Alaska Outer Continental Shelf

OCS EIS/EA
MMS 2010-022

Beaufort Sea Planning Area

Shell Exploration & Production
Ancillary Activities
Marine Surveys
Beaufort Sea, Alaska

ENVIRONMENTAL ASSESSMENT

Prepared By:
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U.S. Department of the Interior
Bureau of Ocean Energy Management,
Regulation, and Enforcement
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1. PURPOSE AND NEED

Shell Exploration and Production, Inc. (Shell) has submitted an Ancillary Activity Notice to the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)[1] for "Marine Surveys in the Beaufort Sea, Alaska, during 2010" and supporting documents (Shell, 2010a) for a proposed open-water season survey program within the Federal outer continental shelf (OCS) and Alaska State waters of the Beaufort Sea (Figure 1 and Figure 2). Ancillary activities are activities conducted by a leaseholder on BOEMRE-issued leases for the purposes of obtaining data and information to develop an Exploration Plan (EP) or Development and Production Plan (DPP) (30 CFR 250.105 and 250.207). The activities proposed by Shell, which are described in greater detail in the proposed action alternative, include shallow hazard and site clearance surveys, ice gouge surveys, strudel scour surveys, marine baseline studies, and seafloor soil sampling.

The BOEMRE is responsible for regulating and monitoring the oil and gas operations on the Federal OCS. The BOEMRE regulates operations to promote orderly exploration, development, and production of mineral resources; and to prevent harm or damage to, or waste of, any natural resource, any life or property, or the marine, coastal, or human environment.

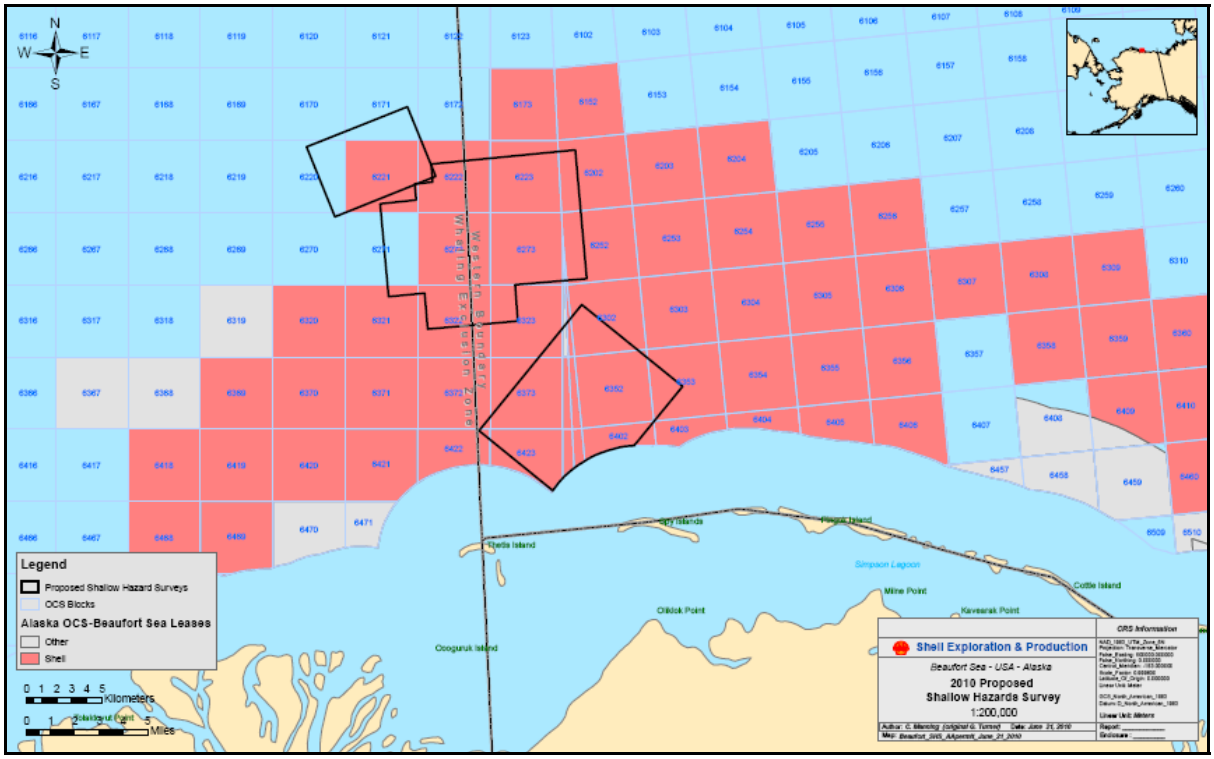

Figure 1 Locality of Shell's proposed 2010 shallow hazards surveys in the Beaufort Sea.

Regulations for oil and gas operations in the OCS are specified in 30 CFR 250. The regulations at 30 CFR 250.209 state that ancillary activities must comply with the performance standards listed in 30 CFR 250.202(a), (b), (d) and (e). These standards state that proposed activities shall be conducted in a matter that conforms to the Outer Continental Shelf Lands Act, applicable implementing regulations, lease provisions and stipulations and other Federal laws; is safe; does not unreasonably interfere with other uses of the OCS, including those involved with national security or defense, and does not cause undue or serious harm to the human, marine, or coastal environment, respectively.

[1] Formerly the Minerals Management Service (MMS)

Under 30 CFR 250.208, the lessee must provide a written notification to BOEMRE at least 30 calendar days in advance of and receive concurrence from BOEMRE before commencing ancillary activities. In cases where the Regional Supervisor-Field Operations notifies the lessee that the proposed ancillary activities do not comply with the standards, the lessee will be required to submit an EP or DPP and the ancillary activity will not be started until the Regional Supervisor approves the EP or DPP (30 CFR 250.209).

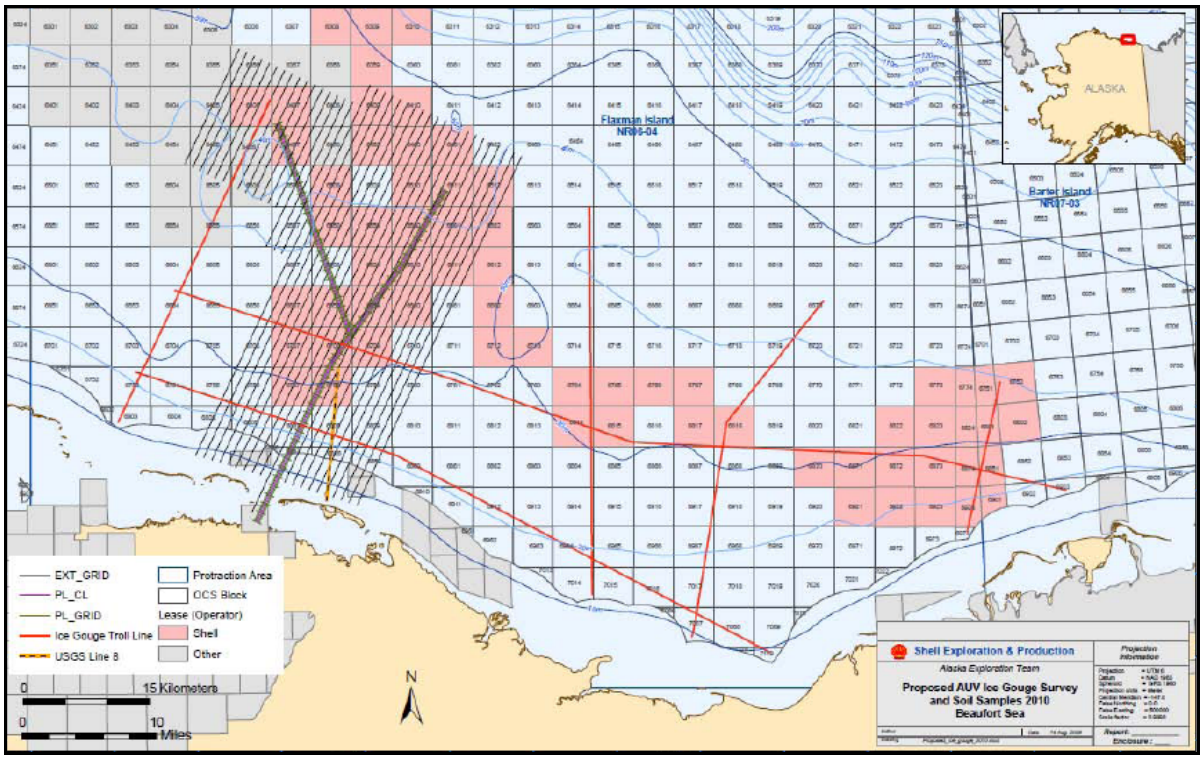

Figure 2 Overview of Shell's proposed ice gouge, strudel scour, baseline studies and seafloor soil sampling areas in the Beaufort Sea.

