting activities, but more widespread implementation for similar activities could be more effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are widespread and long lasting.

## 2.5 Marine and Coastal Birds

### 2.5.1 Significance Threshold

**Threatened and Endangered Species:** An adverse impact that results in a decline in abundance and/or change in distribution requiring one or more generation for the indicated population to recover to its former status.

**All Other Marine and Coastal Birds:** An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status.

### 2.5.2 Level of Effects

#### Negligible

- Localized short-term disturbance or habitat effect experienced during one season that is not anticipated to accumulate across one year.
- No mortality is anticipated.
- Mitigation measures implemented fully and effectively or are not necessary.

#### Minor

- Widespread annual or chronic disturbances or habitat effects not anticipated to accumulate across one year, or localized effects that are anticipated to persist for more than 1 year.
- Anticipated or potential mortality is estimated or measured in terms of individuals or <1% of the local post-breeding population.
- Mitigation measures are implemented on some, but not all, impacting activities, indicating that some adverse effects are avoidable.
- Unmitigatable or unavoidable adverse effects are short-term and localized.

**Moderate**

- Widespread annual or chronic disturbances or habitat effects anticipated to persist for more than one year, but less than a decade.
- Anticipated or potential mortality is estimated or measured in terms of tens or low hundreds of individuals or <5% of the local post-breeding population, which may produce a short-term population-level effect.
- Mitigation measures are implemented for a small proportion of similar impacting activities, but more widespread implementation for similar activities likely would be effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are short-term but more widespread.

**Major**

- Widespread annual or chronic disturbance or habitat effect experienced during one season that would be anticipated to persist for a decade or longer.
- Anticipated or potential mortality is estimated or measured in terms of hundreds or thousands of individuals or <10% of the local post-breeding population, which could produce a long-term population-level effect.
- Mitigation measures are implemented for limited activities, but more widespread implementation for similar activities would be effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are widespread and long lasting.

## 2.6 Marine Mammals

### 2.6.1 Significance Threshold

**Threatened and Endangered Species:** An adverse impact that results in a decline in abundance and/or change in distribution requiring one or more generation for the indicated population to recover to its former status.

**All Other Marine Mammals:** An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status.

### 2.6.2 Level of Effects

**Negligible:**

- No measurable impacts and no population-level effects.
- May cause brief behavioral reactions such as temporary avoidances of or deflections around an area.
- Localized, short-term disturbance or habitat effects experienced during one season are not anticipated to accumulate across multiple seasons.
- No mortality or detectable impacts to reproductive success or recruitment are anticipated.
- Mitigation measures are fully implemented or are not necessary.

**Minor:**

- Low but measurable impacts with no population-level effects.
- A small number of mortalities are unlikely but possible.
- May cause behavioral reactions such as avoidances of or deflections around an area.

- Localized, disturbance or habitat effects experienced during one season may accumulate across subsequent seasons, but not over one year.
- Mitigation measures are fully implemented or are not necessary.

**Moderate:**

- Mortalities or disturbances could occur, but no detectable population-level effects.
- A small number of mortalities are likely, but not to an extent resulting in detectable population level effects.
- Adverse impacts to ESA-listed species could occur.
- Widespread annual or chronic disturbances or habitat effects could persist for more than one year and up to a decade.
- Widespread implementation of mitigation measures for similar activities may be effective in reducing the level of avoidable adverse effects.
- Unmitigated or unavoidable adverse effects may be short term and widespread, or are long term and localized.

**Major:**

- Mortalities or disturbances occur that have detectable population-level effects.
- Mortality might occur at or above the estimated Potential Biological Removal<sup>1</sup> (PBR) as a result of the proposed action.
- Widespread seasonal or chronic effects are cumulative and are likely to persist for more than one decade.
- Mitigation measures are implemented only for a small portion of similar impacting activities, but more widespread implementation for similar activities could be more effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are widespread and long lasting.

## 2.7 Terrestrial Mammals

### 2.7.1 Significance Thresholds

An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status. Any major level of effects is significant.

### 2.7.2 Level of Effects

**Negligible:**

- No adverse impacts to individuals. Temporary, nonlethal adverse effects could affect some individuals.
- Localized, short-term disturbance or habitat effects may be experienced during one season but not across multiple seasons.
- No impacts to reproductive success or recruitment are anticipated.
- Mitigation measures are implemented fully and effectively or are unnecessary.

**Minor:**

- Population-level effects remain undetectable, however a small number of individuals could experience long-term adverse effects or mortality.

- Widespread annual or chronic disturbances, habitat effects, and localized effects are not anticipated to accumulate beyond 1 year.
- Mitigation measures may be implemented on some, but not all, impacting activities, indicating that some adverse effects are unavoidable.
- Moderate:
- Population impacting mortalities or disturbances are detectable, but are insufficient to result in population level effects.
- Widespread annual or chronic disturbances or habitat effects should persist from 1-10 years .
- Widespread implementation of mitigation measures for similar activities may effectively reduce the level of adverse effects.
- Unmitigable or unavoidable adverse effects are short term but widespread, or are long term and localized.

**Major:**

- Mortalities or disturbances occur that have measurable population level effects.
- Widespread seasonal, chronic, or effects from subsequent seasons are cumulative and are likely to persist for more than 10 years.
- Mitigation measures are only implementable for a small proportion of similar impacting activities, but more widespread implementation for similar activities could be more effective in reducing the level of avoidable adverse effects.
- Adverse effects are unmitigable, widespread, and lingering.

## 2.8 Sociocultural Systems

Sociocultural systems include social organization, cultural values, and institutional arrangements.

### 2.8.1 Significance Threshold

A disruption of social organization, cultural values, and/or institutional arrangements with a tendency towards displacement of existing social patterns.

### 2.8.2 Level of Effects

**Negligible:**

- Periodic disruption of social organization, cultural values, and/or institutional arrangements occurs without displacement of existing social patterns.

**Minor:**

- Disruption of social organization, cultural values, and/or institutional arrangement occurs for a period of less than one year, without a tendency toward displacement of existing social patterns.

**Moderate:**

- Chronic disruption of social organization, cultural values, and/or institutional arrangements occurs for a period of more than one year, without a tendency toward displacement of existing social patterns.

**Major:**

- Disruption of social organization, cultural values, and/or institutional arrangements with a tendency towards displacement of existing social patterns.