The BOEMRE has prepared this environmental assessment (EA) to determine whether Shell's proposed ancillary activities would result in significant effects to the environment, as defined at 40 CFR 1508.27, which would trigger the need to prepare an environmental impact statement (EIS) and to assist with BOEMRE planning and decision-making (40 CFR 1501.3b).

1.1. Previous Applicable NEPA Analyses and Biological Opinions

This EA implements the tiering process described in 40 CFR 1502.20 which encourages incorporation, by reference, of issues discussed in a broad EIS into a subsequent assessment focusing on a site specific action which is included in the broader statement. This EA tiers from the following documents:

- Final Environmental Impact Assessment, Beaufort Sea Planning Area Oil and gas Lease Sales 186, 195 and 202 (OCSEIS/EA MMS 2003-001) February 2003. (Beaufort EIS)
- Environmental Assessment, Proposed Lease Sale 195 Beaufort Sea Planning Area (OCS EIS/EA MMS 2004-028) July 2004
- Environmental Assessment, Proposed Lease Sale 202 Beaufort Sea Planning Area-- 2006 (OCS EIS.EA MMS 2006-001) August 2006

This EA also incorporates, by reference, the following documents under 40 CFR 1502.21. The abbreviation of the document title, shown in parenthesis at the end of the citation, is used in the text:

- Final Programmatic Environmental Assessment, Arctic Ocean Outer Continental Shelf Seismic Surveys (OCS EIS/EA MMS 2006-038) June 2006. (Seismic PEA)
- Draft Environmental Impact Statement, Beaufort Sea and Chukchi Sea Planning Areas Oil and Gas Lease Sales 209, 212, 217, and 221 (OCS EIS/EA MMS 2008-0055) November 2008. (Draft Arctic Multiple-Sale EIS)
- Biological Opinion Oil and Gas Leasing and Exploration Activities in the U. S. Beaufort and Chukchi Seas, Alaska: and Authorizations of Small Takes Under the marine Mammals Protection Act. NMFS Alaska Region. July 2008. (2008 ARBO)
- Biological Opinion for Beaufort and Chukchi Sea Program Area Lease Sales and Associated Seismic surveys and Exploratory Drilling. Fairbanks, AK; USDOI, FWS Field Office. September 2009. (2009 ARBO)

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2. ALTERNATIVES

A description of the Proposed Action and the Alternatives which were considered during this analysis are provided below. A list of resources which were examined during the scoping process but not analyzed further, and the justification for their elimination, are provided in Section 4.1.3

2.1. Alternative 1: No Action

Under the No Action Alternative, the activities proposed by Shell's ancillary activity notice would not be undertaken and the data acquisition would not take place as scheduled, if at all.

The No Action Alternative would eliminate any potential adverse effects from the proposed action during the 2010 open-water season. Potential economic benefits to the communities and residents of the North Slope would be delayed or would not be realized.

2.2. Alternative 2: Proposed Action

Shell proposes to conduct three marine surveys, an environmental baseline study and a seafloor soil sampling program in the Beaufort Sea during the open water season between July and October of 2010 (Table 1). The marine surveys will be carried out in compliance with Notice to Leases (NTL) No. 05-A01 (http://alaska.mms.gov/regs/NTL%202005-A01.pdf) which establishes the data a lessee must collect when conducting a shallow hazards survey.

Table 1 Summary of Shell's proposed ancillary activities in the Beaufort Sea, July – October 2010.

Activity	Description	Duration	Vessel(s)
Shallow Hazards & Site Clearance Survey[1]	Dual frequency side scan sonar Singlebeam echo sounder Multibeam echo sounder Deep penetration profiler (40 in^3 seismic airgun) Medium penetration profiler (40 in^3seismic airgun) Shallow sub-bottom profiler Aerial survey[2]	70 days	M/V Mt. Mitchell
Ice Gouge Survey	Autonomous Underwater Vehicle (AUV) Dual frequency side scan sonar Multibeam echo sounder Dual frequency sub-bottom profiler	40 days	M/V Ocean Pioneer
Strudel Scour Survey	Airborne visual survey Side scan sonar Singlebeam echo sounder Multibeam echo sounder	5 days	R/V Annika Marie
Marine Baseline Studies Program[3]	Deployment of Metocean buoy Deployment of AWAC meter	5 days[3]	M/V Mt. Mitchell
Marine Baseline Studies Program	Acoustic recorder deployment[4]	20 days	R/V Alpha Helix M/V Arctic Seal
Seafloor Soil Sampling Program	Vibracore Cone Penetration Test (CPT)	15 days	M/V Ocean Pioneer

Note: [1]The lease blocks border on State submerged lands and this may result in the survey extending into State waters
[2]Aerial marine mammal monitoring beginning late August 2010
[3]Metocean buoy & Acoustic Wave and Current (AWAC) Meter deployment
[4]Approximate locations shown in Figure 3.

During the 2010 open water season between July and October, biological, oceanographic, and geological surveys are to be carried out during preparation for exploration and production within OCS leases in, and adjacent to, areas leased in the Beaufort Sea. These proposed surveys would provide data of biological and physical features necessary for mitigation of possible future effects in exploration and production of OCS leases.

2.2.1. Shallow Hazards and Site Clearance Surveys

These surveys would provide characteristics of seafloor conditions of OCS lease areas. Shallow hazard surveys include deep and medium sub-surface profiling using a 40 in^3 seismic airgun, multi-beam echo sounders, and dual frequency sub-bottom profilers for determining the bathymetry and mapping objects located beneath the seafloor (e.g. permafrost layers and gas hydrates). Site clearance surveys include sonar surveys used for mapping objects on the benthic surface (pipelines, anchors, or shipwrecks). The focus of these activities is on the Shell OCS leases. Surveys will be conducted from 3 mi to 20 mi (5 – 32 km) offshore of Harrison Bay at Oliktok Dock, and continuing east through Camden Bay and off Point Thomson, covering an area of approximately 216 mi^2 (560 km^2) with 351 linear miles (565 km) surveyed.

Aerial marine mammal monitoring flights using a DeHaviland Twin Otter (or similar aircraft) will begin approximately August 20, 2010, as described in Shell's Incidental Harassment Authorization (IHA) application (Shell, 2009a). Surveys will be flown daily, weather and flight conditions permitting, and continued for 5 to 7 days after all activities at the site have ended.

2.2.2. Ice Gouge Survey

The ice gouge survey includes sonar surveys (Table 1), deployed using an autonomous underwater vehicle (AUV). The survey provides characteristics of the density, severity, location, and bathymetry of ice gouges where the ice extends to, and scrapes on, the seafloor. This survey provides baseline data for modeling future locations of ice gouges and better enable prospective deployment of pipelines for mitigation of potential damage that could be caused by moving ice. This survey would be conducted in both state and OCS waters, from Pt. Thomson at the east side of Camden Bay to the Sivulliq prospect area (Figure 2).

2.2.3. Strudel Scour Survey

Strudel scour is a localized phenomenon that occurs each spring in the Arctic when melting fresh water in coastal rivers and streams flows over shore-fast ice as it travels to the Beaufort Sea. The water flows through cracks in the ice and the resultant downward pressure can "scour" holes in the seafloor.

The strudel scour survey consists of two phases; a previously conducted airborne visual reconnaissance by helicopter during the spring of 2010 before the ice receded from the shoreline that located potential strudel scour locations and ship based side scan sonar and multibeam bathymetry mapping of the seafloor at the locations selected during the airborne reconnaissance. The strudel scour survey will provide characteristics of the density, severity, locations, and bathymetry of strudel scour erosion to aid in planning future pipeline routes. Vessel surveys will deploy from Pt. Thompson and survey selected areas in Camden Bay.