## 2.9 Subsistence

### 2.9.1 Significance Threshold

Adverse impacts which disrupt subsistence activities, or make subsistence resources unavailable, undesirable for use, or only available in greatly reduced numbers, for a substantial portion of a subsistence season for any community.

### 2.9.2 Level of Effects

**Negligible:** Subsistence resources could be periodically affected with no apparent effect on subsistence harvests.

**Minor:** Adverse impacts to subsistence activities are of an accidental and/or incidental nature and limited to a short-term (within one season or the duration of the project).

**Moderate:** Adverse impacts which disrupt subsistence activities, or make subsistence resources unavailable, undesirable for use, or only available in greatly reduced numbers, for a substantial portion of a subsistence season for any community.

**Major:** Adverse impacts resulting in one or more important subsistence resources becoming unavailable, undesirable for use, or available only in greatly reduced numbers for any community.

## 2.10 Economy

The effects levels used for this analysis focus on the impacts associated with the Proposed Action on socioeconomic systems, including employment, personal income, and revenues accruing to the local, state, and federal government.

### 2.10.1 Significance Threshold

Economic effects that would cause important and sweeping changes in the economic well-being of the residents or the area or region. Local employment is increased by 20% or more for at least 5 years.

### 2.10.2 Level of Effects

**Negligible**

- No measurable effects beyond short term, periodic impacts.

**Minor**

- Adverse impacts to the affected activity or community are avoidable with proper mitigation.
- Impacts would not disrupt the normal or routine functions of the affected activity or community. Economic systems would be impacted for a period of up to 1 year.
- Once the impacting agent is eliminated, the affected activity or community will return to a condition with no measurable effects from the proposed action without any mitigation.

**Moderate**

- Impacts to the affected activity or community are unavoidable. Proper mitigation would reduce impacts substantially during the life of the project.

- Effects on economic systems would be unavoidable for a period longer than 1 year.
- The affected activity or community would have to adjust somewhat to account for disruptions due to impacts of the project.
- Once the impacting agent is eliminated, the affected activity or community will return to a condition with no measurable effects from the proposed action if proper remedial action is taken.

**Major**

- Impacts to affected community are unavoidable.
- Proper mitigation would reduce impacts somewhat during the life of the project.
- The affected activity or community would experience unavoidable disruptions to a degree beyond what is normal.
- Once the effect producing agent is eliminated, the affected activity or community may retain measurable effects of the proposed action indefinitely, even if remedial action is taken.

**2.11 Public Health****2.11.1 Level of Effects****Negligible**

- Infrequent minor acute health problems, not requiring medical attention.
- No measurable effects on normal or routine community functions.
- No long-term consequences for Public Health or well being.

**Minor**

- Public Health affected, but the effects would not disrupt normal or routine community functions for more than one week.
- Effects would not occur frequently.
- Effects would not affect large numbers of individuals.
- Effects could be avoided with proper mitigation.

**Moderate**

- Adverse effects on Public Health occurring for brief periods of time that do not result in or incrementally contribute to deaths or long-term disabilities.
- Effects can be prevented, minimized, or reversed with proper mitigation.
- Effects could occur more frequently than minor events, but would not be frequent.

**Major**

- Effects on Public Health would be unavoidable and would contribute to the development of disabilities, chronic health problems, or deaths.
- Alternatively, occurrence of minor health problems with epidemic frequency.
- Effective mitigation might minimize the adverse health outcomes but would not be expected to reverse or eliminate the problem.

## 2.12 Environmental Justice

Executive Order 12898 requires Federal Agencies to evaluate whether proposed projects would have “disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low income populations.”

### 2.12.1 Significance Threshold

The significance threshold for Environmental Justice is when minority or low-income populations experience disproportionate, high adverse human health or environmental effects from the proposed action. Disproportionately high adverse impacts are those impacts which exceed the significance thresholds for subsistence or sociocultural effects for minority populations or low income populations.

### 2.12.2 Level of Effects

The levels of effect for Environmental Justice correspond to the levels of effects for subsistence, sociocultural, or public health effects as experienced by minority populations or low income populations.

## 2.13 Archaeology

### 2.13.1 Level of Effects

#### Negligible

- This category equates to No Historic Properties Affected as defined by 36 CFR 800.4(d)(1), the Code of Federal Regulations that promulgates Section 106 of the National Historic Preservation Act of 1966 as amended.

#### Minor

- This category equates to a finding of No Historic Properties Affected when the Agency identifies a potential conflict within an Area of Potential Effect due to the presence of a geomorphological feature and revises the plan to avoid it prior to consultation with the State Historic Preservation Officer.

#### Moderate

- This category equates to a finding of No Adverse Effect as defined by 36 CFR 800.5(b) when the SHPO identifies a conflict that requires a change in plan to avoid effects on an Historic Property as defined by 36 CFR 800.16(l)(1&2).

#### Major

- This category equates to a finding of Adverse Effect as defined by 36 CFR 800.5(C) requiring mitigation and a Memorandum of Agreement.

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<sup>1</sup> Marine mammal stock management under the MMPA is based on a theoretical concept called Potential Biological Removal (PBR). The PBR is defined as the maximum number of animals, not including natural mortalities, which may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustained population. An optimum sustained population is defined as the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem. For example, as the bowhead whale population continues to grow, it continues to approach its carrying capacity. Contemporary population ecology suggests that at carrying capacity, a stable population is achieved when mortality equals productivity.

The PBR is calculated as the product of the minimum population estimate, one-half the theoretical productivity rate, and a “recovery factor”. For example, the current estimate for the rate of increase for the bowhead whale stock (3.3%) should not be used as an estimate of maximum productivity because the population is currently being harvested and because the population has recovered to population levels where the growth is expected to be significantly less than maximum productivity. For the Western Arctic bowhead whale stock, the population size is estimated to be 12,631 (estimated in 2004), the theoretical productivity rate is 0.2, and the recovery factor is 0.5. Schweder (2009) estimated the yearly growth rate to be 3.2% from 1984- 2003 using a sight-resight analysis of photographs. Koski et al. (2010) provided an estimate of 12,631 95% CI: 7,900-19,700 bowheads derived from sight-resight results from aerial photographs sampling in 2003-2004. A spring survey conducted in 2011 was successful and data therefrom is in the process of being analyzed. The PBR is generally only used by the NMFS to guide decisions regarding the allowable removal of individual animals from a stock. The conceptual PBR is used in the level of effects to identify a threshold whereby maximum population growth is sustained or not. If an anticipated effect could result in a loss of whales that exceeded the PBR, this would be inferred to be a population-level effect. In reality, given the conservative values used to derive the PBR, the loss of marine mammals that exceeded calculated PBR could be entirely consistent with a stable population.