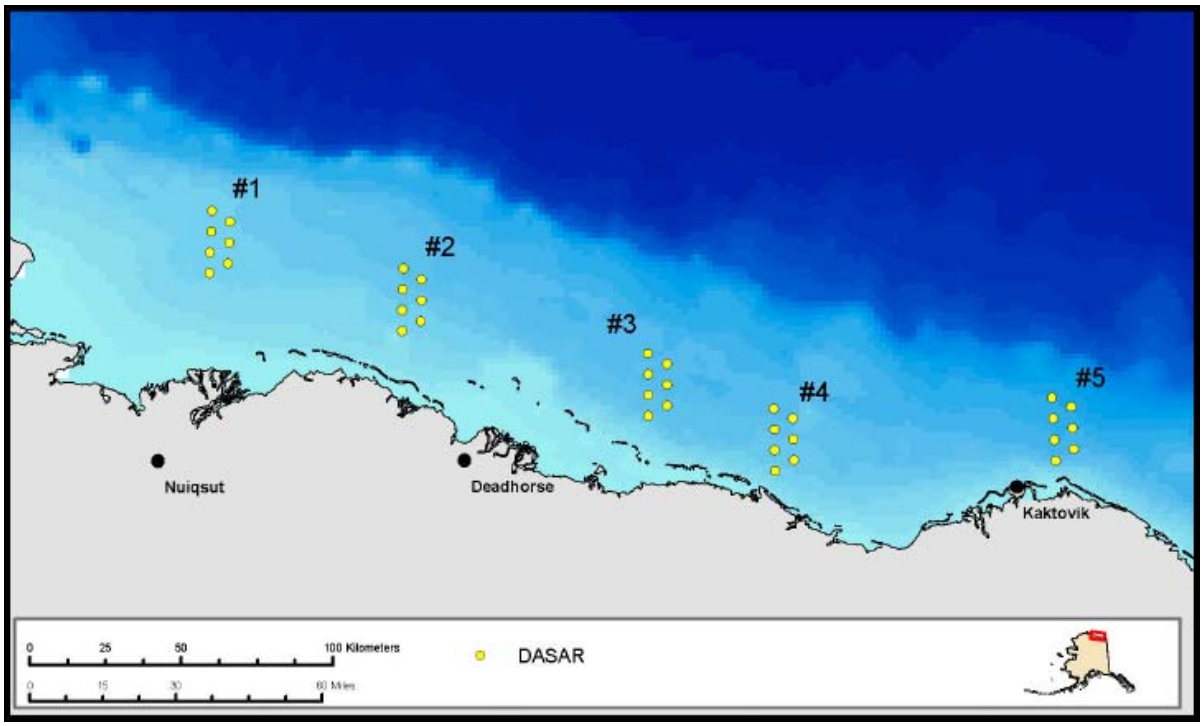

Figure 3 Approximate locations of the acoustic recorder (DASAR) arrays deployed in support of the marine baseline study program.

2.2.4. Marine Baselines Study Program

The marine baseline studies program provides additional data to supplement existing sets to better define environmental conditions in the vicinity of Shell's OCS leases. The Metocean buoys will provide meteorological data and the Acoustic Wave and Current (AWAC) sensors will be used to monitor ocean waves and currents. Benthic sampling will be used to identify the physical, chemical and biological characteristics of the seafloor at the lease sites and along a possible future pipeline route. The Metocean buoys will be deployed in Harrison and Camden Bays. The 2010 studies program will also deploy a network of directional autonomous seafloor acoustic recorders (DASAR) (Figure 3) to provide near real-time tracking information for migrating Bowhead whales.

2.2.5. Seafloor Sediment Sampling Program

The seafloor sediment sampling program will analyze the stability and the chemical and biological structure of sea floor sediments within the lease area and potential pipeline corridor. Vibracore samples will be collected and cone penetration tests (CPT) will be used to provide sediment composition and density information to supplement the shallow hazard survey and define the sub-seafloor environment. Samples will be collected along the potential pipeline route at approximately 0.75 mi (1.2 km) intervals. Additional samples may be collected if unusual or unexpected conditions are encountered .

2.2.6. Mitigation Measures

2.2.6.1. Marine Mammals

2.2.6.1.1. Cetaceans, Pinnipeds and Polar Bear

The following mitigation measures are consistent with Incidental Harassment Authorization (IHA) requirements and Incidental Take Statements issued for similar surveys in the Arctic. An IHA specific to the proposed action was not issued prior to this EA; however, the mitigation measures listed below are noted, and incorporated by reference, in the Shell Application for Incidental Harassment Authorization for the Non-Lethal Taking of Whales and Seal in Conjunction with a Proposed Open Water Marine Survey Program in the Beaufort and Chukchi Seas, Alaska 2010 (Shell, 2009a). The National Marine Fisheries Service (NMFS) may change the mitigation proposed by Shell or require additional mitigation in a project-specific IHA.

The mitigation measures for polar bears and walrus incorporated by reference are those provisions contained in Shell's:

- Marine Mammal Monitoring and Mitigation Plan for Proposed Open Water Survey Program in the Beaufort and Chukchi Seas, Alaska, During 2010 (Shell, 2009b)
- Polar Bear Interaction Plan (Shell, 2009a)
- Fish and Wildlife Service (FWS) Letter of Authorization (LOA) issued on May 19, 2010 (FWS, 2010a).

General Mitigation (whales):

- Avoid concentrations or groups of whales by all vessels under the direction of Shell. Operators of support vessels should, at all times, conduct their activities at the maximum distance possible from such concentrations of whales.
- Reduce vessel speed when within 300 yards (275 m) (of whales and those vessels capable of steering around such groups should do so. Vessels may not be operated in such a way as to separate members of a group of whales from other members of the group.
- Avoid multiple changes in direction and speed when within 300 yards (275 m) of whales. In addition, operators should check the waters immediately adjacent to a vessel to ensure that no whales will be injured when the vessel's propellers (or screws) are engaged.
- Do not operate support vessels (including small boats), to the extent that they are being used, at a speed that would make collisions with whales likely.
- When weather conditions require, such as when visibility drops, adjust vessel speed accordingly to avoid the likelihood of injury to whales.

General Mitigation (polar bear and walrus):

- Avoid concentrations or groups of walruses and polar bears hauled out onto ice or land by all vessels. Operators of support vessels should conduct their activities at the maximum distance possible from known or observed concentrations of animal at all times. Under no circumstances, other than emergency, should vessels operate within 800 m (0.5 mi) of walruses or polar bears observed on land or ice.
- Vessels must reduce speed when walruses or polar bears are observed in the water. Vessels capable of steering around these animals must do so. Vessels may not be operated in such a manner as to separate members of a group of walruses or polar bears from other

members of the group. Vessels should avoid multiple changes in direction and speed when walruses or polar bears are present.

- Restriction of walrus or polar bear movements, by any means, in sea or on land, is prohibited and separation distances must be maintained until animals have left the area.
- Currently proposed polar bear critical habitat mitigation includes: a 1.6 km (1 mi) no disturbance zone around the barrier islands; and sea ice habitat.

Seismic Vessel Mitigation:.

- 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 safety radius, calculate and implement an alternative ship speed or track or de-energize the airgun array.
- Exclusion and Monitoring-Safety Zones:
  - At the beginning of the survey conduct Field Sound Source Verification tests and establish the distances to the various isopleths (190 dB for seals and polar bear, 180 dB for mysticetes cetaceans and walrus, and 160 dB re 1 µPa (rms) for aggregations of cetaceans) and monitor with trained marine mammal observers (MMO) a preliminary exclusion zone for cetaceans surrounding the airgun array on the source vessel where the received level would be 180 dB re 1 µPa (rms). For purposes of the field verification test, this radius is estimated to be 135m (410 ft) from the seismic source.
  - Establish and monitor with trained observers a preliminary exclusion zone for ice seals surrounding the airgun array on the source vessel where the received level would be 190 dB re 1 µPa (rms). For purposes of the field verification test, this radius is estimated to be 35 m (115 ft) from the seismic source.
  - Whenever the vessel monitoring program detects an aggregation of 12 or more mysticete whales within an acoustically verified 160-dB (rms) zone ahead of, or perpendicular to, the seismic vessel track, the operator shutdown the seismic airgun array and/or other acoustic sources, and not proceed with powering up the airgun array until the MMO confirms that no mysticete whale aggregations are likely to occur within the 160-dB zone based upon ship course, direction and distance from last sighting and the last aggregation sighting appropriate safety zones. For purposes of the field verification test, this radius is estimated to be 1,525 m (0.95 mi) from the seismic source.
- Power-down and shutdown:
  - Immediately power-down the seismic airgun array and/or other acoustic sources, whenever any cetaceans or walrus are sighted approaching close to or within the area delineated by the 180 dB-re 1 µPa (rms), or ice seals or polar bears are sighted approaching close to or within the area delineated by the 190 dB re 1 µPa (rms) isopleth as established for the authorized seismic airgun array. If the power-down operation cannot reduce the received sound pressure level at the cetaceans and walrus; or ice seal and polar bear to 180, dB or 190 dB isopleth, whichever is appropriate, the operator must immediately shutdown the seismic airgun array and/or other acoustic sources.
  - Do not proceed with powering up the seismic airgun array unless the marine mammal exclusion zones are visible and no marine mammals are detected within the appropriate safety zones; or until 15 minutes (for small odontocetes, pinnipeds)

or a minimum of 30 minutes (for mysticetes) after there has been no further visual detection of the animal(s) within the safety zone and the MMO is confident that no marine mammals remain within the appropriate safety zone.