**APPENDIX B**  
**CUMULATIVE EFFECTS SCENARIO**

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## **B-1. PAST, PRESENT AND REASONABLY FORESEEABLE FUTURE ACTIONS**

The Council on Environmental Quality (CEQ) Regulations define cumulative effects at 40 CFR 1508.7:

*Cumulative impact* is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 CFR 1508.7)

This appendix provides a description of past, present and reasonably foreseeable future actions in the Chukchi and Beaufort Seas, which may contribute to cumulative impacts of oil and gas activities in these areas.

## **B-2. IMPACT SOURCES**

The main sources of impacts which could have a cumulative impact with the proposed action on the resources in the Arctic OCS are: (1) marine vessel traffic, (2) aircraft traffic, (3) subsistence and other community activities, (4) scientific research activities, and (5) oil and gas-related activities.

### **2.1. Marine Vessel Traffic**

Past marine vessel traffic has been associated with subsistence hunting, oil exploration, research, and military activities. Weather and ice have traditionally limited marine vessel traffic in the proposed exploration area to July through September.

The number of marine vessels in both the Beaufort and Chukchi Seas has increased in recent years due to advances in the technology of ice strengthening and ice breaking capacities of marine vessels, changes in ice cover and classifications of ice, increases in use of both the Northeast Passage over Russia and the Northwest Passage through Canada for commercial and tourist voyages, and increased interest in scientific and economic pursuits in the area. Reasonably foreseeable traffic in the region includes small craft involved in the fall whaling hunt at Barrow and Wainwright; USCG vessels; cargo vessels; other supply ships, tugs, and barges; cruise ships; and vessels associated with scientific endeavors. The USCG estimates that from 2008 to 2010 the number of vessels in the Arctic increased from around 100 to more than 130, and the number of transits through the Bering Strait increased from around 245 to more than 325 (USCG, 2011). The estimated number of miles of non-seismic vessel traffic in the Chukchi Sea for July through October increased from approximately 2,000 miles in 2006 to more than 11,500 miles in 2010 (Marine Exchange of Alaska, 2011). Vessel tracks from 2009 indicate vessel transits in the vicinity of Barrow and Wainwright are traditionally concentrated along the coast (Marine Exchange of Alaska, 2011).

Marine vessels are the greatest contributors of anthropogenic sound introduced to the Beaufort Sea. Sound levels and frequency characteristics of vessel sound generally are related to vessel size and speed. Larger vessels generally emit more sound than do smaller vessels. Same size class vessels travelling at higher rates of speed generally emit more sound than the same vessels travelling at lesser speeds. Vessels underway with a full load, or vessels pushing or towing loaded non-powered vessels, generate more sound than unladen vessels in a similar size class. The most common sources of marine vessel mechanical components that generate sound waves are propulsion engines, generators, bearings, pumps, and other similar components. Operations and navigation equipment, including fathometers and sonar equipment, are also inclusive of onboard mechanical components that cumulatively create and propagate sound into the marine environment through the vessel hull. The most intense level of sound pressure introduced into the water from an underway marine vessel originates from cavitation associated with the energy of

spinning propellers. Moored vessels can generate sound from the operation of engines and pumps. Cranes or other similar operational equipment performing construction activities or other work functions may transmit sound directly to the marine environment through the air-water interface or indirectly through propagation of sound waves through hulls or other support structures.

## 2.2. Aircraft Traffic

Air traffic has increased in recent years, mostly from increases in academic and commercial ventures, and increases in military operations. Aircraft traffic in the Arctic includes fixed wing and helicopter flights for research programs and marine mammal monitoring operations; cargo flights for supplies to villages and for commercial ventures including oil and gas related activities (such as crew changes and supply flights); flights for regional and inter-village transport of passengers; air-ambulance and search and rescue emergency flights; general aviation for the purpose of sport hunting and fishing or flightseeing activities; and multi-governmental military flights. An average of 306 commercial flights per month occurred from Wainwright airport between July and October, 2000 to 2008 (Bureau of Transportation Statistics, 2009).

## 2.3. Subsistence Activities and Other Community Activities

Subsistence hunting and other community activities associated with regional native villages such as Nuiqsit and Kaktovik have persisted for millennia, and are expected to continue during the period of Proposed Action. Marine traffic associated with subsistence hunting consists of small craft used during fishing, seal hunting, and whale hunts. Vessel traffic associated with other community activities consists primarily of supply barges traveling close to shore, within state waters. Overall, vessel traffic associated with native village activities within the Proposed Action area is expected to be very low.

## 2.4. Scientific Research Activities

A considerable scientific research effort by governmental, non-governmental, and academic organizations operating from marine vessels and aircraft occurs annually in the Beaufort Sea and Chukchi Sea. The programs conducted by these organizations are generally expected to have ended for the season, or end for the season during October, but may produce cumulative impacts on resources analyzed for the Proposed Action. Marine environmental baseline studies involve deployment of oceanographic equipment for collecting water and sediment samples, and use of nets and trawls for fish sampling and collection of phytoplankton, zooplankton, benthic invertebrates, and pelagic invertebrates. Also continuing will be observations of marine and coastal birds and marine mammals using standardized survey transect methods and passive acoustic monitoring. Metocean buoys and acoustic wave and current meters will continue to be deployed for studies of physical oceanography and climate. Previous environmental assessments, such as the environmental assessment for Shell's Beaufort Sea marine research program, describe the techniques used and the effects of these programs in detail (USDOJ, BOEMRE, 2011).