- Ramp up
  - Conduct a 30-minute period of marine mammal observations by at least two trained MMOs prior to commencing ramp-up: (1) at the commencement of seismic operations; and (2) at any time electrical power to the airgun array has been discontinued for a period of 10 minutes or more and the MMO watch has been suspended;
  - Do not commence ramp-up if the-complete 180 dB re 1 μPa (rms) safety radii are not visible for at least 30 minutes prior to ramp-up in either daylight or nighttime and not commence ramp-up at night unless the seismic source has maintained a sound source pressure level at the source of at least 180 dB re 1 μPa rms during the interruption of seismic survey operations. If a sound source of at least 180 dB re 1 μPa rms has been maintained during the interruption of seismic operations, then the-30 minute pre-ramp-up visual survey is waived; and
  - Ramp-up the airgun arrays at no greater than 6 dB per 5-minute period starting with the smallest airgun in the array and then adding additional guns in sequence until the full array is firing, if no marine mammals are observed while undertaking conditions noted above: (1) at the commencement of seismic operations and (2) anytime after the airgun array has been powered down for more than 10 minutes.
- General
  - Inspection of all equipment for the presence of invasive species before deployment

2.3. Alternatives Considered but Not Included for Further Analysis

"Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense…"(CEQ's Question 2a of NEPA's Forty Most Asked Questions). Alternatives must also meet the purpose and need of the proposal (40 CFR 1502.13). The purpose of the proposed ancillary activities is to allow Shell to obtain data and information for an Exploration Plan (EP) or Development and Production Plan (DPP) (30 CFR Part 250.105 and 250.207). No additional alternatives that meet the purpose and need for the proposal were identified by BOEMRE.

One alternative considered in this EA was the use of existing data from past shallow hazards surveys in the same location. Although some site clearance shallow hazards survey data was collected in the Harrison Bay area, as noted in OCS Study MMS 2002-017, none of the data collected would be useful for assessing the shallow hazards for the locations Shell is proposing to survey in 2010. Furthermore, since BOEMRE requires the applicant to provide current side scan sonar and bathymetry data, Shell would still need to collect additional data even if the other previously collected data were adequate for shallow hazards assessments.

Another alternative considered was limiting the location, extent and timing of the activities. This alternative is not considered reasonable because the data and information that must be collected is location specific. Furthermore, the survey needs to be of an extent sufficient to provide the data and information needed (for example, as specified in NTL A05-01, Shallow Hazards and Site Clearance Surveys). Finally, the activities must be conducted during the open-water season to ensure marine vessel access to all of the survey areas and this coincides with the timing of the proposed activity.

3. AFFECTED ENVIRONMENT

3.1. Water Quality

There is very little development in the watersheds of the U.S. Arctic, and because of this, nonpoint pollution runoff from watersheds to the Beaufort Sea is limited. The main rivers of the region (Colville, Kuparuk, Sagavanirktok, and Canning) carry naturally-occurring loads of sediment, trace metals and hydrocarbons into the Alaskan Beaufort Sea environment.

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 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) and incorporated herein.

The water quality in the Beaufort Sea region has been documented through several studies, monitoring and regulatory programs. Measurements that have been collected over time for water quality constituents include: total organic carbon, particulate organic matter, hydrocarbons, suspended sediments, turbidity, pesticides, polychlorinated biphenyls and heavy metals. The sources of these contaminants include: vessels, airborne pollutants, coastal development runoff, and existing oil and gas operations. Climate change is currently affecting the Arctic environment and is anticipated to have major effects in the future. These effects include warming sea surface temperatures, a reduction in sea ice coverage and an increase in ocean acidity. All of these factors affect the chemistry and quality of the sea (Hopcroft, et al, 2006).

More detailed background information on the water quality and water chemistry in the U.S. Arctic OCS waters is presented in the Draft Arctic Multiple-Sale EIS and Seismic PEA. These documents are incorporated herein.

3.1.1. Existing Regulatory Control of Discharges

The principal regulatory authority for controlling pollutant discharges into waters of the U.S. is the Clean Water Act (CWA) of 1972, as amended. Section 402 of the CWA establishes the National Pollution Discharge Elimination System (NPDES). In December 2008, an NPDES Vessel General Permit (VGP) was issued by the Environmental Protection Agency (EPA) for "Discharges Incidental to the Normal Operation of a Vessel". The EPA finalized the VGP for the state of Alaska in February 2009. The final VGP applies to owners and operators of non-recreational vessels that are 79 feet (24.08 meters) and greater in length, as well as to owners and operators of commercial vessels of less than 79 feet and commercial fishing vessels of any length which discharge ballast water. The latest information on VGP's and water-quality standards for the EPA is available in 40 CFR Part 131 or on the EPA web site (www.epa.gov). The US Coast Guard (USCG) administers regulations that pertain to discharges from vessels at sea that carry ballast water, oil, noxious liquid substances, garbage and waste (33 CFR Part 151). These regulations provide definitions, prohibitions, applicability and penalties for these vessels.

State of Alaska water quality information, which applies from the shoreline to 3 miles offshore, is available in the Alaska Administrative Code (AAC) 18 AAC 70 or on the Alaska Department of Environmental Conservation website: (www.dec.alaska.gov).

3.1.2. Invasive Species

An "invasive species" is defined as a species whose introduction does or is likely to cause economic or environmental harm or harm to human health where it is introduced." (64 *FR* 6183). Potential

vectors for introducing marine invasive species are ballast-water discharge, fouled ship hulls, oil rigs and equipment placed overboard (e.g., anchors, seismic airguns, ocean-bottom cables).

The Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA) was passed in 1990 and amended by the National Invasive Species Act of 1996 (NISA). The U.S. Coast Guard developed regulations (33 CFR 151 Subpart D) that implement provisions of this Act and its amendment. Vessels brought into the State of Alaska or Federal waters are subject to these Coast Guard regulations which are intended to reduce the transfer of invasive species. The regulations require the "removal of fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, State, and Federal regulations." The regulations, however, do not specifically call for the same removal procedures for ocean-bottom cables or seismic equipment.

A non-native marine amphipod has spread widely in Alaska harbors, ranging from Ketchikan in Southeast Alaska to Dutch Harbor in the Aleutian Islands (Ashton, et al., 2008). A non-native spider crab species was identified in coastal waters of Antarctica, raising new concerns that a temperate species could cross over and thrive in a polar environment (Tavares and De Melo; 2004).

3.2. Marine Mammals

Fourteen (14) species of marine mammals, protected under the Marine Mammal Protection Act (MMPA) of 1972, are common to the proposed Beaufort Sea survey area. These species include bowhead whales (*Balaena mysticetus*), gray whales (*Eschrichtius robustus*), minke whales (*Balaenoptera acutorostrata*), humpback whales (*Megaptera novaeangliae*), beluga whales (*Delphinapterus leucas*), narwhal (*Monodon monoceros*); ice seals (bearded seal (*Erignathus barbatus*), ringed seal (*Phoca hispida*), spotted seal (*P. largha*), and ribbon seal (*P. fasciata*)); Pacific walrus (*Odobenus rosmarus*); and polar bear (*Ursus maritimus*). Specific information pertaining to these species may be found in the Beaufort EIS (MMS, 2003; III-39 through III-49; III-54 through III59); Draft Arctic Multiple-Sale EIS (MMS 2008; 3-75 through 3-3-92; 3-99 through 3-107: and 3-122 through 3-141); 2006 ARBO (MMS, 2006; 7 - 35) and 2008 ARBO (MMS, 2008; 2 - 10).

The beluga whale, narwhal, killer whale, harbor porpoise, gray whale, minke whale, humpback whale, spotted seal, ribbon seal, and walrus are typically uncommon or rare in the project area during the period of the proposed activity. Very few, if any, encounters between the proposed activities and individuals of these species are expected to occur and these species will not be discussed further.