**2014 BOEM ANIMIDA III (AK-11-14b).** The Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA) and continuation of ANIMIDA (cANIMIDA) started in 1999 and has provided baseline data and monitoring results for chemical contamination, turbidity, Boulder Patch productivity, and subsistence whaling in the vicinity of oil industry development in the Beaufort Sea OCS. Northstar and Liberty prospects were monitored prior to development and Northstar into development and production. Activities include both nearshore and offshore components, both concentrating in the region north and west of Camden Bay. Nearshore components are achieved by small vessel support in the open water season. Larger vessel support will be needed in offshore Camden Bay collections along the Beaufort Sea shelf break. Primary biological/contaminant field surveys should occur in the open-water period, with some effort during breakup with high river flow, and at least once during the ice-covered season. Sediment and biota sampling will be scheduled such that stations sampled in eastern, central, and western Beaufort in ANIMIDA and cANIMIDA will be resampled at least once and the new deeper eastern Beaufort Region stations around Sivulliq and Torpedo would be sampled at least twice. Focus will

be on oil and gas development potential contaminants in sediments and benthic biota, and distribution and abundance of benthic biota.

**2014 BOEM ANIMIDA III: Boulder Patch and Other Kelp Communities in the Development Area (AK-11-14a).** The Boulder Patch kelp bed surveys and monitoring will be conducted using small vessel support in the open water season in the Stefansson Sound region to the north and west of Camden Bay. Kelp production will be measured using established or comparable techniques. Oceanographic measurements shall include ambient light intensity and total suspended solids using established or comparable techniques. Data will be combined with the existing long-term dataset. The extent of kelp in Camden Bay will be surveyed and GIS maps constructed of kelp and implied (boulder and or hard bottom) kelp beds in the study area.

**2014 BOEM Distribution and Abundance of Select Trace Metals in Chukchi and Beaufort Sea Ice (AK-13-03-04).** The concentrations of certain trace metals are substantially elevated in sea ice relative to seawater, as indicated by results of previous studies in Antarctica and the Bering Sea. Consequently, sea ice melt has been shown to increase concentrations of some elements in surface waters, but the processes controlling the retention and subsequent release of trace metals in sea ice are not well understood. Offshore surface seawater and aerosols samples will be collected on board the R/V Mirai in collaboration with the Japanese Agency for Marine-Earth Science and Technology (JAMSTEC). Snow will be collected onboard the ship opportunistically during snow events. A total of ~80-100 ice core samples will be collected from 10 stations during the sea ice sampling effort in Camden Bay. This sampling will involve travel by snow machine from Kaktovik/Barter Island to Camden Bay during April-May, 2014.

**2014 BOEM Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (AK-12-02)** This ongoing study will track the movements and document the behavior of bowhead and gray whales using satellite telemetry. Tagging operations will focus on locations nearby St. Lawrence Island during the months of April and May; Barrow during the months of May and September/October; and in Canada during July and August. Only smaller vessels used by tagging crews will be involved. Bowhead whale vocalization rates and ambient noise levels will be documented using an acoustic tag to develop analysis of call rates relative to behavior and disturbance. Tags equipped with environmental sensors will be deployed to monitor, summarize, and transmit ambient oceanographic conditions as bowheads migrate.

**2014 BOEM Aerial Surveys of Arctic Marine Mammals Project (AK-11-06).** ASAMM aerial surveys are conducted in the western Beaufort and northeastern Chukchi Seas (68°N-72°N latitude and 140°W-169°W longitude), extending from the coast to a maximum of approximately 315 km offshore, encompassing 230,000 km<sup>2</sup>. Two teams are required to cover the study area: one team, based out of Barrow, Alaska, surveys the northeastern Chukchi Sea and the other team, based out of Deadhorse, Alaska, surveys the western Beaufort Sea. Fixed-wing, twin-turbine Aero Commander aircraft were used for all surveys in 2012. These aircraft have a 5.5-hour flight endurance and are outfitted with bubble windows for downward visibility. Line-transect surveys are flown every day, weather and logistics permitting, at an altitude of 1,200 ft in the Chukchi Sea and 1,500 ft in the Beaufort Sea. The ASAMM project is conducted by the National Marine Mammal Laboratory (NMML), funded by the Bureau of Ocean Energy Management (BOEM), and permitted through the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service. Daily reports from the 2013 field season as well as previous years' reports are available on the NMML website at <http://www.afsc.noaa.gov/NMML/cetacean/bwasp/index.php>

**2014 BOEM Characterization of the Circulation on the Continental Shelf Areas of the Northeast Chukchi and Western Beaufort Seas (AK-12-03a)** This project will coordinate and collaborate with other research projects in the area (BOEM, WHOI, industry, etc.) to synthesize and integrate all available physical oceanographic data collected at the junction of the Beaufort and

Chukchi Seas north of Barrow, AK. Various vessels will be used to deploy and retrieve buoys and slocum gliders during the open-water season of 2013, most likely in September. This study will involve using a suite of instrumentation including: ADCPs, CTDs, Ice Profiling Sonar (IPS5), gliders, surface drifters and HF radars. Long Range HF radar systems presently deployed along the Chukchi coast at Point Lay, Wainwright and Pt. Barrow will be modified to increase the maximum observable range to approximately 250 km to capture the summer surface current flow over a larger area of the Chukchi shelf and around Hanna Shoal. A planned HF radar deployment at Cape Simpson (CIAP funds) will capture surface current flow along the western Beaufort shelf and slope and within Barrow Canyon. Gliders, surface drifters, moored ADCPs and towed CTDs will collect data on depth and time dependent current, temperature and salinity structure. Ice Profiling Sonar and moored ADCPs will be used to calculate ice drift and velocity. Sea ice extent will be obtained from satellite information, while drifting buoys will be crucial for computing flow trajectories and diffusivities. Data from the ADCPs, CTDs, glider deployments, HF radars, planned drifter measurements and available industry data will be synthesized to acquire a comprehensive characterization of the circulation in the study area.

#### **2014 BOEM U.S.-Canada Transboundary Fish and Lower Trophic Communities (AK-12-04)**

The survey will sample fish, invertebrates, and related biological and oceanographic habitat characteristics between longitudes 141° and 147° in the U.S. and into Canadian waters to ~138° (across the Canadian border to Herschel Island and the Mackenzie canyon) during the 2013 open water season. This survey will expand the scope and reach of a Beaufort Sea Pilot Fish Survey conducted in 2008. Methodologies will follow those from the 2008 survey and the ongoing BOEM Central Beaufort Sea Fish Survey, modified in consideration of lessons learned from the earlier work. Sampling will deploy gear types such as beam trawl (10m wide), otter trawl, Isaacs-Kidd, and bongo nets. This study will include additional field surveys in both the under-ice and open water seasons to provide a better understanding of variability and collect additional habitat characteristics; collect invertebrates in both the water column and benthos; collect CTD data to document hydrographic structure; and collect and analyze ecological (e.g. energetics, isotope, genetic and otolith) samples for a foodweb model.