The marine mammals most likely to be encountered, and potentially affected, by proposed activities include: bowhead whale, polar bear, bearded seal, and ringed seal. Bowhead whale encounters are likely to be most common during the fall migration and within 100 km (60 mi) of the coast. Encounters with polar bears, ringed seals and bearded seals could occur at any time during the period of proposed activity.

3.2.1. Changes in the Physical Environment

Changes to the physical environment which are most likely have an impact on the resources in the project area are ice melt rate and the persistence of ice cover. The proposed activities are dependent upon open water and the schedule will, therefore, be managed to reflect the ice coverage. Historically the proposed area of activity has been ice free for several weeks during July 1 to October 31. The effect of physical environmental change over the short time period of the proposed activity is expected to be well within the historical variation in the project area.

3.2.2. Bowhead Whale

The bowhead whale is an endangered marine mammal present seasonally in the Beaufort Sea that serves as an important subsistence species for Alaskan Native hunters. No critical habitat has been designated for this species. Data indicate that the regional stock of bowheads is increasing in abundance. During the spring (mid-March to approximately mid-June), bowheads migrate north and east through leads in the ice on their way to summer feeding grounds in the eastern US and Canadian Beaufort. Bowhead whales have been observed throughout the summer in waters along the eastern Beaufort Sea coast of Alaska. In the autumn, bowheads move westerly through the Alaska Beaufort Sea toward the Chukchi Sea as they migrate back to the Bering Sea from mid-September through October.

3.2.3. Bearded Seal

Bearded seals are an important subsistence species for Alaskan Native hunters, are the largest of the northern phocids, and have a circumpolar distribution. During periods of open-water, bearded seals are present mainly in relatively shallow areas (less than 200 m (650 ft)). Most of the bearded seals are found in the Bering and Chukchi Seas. They are predominantly benthic feeders with a diet consisting of a variety of invertebrates. Bearded seals are uncommon or rare in the project area during the time of proposed activity and few, if any, would be encountered.

3.2.4. Ringed Seal

Ringed seals have a circumpolar distribution and are an important subsistence species for Alaskan Native hunters. Although their range extends into the western Beaufort Sea, their numbers are considerably higher in the Bering and Chukchi Seas, especially during winter and spring. In the early summer, the highest densities of ringed seals are found in fast nearshore and pack ice. Ringed seals are the most abundant seal in the area of the proposed action and are more likely to be encountered than bearded seals.

3.3. Polar Bear

The polar bear (*Ursus maritimus*) is a threatened species that occurs primarily on pack ice, coastal areas, and barrier islands. Occasionally polar bears have been observed on isolated floating ice or swimming in open water within the Beaufort Sea. The presence of polar bears has been documented during recent vessel-based seismic surveys in the Beaufort Sea (Savarese et al. 2009).

3.4. Polar Bear Critical Habitat

The distribution, abundance and status of the threatened polar bear (*Ursus maritimus*) were most recently described in Section 7 consultation documents (MMS, 2009a; FWS, 2009). The FWS proposed critical habitat for the polar bear in 2009 (74 FR 56058). Three different units were identified: sea ice, terrestrial denning, and barrier island habitats. A final designation of polar bear critical habitat has not been made.

3.5. Marine and Coastal Birds

The general distribution and abundance of birds for the Beaufort Sea has been updated from resource information contained in the Beaufort EIS (MMS, 2003; pages III-49 through III-54). Most marine birds that occur in the Beaufort Sea are present during the open-water season. Arrival times usually coincide with the formation of leads during spring migration to coastal breeding areas. Migration times vary between species, but 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 project area twice each year. Some marine and coastal birds may breed outside the project 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 left the Beaufort Sea by late fall before the formation of sea ice.

3.5.1. Climate Change Effects

Temperatures over Arctic land areas have risen and continue to rise at roughly twice the rate of the rest of the world. Some trends attributable to climate change reflected in coastal and marine birds are evident and are expected to continue. Section 3.3.5.1 of the Draft Arctic Multiple-Sale EIS briefly described likely ongoing effects on coastal and marine birds from changes in oceanographic processes and sea-ice distribution, duration of snow and ice cover, distribution of wetlands and lakes, and sea level rise. That section concluded that continued climate change can result in short- and long-term and beneficial or detrimental population-level effects on coastal and marine birds. Exactly how Arctic birds/bird groups are responding to climate change over time and space cannot be predicted.

3.5.2. Descriptions of Species and Species Groups

Marine and coastal birds can be grouped according to certain aspects of their life-history or status: ESA-listed birds, loons and waterfowl, seabirds, shorebirds, and raptors/ravens. The timing and specific location of the proposed activities influence which birds could be affected. Birds listed as threatened or candidate (four species) or abundant in the proposed project area (five species) have the greatest potential for adverse effects and are described further. These nine species were carried forward to the effects analysis in Sections 4.2.5 and 4.3.5 (Table 2).

Table 2 Marine and coastal birds in the Beaufort Sea (from AMS 2008) most likely to be affected by the proposed action.

Species	Threatened or candidate species	Abundant in offshore action area	Carried forward under effects analysis
ESA-Listed Species			
Spectacled Eider	Yes		Yes
Steller's Eider	Yes		Yes
Kittlitz's Murrelet	Yes		Yes
Yellow-billed Loon	Yes		Yes
Loons and Waterfowl			
Long-tailed Duck		Yes	Yes
Common Eider		Yes	Yes
King Eider		Yes	Yes
Seabirds			
Northern Fulmar		Yes	Yes
Short-tailed Shearwater		Yes	Yes

Note: An empty cell indicates Not Applicable

3.5.2.1. ESA-listed Birds

The distribution, abundance and legal status of birds designated as threatened or listed as candidate species under the ESA were most recently described in the Section 7 consultation documents (MMS, 2009a; FWS, 2009). These include the Steller's eider (*Polysticta stelleri*; threatened), the

spectacled eider (*Somateria fisheri*; threatened), the Kittlitz's murrelet (*Brachyramphus brevirostris*; candidate species), and the yellow-billed loon (*Gavia adamsii*; candidate species) and are often collectively referred to as ESA-listed birds.

The only recent notable change in this baseline information is that individual Kittlitz's murrelets have recently been documented to occur in the Beaufort Sea, immediately east of Barrow.

These four species, due to their special status, are carried forward into the effects analysis (Chapter 4).

3.5.2.2. Loons and Waterfowl.

The Beaufort EIS and Draft Arctic Multiple-Sale EIS described 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*) as occurring in nearshore coastal waters of the Beaufort Sea. Waterfowl species that are more abundant and occur in more offshore areas of the Beaufort Sea include the long-tailed duck, the common eider, and the king eider and are described below.

Long-Tailed Duck (*Clangula hyemalis*). The long-tailed duck has decreased considerably since 1989, but 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 (Johnson and Herter, 1989). While most long-tailed ducks migrate within 45 km (28 mi) of shore (roughly along the 20 m [65 ft] isobath), 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 the lagoon and the sea (Johnson, Frost, and Lowry, 1992; Johnson, Wiggins, and Wainwright, 1992; Kinney, 1985). Brackney and Platte (as cited in Lysne, Mallek, and Dau, 2004) observed long-tailed ducks feeding heavily in passes between barrier islands.

Common Eider (*Somateria mollissima*). 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. 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 (65 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, although large numbers of female common eiders were observed molting in the eastern Beaufort Sea in Canada (Johnson and Herter, 1989).

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 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 shallow waters (<10 m [<33 mi]), 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.

Our most recent information still indicates that 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. When traveling west along the Beaufort Sea coast, approximately 90% of the common eiders migrate within 48 km (30 mi) of the coast; 7% migrate 13-16 km (8 – 10 mi) from shore, roughly along the 17 - 20 m (65 – 66 ft) isobath (Johnson and Herter, 1989, citing Bartels, 1973).

King Eider (*Somateria spectabilis*). 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, 2006). Dau and Larned (2005, 2006, 2007) surveyed the Chukchi and Beaufort Seas' coastlines found 800, 3,045, and 1,621 king eiders in 2005, 2006, and 2007, 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 2 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).

3.5.2.3. Seabirds.

The Beaufort EIS and Draft Arctic Multiple-Sale EIS described 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*) as occurring in the Beaufort Sea. Seabird species that are more abundant and occur in areas further offshore of the Beaufort Sea include the northern fulmar and the short-tailed shearwater and are described below.

Northern Fulmar (*Fulmarus glacialis*). Fulmars do not breed in the Beaufort Sea 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.