**2014 Pacific Arctic Group (PAG).** Ongoing activities in the general Beaufort Sea and Chukchi Sea regions include multinational efforts carried out by the Pacific Arctic Group (PAG). Organized under the International Arctic Science Committee (IASC), the PAG mission is to serve as a Pacific Arctic regional partnership to plan, coordinate, and collaborate on science activities of mutual interest to the Arctic region. Some of these activities could coincide in time and space with Shell's proposed exploration plan activities. The Diversified Biological Observatory is a multi-national cooperative effort coordinated by the PAG, with the USA, Canada, Russia, Japan, China, and Korea contributing cruise data from past, ongoing, and planned research programs. The programmatic sampling includes continuation of collections from prior and existing research stations, including BOEM-funded projects. Focus is on five geographical research areas within the Bering Sea, Bering Strait, Chukchi Sea, and Beaufort Sea. This work includes the synthesis of studies in fields including physical oceanography, marine chemistry, biological oceanography and marine biology (primary productivity, zooplankton, phytoplankton, ice algae, epontic, pelagic, and benthic collections), and marine mammal and marine bird ecology (PAG, 2011).

## 2.5. Oil and Gas Related Activities

Past oil and gas related activities in the Beaufort Sea and Chukchi Sea OCS include exploration wells, exploration seismic surveys, shallow geologic hazards surveys, geotechnical sampling programs, baseline biological studies and surveys, biological, chemical and physical oceanography monitoring programs, and other environmental studies and sampling programs including ongoing work funded by industry for the purpose of understanding the environment within and outside the project areas.

Current reasonably foreseeable oil and gas related activities in the Arctic OCS during 2014 include:

- SAExploration Holdings Inc. (SAE) three dimensional (3D) on-ice seismic survey in the Colville River Delta area of the Alaskan Beaufort Sea during the winter of 2014. (G&G Seismic Survey Application #14-01): February 15 – May 31, 2014. Project would not overlap temporally or geographically with the Proposed Action area.
- Chukchi Sea Environmental Studies Program (CSESP) research efforts in the region encompassing the ConocoPhillips, Shell Exploration and Production, and Statoil USA Exploration and Production lease areas in the Chukchi Sea. The CSESP projects would not occur geographically with the Proposed Action.
- SAE 3D ocean bottom seismic survey in the Colville River Delta area of the Alaskan Beaufort Sea during the 2014 Beaufort Sea open water season (G&G Seismic Survey Application #14-02): July 1 2014 – October 15, 2014. Project would not occur geographically with the Proposed Action.
- TGS NOPEC Geophysical Company. 2014 Chukchi Sea 2D Seismic Survey (G&G Seismic Survey Application #14-05): August 1, 2014 – October 31, 2014. Project would occur temporally with the Proposed Action.
- BPXA 2014 Winter Geotechnical and Seabottom Investigation: March 2014 through early May 2014. Categorical Exclusion granted February 6, 2014. Project will not occur temporally with the Proposed Action.
- BPXA 2014 open water Ancillary Activities: July through September, 2014. BOEM EA in process. Project will not occur geographically with the Proposed Action.

## 2.6. Climate Change and Ocean Acidification

Climate change is an ongoing consideration in evaluating cumulative effects on environmental, social and economic resources of the Arctic region (NOAA, 2011). It has been implicated in changing weather patterns, changes in the classification and seasonality of ice cover, ocean surface temperature regimes, and the timing and duration of phytoplankton blooms in the Chukchi Sea. These changes have been attributed to rising carbon dioxide (CO<sub>2</sub>) levels in the atmosphere and corresponding increases in the CO<sub>2</sub> levels of the waters of the world's oceans. These changes have also led to the phenomena of ocean acidification (IPCC, 2007; Royal Society, 2005). This phenomenon is often called a sister problem to climate change, because they are both attributed to human activities that are leading to increased CO<sub>2</sub> levels in the atmosphere. The capacity of the Arctic Ocean to uptake CO<sub>2</sub> is expected to increase in response to climate change (Bates and Mathis, 2009). Further, ocean acidification in high latitude seas is happening at a more advanced rate than other areas of the ocean. This is due to the loss of sea ice that increases the surface area of the Arctic seas. The resultant exposure of surface water lowers the solubility of calcium carbonate, resulting in lower saturation levels of calcium carbonate within the water that in turn leads to lower available levels of the minerals needed by shell-producing organisms, such as pteropods, foraminifers, sea urchins, and molluscs (Fabry et al., 2009; Mathis, Cross, and Bates, 2011).

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**APPENDIX C**  
**AIR QUALITY**

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## Air Quality

The BPXA seismic survey proposes to operate survey and support vessels on the OCS requiring the operation of large marine diesel propulsion and auxiliary engines that will contribute to the budget of emissions already existing within the project area. In addition, close proximity of the Proposed Action to land areas requires the use of onshore surface vehicles. Over time, the emissions will be transported by the wind and may have an effect on the air quality of onshore areas. Thus, it is appropriate to assess the quantity of emissions expected from the survey ships and vehicles to determine the degree of air quality effects.

The purpose of the air quality evaluation is to assess whether emissions from the Proposed Action have the potential to adversely impact air quality on the North Slope adjacent to the Beaufort Sea OCS. The Proposed Action includes plans to use ocean-going vessels that will be continually traversing a planned geographic grid for seismic research.

The proposed ships will not be temporarily or permanently anchored or secured to the seabed in a fashion similar to drillship operations during oil and gas exploration. As such, the ships are assumed to be mobile sources throughout the survey period and categorized as marine diesel engines. Likewise, the onshore vehicles are mobile sources. Thus, all the sources of emissions are considered mobile and transitory in nature.