Short-Tailed Shearwater (*Puffinus tenuirostris*). Shearwaters do not breed in the Beaufort Sea 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. In certain years, an estimated 100,000 short-tailed shearwaters passed Point Barrow in 1 day in mid-September (Divoky, 1987).

3.5.2.4. Shorebirds

The most common shorebird species include dunlin (*Calidris alpina*) and phalaropes (*Phalaropus spp*.) (Alaska Shorebird Group, 2004). Nearshore and shoreline habitats are especially important habitats where shorebirds replenish energy reserves after breeding and prior to southward migration. These areas are outside of the proposed project area and these species are not evaluated further.

3.5.2.5. Raptors/Ravens

Raptors along nearshore and shoreline areas of the Beaufort Sea consist of small numbers of snowy owls and transient peregrine falcons, golden eagles, northern harriers, and rough-legged hawks. Ravens have recently expanded their distribution across portions of the North Slope. These species do not typically extend into offshore areas during the open-water season and are not evaluated further.

3.6. Fish

The Arctic seas, with their severe climate and perennial ice cover, present challenging conditions and logistical difficulties for research on fish in the region. Commercial fishing has not occurred in the region aside from a few artisanal fisheries involving village fishers in State waters. Therefore the typically published stock assessments and monitoring data associated with commercial fishing do not exist. Subsistence fishing has long been an integral part of rural life in the U.S. Arctic.

Because of the logistical difficulties of scientific research and the lack of commercial fishing data, the published information on fish in the U.S. Arctic seas is mostly on adult fish in the nearshore environment during the open-water season. The literature that is available on Arctic fish more often addresses general distribution and abundance; very limited information regarding discrete populations, migration, offshore occurrence and life history of most fish species in the U.S. Arctic is available at this time.

Some of the fish information pertinent to the proposed activities is summarized below:

In the summer of 2008, a field survey of western Beaufort Sea fish was conducted by NOAA/University of Washington/University of Alaska personnel (Loggerwell and Rand, in prep.) Some of the results of this 2008 survey include:

- Across all bottom trawls, 6% of all weight was comprised of vertebrate fish species and 94% by weight was invertebrates.

- Arctic cod (*Boreogadus saida*) were the most abundant fish caught during the summer 2008 survey, both by weight and numbers. Walleye pollack (*Theragra chalcogramma*) were present, but primarily as subadults
- The pollock caught in the Beaufort Sea survey are in densities far lower than in the Bering Sea where they are fished commercially.
- 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 (weight).
- No specimens of the five Pacific salmon species (*Oncorhynchus sp.)* were captured in any of the sampling in the 2008 survey.
- Comparing the preliminary results of the NOAA 2008 data to opportunistic offshore bottom-trawl surveys conducted by Frost and Lowry (1983) in 1976 and 1977, the NOAA authors indicate that there has been a shift in fish species composition and community structure in the central Beaufort Sea over the past three decades

Past and ongoing effects of climate change in the Arctic affect fish in several ways including changes in lower trophic food sources and changes in ice habitat extent and qualities (Hopcroft, et al, 2006).

3.6.1. Beaufort Sea: Fish Distribution and Behavior

Marine fishes in the Beaufort Sea prefer the colder, more saline water seaward of the nearshore brackish-water zone. As summer progresses, the nearshore zone becomes more saline due to decreased freshwater input from rivers and streams. During this time, some marine fishes move shorewards and feed nearshore on the abundant epibenthic fauna (Craig, 1984). In fall, when diadromous fishes have moved into freshwater systems to spawn and overwinter, some of these marine fish species remain in the nearshore area to feed.

As nearshore ice thickens in winter, marine fishes probably continue to feed under the ice but eventually depart the area and move further offshore as ice freezes to the bottom to approximately 2 m (6 ft) thick. Seaward of the bottomfast ice, marine fishes continue to feed and reproduce in nearshore waters all winter (Craig, 1984). Arctic cod spawn under the ice between November and February (Craig and Halderson, 1981).

The freshwater environment of the Arctic Coastal Plain consists of slow-moving rivers and streams, lakes, ponds and a maze of interconnecting channels. Many of these waters support migratory fish populations that move between the marine and freshwater environments (Parametrix, 1996).

Arctic cod and the five species of Pacific salmon are discussed further under the Essential Fish Habitat (EFH) section.

3.7. Essential Fish Habitat

Two of the Fishery Management Plans in Alaska apply to the area under consideration in this EA: the Fishery Management Plan for Fish Resources of the Arctic Management Area (NPFMC, 2009) (Arctic FMP); and the Salmon Fishery Management Plan for Coastal Alaska (1990). EFH is listed for the following species in the two fishery plans that overlap the area of proposed activities: Arctic Cod (*Boreogadus saida*) (adult and late juvenile) and the five species of Pacific salmon (*Oncorhynchus sp.*) (adult and late juvenile). Pacific salmon eggs and larvae EFH do not occur in the area of proposed activities nor does the Saffron cod and Opilio crab EFH, which was described in the Arctic FMP. The full description of EFH for these species can be found on the NMFS-Alaska website: (http://www.fakr.noaa.gov/npfmc/fmp/fmp.htm).

3.7.1. Arctic Cod

Arctic cod is a widely distributed in the U.S. Arctic in the pelagic, demersal and nearshore environments depending on the time of year and the stage of their life history. The absolute numbers of Arctic cod and their biomass is one of the highest of any finfish in the region (Logerwell and Rand, in prep., Lowry and Frost, 1981). They are associated with sea ice, using it for shelter, prey avoidance and as a forage habitat to feed on microorganisms on the underside of the ice, much like an upside down benthic habitat. The species also follow sea ice as they migrate between onshore and offshore for seasonal spawning.

Arctic cod move and feed in different groupings, dispersed in small and very large schools, throughout the water column (Welch et al, 1993). Frost and Lowry (1981) found smaller Arctic cod more often in water less than 100 m deep.

Results of a 2008 NOAA survey showed that Arctic cod were the most abundant fin-fish caught in a summer survey in the Central Beaufort Sea, both by weight and absolute numbers. Pelagic yearling-and-older Arctic cod were most abundant at the continental shelf-break (100 m, 328 ft); pelagic young-of-year were most commonly found inshore. (Loggerwell and Rand, in prep.).

Ringed seals, ribbon seals, spotted seals, beluga whales and several seabird species depend heavily on Arctic cod. Ice seals particularly depend upon Arctic cod in the winter (Bluhm and Gradinger, 2008; Dehn et al, 2007; Divoky et al, 1984; Frost and Lowry, 1984; Welch et al, (1993)). The biomass of Arctic cod (as both predator and prey) transfers energy throughout the food web. The abundance, wide distribution and the role in the food web of Arctic cod in the Beaufort Sea make this species very important in the ecosystem of the U.S. Arctic region.

3.7.2. Pacific Salmon

Generally, there is little evidence of viable self-sustaining salmon populations in the Beaufort Sea. Salmon "populations" currently have a difficult time establishing and persisting, most likely because of the marginal freshwater habitats for overwintering (Craig, 1989; Fechhelm and Griffiths, 2001). Fechhelm and Griffiths (2001) indicate that only a few isolated spawning stocks of chum and pink salmon might occur in the Beaufort Sea area, primarily the Sagavanirktok and Colville rivers. In the marine environment, adult pink and chum salmon in Alaska seas can be found down to 200m (660 ft) depth.

Sockeye, coho, and king salmon are even more rare than pink and chum salmon in the Beaufort Sea. No sockeye or coho salmon and only a single king salmon were collected during 17 seasons of intensive sampling in Prudhoe Bay (Babaluk et al., 2000). Based on this information, it appears that self-sustaining salmon populations do not occur at this time and that the low numbers of salmon caught in the Beaufort are likely strays from the Chukchi Sea or Bering Sea populations. Loggerwell and Rand (in prep) did not capture salmon in their 2008 Beaufort Sea survey. Therefore the occurrence of salmon in the proposed project area is likely to be low.