### 1.0 EXISTING CLEAN AIR ACT AIR QUALITY CLASSIFICATION ON THE ALASKA NORTH SLOPE

Impacts from pollutants emitted over the open sea are influenced predominately by wind, which is the mechanism that dilutes and disperses air pollutants, and is also the means to transport pollutants across large areas. The impacts are further influenced by the route and speed of the ship. The existing air quality conditions near an onshore area are influenced primarily by the number and type of emissions sources located onshore. Winds are fairly persistent over the coastline adjacent to the Beaufort Sea where the area is flat and open to the winds of the Arctic Ocean. The mean annual wind speed is 12.4 miles per hour (mph), defined on the Beaufort scale as a moderate breeze, which is sufficient to cause dispersion and diffusion of air pollutants (Wang, Wu, Cheung, and Lam, 2000; NOAA, 2010). The Arctic is characterized by episodes of strong winds and the vast open area on the North Slope provides little to slow them down (Spall, Pickart, Fratantoni, et al., 2007).

The existing air quality conditions are determined by the Environmental Protection Agency (EPA) based on data obtained from emission monitor equipment located near communities on the North Slope coastline. The National Ambient Air Quality Standards (NAAQS) are compared to the monitored data to determine how often and to what extent federal standards are violated over a specific geographical area. The air quality is classified within the geographical area by the EPA based on this data. These geographical areas are referred to as air quality control regions (AQCR) and are defined by authority of the EPA.

There are four such areas defined in Alaska. The North Slope land area adjacent to the Beaufort Sea OCS is included in the Northern Alaska Intrastate AQCR (40 CFR Part 81). The northern Alaska area is defined by the EPA as a clean air resource, meaning the monitors are not detecting pollutant concentrations high enough to consistently violate federal standards. Also, the area is classified as an attainment/unclassifiable area, meaning all federal requirements for healthful air quality are being maintained over the long-term.

## 2.0 REGULATORY REVIEW

Outside air, referred to in a regulatory context as ambient air, becomes a concern when potential exists for harmful gases, particles, and other contaminants to build up in the lower atmosphere sufficient to cause measurable damage to human health, wildlife, or property (Monks, Granier, & Stohl, et al., 2009). Thus, the EPA established the NAAQS to serve as the benchmark for determining when the potential for harm exists. The NAAQS represent the numerical limits (criteria) above which concentrations of the most common air pollutants may be harmful to human health; pollutant concentrations are expressed in terms of mass per volume, or micrograms per cubic meter of air ( $\mu\text{g}/\text{m}^3$ ). The NAAQS are updated periodically by the EPA and are provided at <http://www.epa.gov/air/criteria.html>. The six common air pollutants for which EPA regulates through the NAAQS are:

- Carbon monoxide (CO);
- Nitrogen dioxide (NO<sub>2</sub>);
- Sulfur dioxide (SO<sub>2</sub>);
- Fine particulate matter (PM<sub>2.5</sub>);
- Coarse particulate matter (PM<sub>10</sub>);
- Ozone; and
- Lead.

The EPA requires the NAAQS to be attained and maintained, which is accomplished through local, state, and federal regulations. The regulations for controlling stationary emission sources are distinctly different from regulations applicable to mobile sources. Emissions from a single stationary source tend to affect the same downwind area on a consistent basis over a period of time due to the prevailing wind, whereas emissions from a mobile source are dispersed over a much larger area as the continuously moving source approaches and then moves farther away from a sensitive location (daycare, park, etc.). While a single mobile source is not likely to cause a buildup of pollutants in a single area sufficient to exceed the NAAQS, when scores of mobile sources are concentrated in a relatively small area, such as a highway corridor during rush hour, Federal standards are, on occasion, exceeded. Thus, the EPA requires that engines on vehicles be controlled at the point of manufacture, which reduces emissions not only on the highway corridor during rush hour, but on all the roadways wherever the vehicle is operated, thus reducing emissions on a local and regional scale, over the long term. In a similar way, the EPA has a coordinated strategy to focus efforts to reduce emissions from large marine diesel engines, on ships flagged in both the United States and in other countries.

Marine diesel engines emit primarily particulate matter and nitrogen oxides (NO<sub>x</sub>), which includes NO<sub>2</sub>. The pollution from marine vessels is the result of operating two types of engines on ships, main propulsion engines and auxiliary engines.

### 2.1. BOEM Air Quality Regulatory Program

The BOEM Air Quality Regulatory Program (AQRP) (30 CFR Part 550 Subpart C) does not apply to the BPXA survey vessels or any other emission sources or emissions resulting from operation of the survey plan. The BOEM AQRP applies only to a facility, as defined under 30 CFR 550.105, which requires the facility to be permanently or temporarily attached to the seabed for the purpose of drilling during oil and gas exploration, development, and production. Nonetheless, various international strategies and conventions focus efforts to reduce emissions from ships flagged in the United States and other countries. These strategies are discussed in section 2.2.

## 2.2. International Control of Pollution from Ships

The EPA and U.S. Congressional reports concur that large ships similar in size to container ships, tankers, and cruise ships are not trivial contributors to regional and global air pollution (EPA, 2013; Copeland, 2008). According to the EPA, pollution from large marine diesel engines is expected to contribute more than 2.1 million tons of NO<sub>x</sub> emissions each year by 2030, and increase PM<sub>2.5</sub> emissions to 170,000 tons per year (EPA, 2013a).

Emissions from the main propulsion engines onboard ocean-going vessels, including those operating on the OCS, are controlled at the point and time of manufacturer (OEM, Original Equipment Manufacturer) and must meet emission standards imposed by the International Maritime Organization (IMO). The IMO is the United Nations specialized agency with responsibility for maritime safety and security, and is concerned with the prevention of marine pollution from ships. Established in 1959, the IMO includes the United States as a signatory country and the U.S. EPA is a participant on the U.S. delegation to the IMO. In 1973, IMO adopted the MARPOL (short for marine pollution) Convention to minimize specific types of pollution of the seas.

### 2.2.1. MARPOL, International Convention of the Prevention of Pollution from Ships

MARPOL refers to the International Convention on the Prevention of Pollution from Ships, which established a set of agreed-upon standards and criteria (conventions) intended to minimize and prevent pollution from ships. MARPOL consists of six annexes (documents), where each describes regulations for pollution prevention at sea, where each annex is specifically dedicated to rules and regulations of a particular harmful contaminant, substance, or material. The annexes include the prevention by:

- Oil from ships (Annex I in 1983);
- Noxious liquid substances in bulk (Annex II in 1983);
- Harmful substances carried by sea in packaged form (Annex III in 1992);
- Sewage pollution by ships (Annex IV in 2003);
- Garbage pollution from ships (Annex V, revised for 2013), and the
- Prevention of air pollution from ships (Annex VI revised in 2010) (IMO, 2013).

The provisions of each annex are legally binding and enforceable only when ratified by member countries (signatories) whose combined gross tonnage reflects at least half (50 percent) of the world's gross tonnage. MARPOL applies to all vessels operating in U.S. waters as well as ships operating within 200 nautical miles of the coast of North America.

### 2.2.2. MARPOL Revised ANNEX VI

MARPOL Revised Annex VI (Annex VI) has been ratified by 59 countries, including the U.S., representing approximately 84 percent of the world's gross tonnage. As such, the provisions of Annex VI became legally binding and enforceable beginning July 1, 2010 (IMO, 2010). Hence, U.S. OEMs of specific marine diesel engines are required to meet the Annex VI emission standards for NO<sub>x</sub>, and the fuel used in the engines must reduce emissions of SO<sub>x</sub>. Engines not subject to the emission standards of the 2010 Annex VI may be subject to standards set forth in the previous versions of the annex. Large ships of a foreign flag are obliged to meet the standards imposed by the U.S. when navigating within U.S. jurisdictional waters. In addition to emission standards at the manufacturer, Annex VI includes requirements for the certification and operation of vessels and engines, as well as fuel quality used in vessels in the waters of the U.S. In addition, Annex VI establishes limits on NO<sub>x</sub> emissions on engines with a power output of more than 130 kilowatts (kW) (175 horsepower) for the purpose of protecting public health and the environment.

Ships of signatory countries constructed on or after January 1, 1990 but prior to January 1, 2000, or when a major rebuild was completed during this time, must comply with the Tier 1 NO<sub>x</sub> emission limits given in Table C-1. The emission standard in Table C-1 is limited to engines with a power rating of more than 5000 kW (6705.11 hp).

**Table C-1. MARPOL Annex VI NO<sub>x</sub> Emissions Limits**

Tier	Date Enforced	NO <sub>x</sub> Limit g/kW-hr, where n=rpm		
		n < 130	130 ≤ n < 2000	n ≥ 2000
I	2000	17	$45 \cdot n^{-0.2}$	9.8
II	2011	14.4	$44 \cdot n^{-0.23}$	7.7
III	2016*	3.4	$9 \cdot n^{-0.2}$	1.96

Source: Det Norske Veritas (DNV). 2005. Marpol 73/78 Annex VI: Regulations for the prevention of Air Pollution from Ships – Technical and Operational Implications. Regulation 13 Tier I: Current Limits.

The standards presented in Table C-1 apply to both main propulsion and auxiliary engines and require the engines to be operated with sulfur-limited marine fuels.

### 2.3. U.S. 1980 Act to Prevent Pollution from Ships to Implement MARPOL

The international nature of maritime shipping makes implementation and enforcement of marine engine emission standards challenging. Following ratification of a MARPOL annex, each nation that is a signatory to the annex must enact domestic laws to implement the standards and ensure certification and compliance to the laws of the other signatory nations related to ships' emissions. Certification of ships' engines to the pollution prevention standards is the responsibility of the country where the ship is registered, referred to as the flag state. In response, the U.S. enacted the 1980 Act to Prevent Pollution from Ships (1980 APPS). The 1980 APPS is a U.S. federal law enacted to implement the provisions of MARPOL and the ratified annexes. The Act "gives the U.S. Coast Guard the authority to develop regulations and enforce MARPOL . . ." (Council on Foreign Relations, 2013). The 1980 APPS applies to all U.S. flagged ships operating anywhere in the world and, "...to all foreign flagged vessels operating in navigable waters of the U.S. or while at port under U.S. jurisdiction;" the 1980 APPS is codified at 33 U.S. Code §1901 (USLegal, 2013). The regulatory mechanism established in the 1980 APPS to implement MARPOL and its annexes is separate and distinct from the Clean Air Act and other federal environmental laws. The provisions of the 1980 APPS do not apply to any warship, naval auxiliary, ships of the Department of the Navy, or ships operating during a time of war or a declared national emergency.

#### 2.3.1 EPA and U.S. Coast Guard Enforcement of MARPOL

The EPA issued guidance to establish terms under which the USCG and the EPA will mutually cooperate in the implementation and enforcement of Annex VI to MARPOL as implemented by the 1980 APPS. The EPA and USCG entered into a Memorandum of Understanding (MOU) on June 27, 2011, that includes inspections, investigations, and enforcement actions if a violation is detected. Efforts to ensure compliance include oversight of marine fuelling facilities, onboard compliance inspections, and reviews of records. The USCG or EPA may bring an enforcement action for a violation, which may result in criminal and/or civil liability. The memorandum is available at <http://www.epa.gov/enforcement/air/documents/policies/mobile/annexvi-mou062711.pdf> (EPA, 2012b). The EPA and USGC also issued a Joint Letter to ship owners, ship operators, shipbuilders, marine diesel engine manufacturers, and marine fuel suppliers to inform them of the regulations for prevention of air pollution from ships and the requirements of Annex VI (EPA, 2012a).

### 2.3.2 U.S. Required Certifications and Examinations

Each diesel engine regulated under MARPOL aboard U.S. flagged vessels must have an Engine International Air Pollution Prevention (EIAPP) certificate issued by the EPA to document the engine meets the MARPOL NO<sub>x</sub> standard. Some vessels are also required to have an International Air Pollution Prevention Certificate (IAPP) issued by the USCG. Ship operators must also maintain records onboard documenting compliance with the emission standards and fuel requirements. Non-U.S. flagged ships are subject to examination under Port State Control while operating in U.S. waters.

### 2.4. Non-Road and On-Road Engine Tier Standards

The survey is proposed to use equipment that is mobile, non-stationary, and is not expected to be used in one specific area for a long period of time. The engines are proposed to meet the engine emissions regulations established by the Environmental Protection Agency (EPA) at 40 CFR Part 86 for on-road engines, and 40 CFR Parts 89 and 90 for non-road engines. The engines and all equipment will be operated according to the manufacturer's recommended specifications. In addition, the engines will be fueled using Ultra Low-Sulfur Diesel (ULSD) fuel in the diesel engines, which will greatly reduce emissions of sulfur oxides.