EFH quality in the U.S. Arctic can be affected by coastal construction and runoff, vessel discharges, underwater noise, and ongoing oil and gas industry activities including petroleum spills. Climate change in the Arctic is a past and ongoing factor that affects the quality of EFH in several ways including: changes in seawater temperature and acidity; changes in extent and quality of sea ice habitat; and changes in freshwater discharge and nearshore salinities (Hopcroft, et al, 2006)

3.8. Lower Trophic Organisms and Benthic Environment

Sea ice dominates the benthic and coastal habitats of the Beaufort Sea. The sea-ice cover is near 100% for 9 - 10 months each year and potentially freezes to a thickness of 2.5 m (8 ft) during winter

(MMS, 2003). Due to the ice cover, the shallow benthos is highly disturbed and supports few large organisms. Typical benthic nearshore organisms are numerous and diverse, including copepods, amphipods, polychaetes, and small clams (Darnis, et al.. 2008) with differing community compositions dependent upon benthic substrate composition, depth, and distance from shore. Offshore benthic communities can be quite diverse, but generally consist of echinoderms, polychaetes, copepods, and amphipods (Damis, et al., 2008). Most seafloor substrates on the Beaufort Sea OCS consist of aggregations of fine sands, muds, and silts that are gouged frequently by ice keels under ice ridges, with percentages of substrate consisting of mud ranging from 17% to 84% (cANIMIDA, 2004). A focus on differences in communities based on physical factors is addressed in the BOEMRE-sponsored cANIMIDA studies on hydrocarbon chemistry and substrate composition (cANIMIDA, 2004), the Beaufort EIS, and the Seismic PEA. Epontic (on ice) organisms are distributed widely in the Beaufort Sea and consist primarily of euphausiids, amphipods and ice algae (MMS, 2006a; Lee et al, 2008). Ice algae, phytoplankton, and zooplankton species are important contributors to primary production in the proposed study area by both direct impact (consumption by filter feeding surface organisms such as the planktivorous bowhead whale) and indirect impact (particulate matter of dissolved phytoplankton material and subsequent release of organic material drifting to the benthos). Phytoplankton blooms (with concurrent zooplankton and meroplankton stocks) tend to occur in late July to August, with density and duration dependent upon weather conditions (MMS, 2006; Kirchman et al, 2009).

Dunton, et al. (2006) calculated the typical biomass of benthos on the Beaufort seafloor. The calculations include data collected during the past 3 decades of benthic studies for BOEMRE / National Oceanic and Atmospheric Administration OCS Environmental Assessment Program and the Canadian Department of the Environment (MMS, 2006b). The study indicates that an average of about 30 grams per square meter of benthos invertebrate life exists on most of the OCS seafloor. The biomass is slightly lower in the eastern, deepwater portions of the Beaufort Sea and slightly higher in the western portion that is adjacent to the Chukchi Sea. In 2008, a survey of the central Beaufort Sea found opilio / snow crab (*Chionoecetes opilio*) in abundance (Loggerwell and Rand, in prep.). Opilio crab of potential commercial-size were caught in the Central Beaufort Sea primarily at depths between 100 - 150 m (330 – 490 ft), and are indicators of biomass and diversity as their primary prey are benthic invertebrates.

Dense kelp grows on a few areas of the seafloor. The distribution of kelp is limited by three main factors: ice gouging, sunlight, and rock substrate (Dunton and Schomberg, 2000). Ice gouging restricts the growth of kelp to protected areas such as behind barrier islands and shoals. The availability of sunlight limits the growth of kelp to a depth range where a sufficient amount of light reaches the seafloor. This typically occurs in water depths less than 48 ft (15m) deep. Hard substrates, which are necessary for kelp holdfasts, also restrict kelp to areas with low sedimentation rates. These three factors have limited kelp to a few OCS areas. The best known kelp habitat is the Boulder Patch, which is located inshore of the barrier islands in Stefansson Sound (MMS, 2003). Kelp also grows sparsely in West Camden Bay but locations and biological details of these beds are poorly described (MMS, 2006c; Dunton and Schomberg, 2000). All likely kelp habitats have not yet been surveyed. Other kelp habitats may be discovered and recorded as portions of the Beaufort Sea are further explored. The stipulation "Protection of Biological Resources", states that if previously unidentified populations or habitats requiring additional protection are identified in the lease area, the Regional Supervisor of Field Operations may require the lessee to conduct biological surveys to determine extent and composition of these previously unknown resources. Currently known kelp bed unique benthic habitats are within or parallel to offshore barrier islands and therefore within the 3-mile state water zones (further discussion may be found within the Beaufort EIS and Seismic PEA).

3.9. Employment

Approximately 70% of North Slope workers in the oil and gas industry in 2001 and 2006 commute to permanent residences within Alaska but outside the North Slope Borough (NSB), primarily in Southcentral Alaska and Fairbanks. Approximately 30% reside outside of Alaska. The number of those who work and reside in the NSB is negligible. In general, very few North Slope Natives have been employed in the oil-production facilities and associated service industries in and near Prudhoe Bay since production started in the late 1970s. North Slope Natives also tend not to be motivated to relocate to pursue employment. A study contracted by BOEMRE shows that 34 North Slope Natives interviewed constituted half of all North Slope Natives who worked at Prudhoe Bay in 1992, and that the North Slope Natives employed at Prudhoe Bay comprised <1% of the 6,000 North Slope oil-industry workers. This pattern is confirmed by 2003 data showing only 23 NSB Inupiat residents as employed in the oil industry. One of the NSB's main goals is to create employment for Native residents and it has successfully hired many Natives for NSB construction projects and operations. The NSB has been less successful in facilitating the employment of Native people in the oil industry at Prudhoe Bay. The NSB is concerned that the oil industry has not done enough to train unskilled laborers or to allow them to participate in subsistence hunting. The NSB also is concerned that the oil industry recruits using methods common to Western industry. The NSB would like to see industry make serious efforts to hire NSB residents (MMS, 2008).

3.10. Subsistence Activities

Subsistence activities are a central element in the North Slope Borough (NSB) socioeconomic system. The socioeconomic composition of the NSB is a blend of traditional subsistence activities; Federal, State, and Native corporation services and jurisdictions with unique benefits and pressures that are a part of life in the Arctic.

Subsistence activities are assigned the highest cultural values by the Iñupiaq Eskimo of the North Slope and provide a sense of identity in addition to being an important economic pursuit. Subsistence is viewed by Alaskan Natives not just as an activity that is imbedded in the culture; it is viewed as the very culture itself (Wheeler and Thornton, 2005).

Kaktovik is a coastal community 50 mi (80 km) east of the proposed project area. Nuiqsut is 30 mi (48 km) southwest of the project area and about 20 mi (32 km) inland from the coast along the Colville River. Cross Island, from which Nuiqsut hunters base their bowhead whaling activities, is southeast and adjacent to the project area. Concerns regarding short or long-term effects the proposed project may have on the biological species upon which the local residents depend for subsistence will be found in the appropriate sections describing the biology, or water quality of this EA.

3.10.1. Existing Environment for Subsistence Activities

The bowhead whale is a subsistence resource of paramount importance, and, consequently, descriptions of the social organization pertaining to the crew, the hunt, quantity, and distribution of the whale dominate subsistence discourse about the North Slope Inupiaq Eskimo communities (MMS, 2009a).

Bowhead whaling traditions underscore the central values and activities for the Iñupiat of the North Slope. Bowhead whale hunting strengthens family and community ties and the sense of a common Iñupiat heritage, culture, and way of life, and provides a strength, purpose, and unity in the face of rapid change (MMS, 2008; EDAW/AECOM, 2007). Although bowhead whaling traditions are unquestionably significant, harvest of other wild resources, including caribou, fish, avian species, and other marine mammals also are important to the local inhabitants to provide a variety in the diet and nutrition or to provide nutritional needs if few or no bowhead whales are taken (MMS, 2009a).

3.10.2. Subsistence Communities

This discussion focuses on the subsistence activities, related subsistence resources, and subsistence distribution levels that generally occur during the period of Shell's proposed operation in the Beaufort Sea, from July through October.

Kaktovik. During summer, the people of Kaktovik engage in a community-based subsistence fishery. Most households gillnet at beach sites on Barter Island near Kaktovik, where the primary fish harvested is sea run Dolly Varden, or char. In fact, "Kaktovik" means "place where people fish on the beach" (Leffingwell, 1919). Some Kaktovik households also fish to the east, where the primary fish harvested is Arctic cisco (Stephen R. Braund & Associates, 2010; Map 67). Some households have fished westward in the Canning River, but the main level of effort is on Barter Island. In 2002, one of two years with an active census, 79% of the households fished in summer (Pedersen and Linn, 2005; MMS, 2009b). Additional resources harvested in the summer include waterfowl and seal (Impact Assessment Inc., 1990b; MMS, 2009a).