## 3.0 EMISSION SOURCES ONSHORE

A comprehensive statewide inventory of emission sources was prepared by the Alaska Department of Environmental Conservation (ADEC) to support the development of the State's program to control regional haze (ADEC, 2010a). The inventory accounted for all known emission sources of air pollutants across the entire state. Emission sources on the North Slope included in the inventory are:

- Area sources, such as fireplaces, asphalt paving, and gasoline distribution,
- Non-road mobile sources, such as construction equipment and snow vehicles,
- On-road mobile sources, such as passenger cars, trucks, and buses,
- Point sources, such as commercial and residential heating facilities, and
- Aviation sources, ranging from small planes to large commercial aircraft.

An inventory of projected 2018 emissions was included in the ADEC report to account for expected changes in pollutant source activity, such as population, and changes in technology, such as emission controls. The inventory shows there were relatively few emission sources located on the coastline of the North Slope during the period of the emissions study, and there was no indication that the number of sources would be expected to increase in the foreseeable future.

## 4.0 PROJECTED EMISSIONS FROM BPXA SOURCES

An inventory of projected emissions was prepared that reflects the operation of the vessels and vehicles proposed for use in the BPXA Plan of Operations, Table 1, *Summary of Vessels and Other Equipment Involved in Proposed North Prudhoe Bay 2014 OBS Seismic Survey*. As there would be no baseline of emissions associated with the no-action alternative, the projected emissions should be considered the total net emission increase caused by the Proposed Action.

The emission inventory was prepared using the BOEM Form 0138. The form provides emission factors established by the EPA using EPA-approved methodologies. The projected emission inventory includes an evaluation of the following pollutants:

- CO;
- NO<sub>x</sub>, where emissions of NO<sub>x</sub> are assumed to be made up entirely of NO<sub>2</sub>;
- SO<sub>x</sub>, where emissions of SO<sub>x</sub> are assumed to be made up entirely of SO<sub>2</sub>;
- Particulate matter (where emissions of PM are assumed to be made up entirely of PM<sub>10</sub>)
- Volatile organic compounds (VOC)
- Carbon dioxide (CO<sub>2</sub>)

Although a criteria pollutant, an assessment of ozone emissions was not included in the analysis. This is because ozone is not emitted directly by a source; rather ozone is formed through the secondary photochemical reaction between emissions of the precursor pollutants, NO<sub>x</sub> and volatile organic compounds (VOC), and sunlight. As such, an inventory of NO<sub>x</sub> and VOC emissions is provided and serves as an indicator of potential ozone development in the project area. While not a criteria pollutant, CO<sub>2</sub> is considered a greenhouse gas that contributes to global climate change, and is included in the inventory. Diesel fuel contains no lead, a criteria pollutant; thus, the analysis did not include an inventory of lead emissions.

Emissions from operation engines were calculated using the standard EPA method of applying the output power (horsepower) to the emission factors, which are expressed as pounds per horsepower-hour (lb/hp-hr), and applying the number of total operating hours. The emission factors are summarized in Table C-2. The emission rates allow the quantity of each pollutant to be calculated based on the operating power of each engines. As the nature of this survey is such that the exact type and model of each vessel engine, and the identity of the exact onshore vehicles, is unknown, worst-case assumptions were used. The analysis assumed the use of 24 vessels and/or vehicles. Each engine was assumed to operate for 24 hours each day for 92 days, the number of days from July 1 to September 30, 2014. The calculations further assumed the average engine was less than 600 horsepower (hp), which would allow use of the worst-case emission factors.

The emission factors in Table C-2 were applied to the survey data assumptions. The emission factors in Table C-2 reflect higher emission factors than might be applicable to the sources. The power output was assumed to be 80 percent to allow for lower power settings during slow cruise and maneuvering operations rather than continuous maximum cruise speed, and also because diesel engines are typically operated at 80 percent power for good maintenance purposes. No other emission reduction controls were assumed. The data from Table C-2 was used to calculate total project emissions, which are summarized in Table C-3 *Projected Emissions*.

**Table C- 2. Diesel Engine Emission Factors**

Pollutant	Emission Factors (pollutant per power unit <sup>1/</sup> in g/hp-hr)	
	For engines >600 hp	For engines <600 hp
CO	2.40	3.03
NO <sub>x</sub> <sup>2/</sup>	11.00	14.00
PM <sup>3/</sup>	0.32	1.00

Pollutant	Emission Factors (pollutant per power unit <sup>1/</sup> in g/hp-hr)	
	For engines >600 hp	For engines <600 hp
SO <sub>x</sub> <sup>4/</sup>	1.47	1.47
VOC <sup>5/</sup>	0.33	1.12

<sup>1/</sup> Based on engines without any pollution control devices or technologies.

<sup>2/</sup> Assumes all NO<sub>x</sub> are comprised of NO<sub>2</sub>.

<sup>3/</sup> Assumes all particulate matter is defined as PM<sub>10</sub>.

<sup>4/</sup> Assumes all SO<sub>x</sub> in the fuel is converted to SO<sub>2</sub>.

<sup>5/</sup> Defined as total organic compounds.

**Table C- 3. Projected Emissions**

Emission Sources	Projected Emissions (by pollutant in tons for the Noticed Activities)				
	CO	NO <sub>x</sub>	PM <sub>10</sub>	SO <sub>x</sub>	VOC
Main Source Vessel	1.27	5.81	0.17	0.78	0.17
Small Source Vessels	2.88	13.32	0.95	1.40	1.07
Support Vessels	25.17	115.52	4.13	14.90	4.37
Utility Vessels	20.89	96.51	6.89	10.12	7.72
Total	50.21	231.16	12.14	27.19	13.33

The primary criteria pollutants caused by engines operated on the survey vessels are NO<sub>2</sub>, SO<sub>2</sub>, and CO. Emissions of NO<sub>2</sub> emissions are caused by the high pressures and temperatures during the combustion process, whereas emissions of CO, PM, and VOC are due to incomplete combustion. Ash and metallic additives in the fuel contribute to the content of PM<sub>10</sub> in the exhaust. Emissions of SO<sub>2</sub> are mainly linked to the sulfur content of the fuel rather than any combustion variable. Emissions from the combined operation of the equipment would not have the potential to exceed 100 tons per year for any regulatory pollutant except NO<sub>x</sub>, which would be 231.16 tons per year.

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