The bowhead whaling effort takes precedence over any other subsistence activity, and occurs only in the fall. Although Nuiqsut's Cross Island bowhead whale hunt is well documented as part of monitoring and mitigation efforts stemming from petroleum development, less is known about the Kaktovik bowhead whale hunt. Whaling crews use Kaktovik as their home base, leaving the village and returning on a daily basis. The core whaling area is within 12 mi (19 km) of the village with a periphery ranging about 8 mi (13 km) farther, if necessary. This core whaling area is about 50 - 115 mi (80 – 185 km) from survey sites. The extreme limits of the Kaktovik whaling limit would be the middle of Camden Bay to the west. The timing of the Kaktovik bowhead whale hunt roughly parallels the Cross Island whale hunt (Impact Assessment Inc, 1990b; Stephen R. Braund & Associates, 2010; Map 64). The Draft Arctic Multiple-Sale EIS describes the hunting of beluga whales from Kaktovik. On average, one beluga is harvested annually in conjunction with the bowhead whale hunt, but most households obtain beluga through exchanges with other communities.

Nuiqsut. During summer, the people of Nuiqsut harvest whitefish, primarily along channels of the Colville River. They also harvest Arctic char, dog salmon, pink salmon, and the spotted seals that follow the fish upriver. Waterfowl are also hunted, as are summer caribou (Galginaitis et al., 1984). Residents stated that the best caribou hunting takes place in summer, and coastal areas are the most productive for caribou hunting. People prefer the use of boats to access caribou because the capacity of a boat is sufficient for hauling the meat back to the village (Stephen R. Braund & Associates, 2010: Map 112). Although seal is not a preferred meat for human consumption, people use the oil as a condiment. Seals are hunted in nearshore waters during this time. There was general agreement that the best place to harvest them is off the Colville delta (Impact Assessment Inc., 1990a). These activities occur from 30 -120 mi (48 – 193 km) from survey activities (MMS, 2009b).

Bowhead whaling takes precedence over any other subsistence activity, and occurs only in the fall. The 2008 Cross Island bowhead whale hunting season started earlier than any other, with the first crew arriving on August 29, and lasted for 14 days, including days set aside for traveling, butchering, weather days, and scouting days. The captains agreed to stop whaling on September 9 because the four landed whales were considered to be a sufficient harvest. Whale strikes occurred at an average distance of 10.5 km (6.5 mi) from Cross Island. The shorter 2008 season compares with a 21-day season in 2006 and a 27-day season in 2005. Over the past 7 years of reported monitoring (2001 - 2008), the majority of the bowhead whales have been harvested in the northeast quadrant off Cross Island (Impact Assessment Inc., 2009a; MMS, 2009b; Stephen R. Braund & Associates, 2010: Maps 113 and 114).

Barrow. Barrow residents hunt bowhead whales during both spring and fall; in the past, more whales were harvested during the spring whale hunt, but with changing ice conditions the fall hunt has increased in importance as the major whaling season. Hunters use aluminum skiffs with outboard

motors to chase the whales during the fall migration, which takes place in open water up to 30 mi offshore. No other marine mammal is harvested with the intensity and concentration of effort that is expended on the bowhead whale. Subsistence studies conducted in the early 1990s indicated that 58.2% of Barrow's total subsistence harvest was marine mammals, and 43.3% of the total harvest was bowhead whales (MMS 2008a, 2009b; Stephen R. Braund & Associates, 2010: Map 10).

Beluga whales are available from the beginning of the spring whaling season through June and occasionally in July and August in ice-free waters. Belugas are harvested in the leads between Point Barrow and Skull Cliff. Later in summer, belugas occasionally are harvested on both sides of the barrier islands of Elson Lagoon, which is more than 200 mi (322 km) from the nearest of Shell's proposed Beaufort Sea survey areas.

The hunting of bearded seals (ugruk) is an important subsistence activity in Barrow, because the bearded seal is a preferred food and because bearded seal skins are the preferred covering material for the skin boats used in whaling. Most bearded seals are harvested during the spring and summer months and from open water during the pursuit of other marine mammals in both the Chukchi and Beaufort seas, but harvest areas do not extend into the area of Shell's proposed Beaufort Sea surveys (Stephen R. Braund & Associates, 2010; Map 31). Barrow residents harvest marine and freshwater fishes, but their dependency on fish varies according to the availability of other resources. Capelin, char, cod, grayling, salmon, sculpin, trout, and whitefish are harvested. Fishing occurs primarily in the summer and fall months and peaks in September and October. Most fishing occurs at inland fish camps, particularly in lakes and rivers that flow into the southern end of Dease Inlet over 100 mi (160 km) from Shell's proposed survey activities in the Beaufort Sea (MMS, 2008a, 2009b; Stephen R. Braund & Associates, 2010; Maps 16-24).

Walrus are harvested during the summer marine-mammal hunt west of Point Barrow and southwest to Peard Bay. Most hunters travel no more than 15 - 20 mi (24 – 32 km) to hunt walruses, although more recent interviews indicated hunters are traveling as far as 100 mi (160 km) north from Point Barrow in pursuit of walrus. The major walrus-hunting effort occurs from late June through mid-September, with the peak season in August. Traditional harvest areas are at least 90 mi (145 km) west of Shell's proposed Beaufort Sea survey activities (Stephen R. Braund & Associates, 2010; Map 33). Barrow residents hunt polar bears from October to June; no hunting of polar bears is expected to occur during the period of Shell's proposed survey activities. Migratory birds, particularly eider ducks and geese, provide an important food source for Barrow residents because of the dietary importance of birds as the first source of fresh meat in the spring. Most spring bird hunting takes place between April and June), before the proposed start of Shell's survey activities. In late August and early September, with peak movement in the first 2 weeks of September, ducks and geese migrate south and are again hunted by Barrow residents. Birds, primarily eiders and other ducks, are hunted along the coast from Point Franklin to Admiralty Bay and Dease Inlet (MMS, 2008a, 2009b; Stephen R. Braund & Associates, 2010: Maps 25-28).

3.11. Sociocultural Systems and Environmental Justice

Sociocultural systems encompasses three interrelated concepts: (1) social organization, (2) cultural values, and (3) institutional organizations of communities. Social organization is defined to mean how people are divided into social groups and networks. Cultural values are those desirable values that are widely shared explicitly and implicitly by members of a social group. Institutional organization refers to the government and non-government entities that provide services to the community.. For most Alaskan Natives, subsistence (and the relationship between people, land, water, and its resources) is the idiom of cultural identity, and production of subsistence foods is the activity around which social organization occurs. Institutional organizations reflect and affect the social organization and cultural values. For the North Slope of Alaska, Iñupiat traditions and practices largely define social organization and cultural values, while the civil and tribal governments and Native corporations

largely define institutional organization. A detailed explanation of Sociocultural factors appears in Section 3.4.3 of the Draft Arctic Multiple-Sale EIS.

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 and it is primarily through impacts to subsistence activities that impacts to sociocultural systems are assessed (MMS, 2008a).

The Environmental Justice (EJ) Executive Order (59 *FR* 7629) requires each Federal Agency to make the consideration of EJ part of its mission. The Executive Order requires an evaluation in an EIS or EA as to whether the proposed project would have "disproportionately high adverse human health (i.e., community health) and environmental effects…on minority populations and low income populations." Alaska Iñupiat Natives, a recognized minority, are the predominant residents of the North Slope and the Northwest Arctic Boroughs, the area potentially affected by survey activities. The ethnic composition of Kaktovik, Nuiqsut, and Barrow demonstrates that all three communities would be classed as minority communities on the basis of their proportional American Indian and Alaskan Native membership. The Statewide population is 15.4% American Indian and Alaskan Native. On this basis, an evaluation of disproportionate impacts is required. Generally disproportionate impacts on minority and low income populations are assessed based on the impacts to subsistence practices and consequent impacts on sociocultural systems (MMS, 2008a).

The health and welfare of the residents of the NSB is a primary EJ concern, and more specific community health effects are assessed based on impacts to (1) General Health and Well-being; (2) Psychosocial issues; (3) Accidents and Injuries; (4) Contaminant Exposure; (5) Food, Nutrition, and Physical Activity; (6) Non-communicable and Chronic Disease; (7) Cancer; (8) Infectious Diseases; (9) Maternal-Child Health; (10) Water and Sanitation; (11) Health Services Infrastructure and Capacity; and (12) Occupational/Community Health Intersection as discussed in great detail in Appendix J of the Draft Arctic Multiple-Sale EIS.

3.12. Archaeological Resources

Archaeological Resources are historic properties defined as "any prehistoric or historic district, site, building, structure, or object [including shipwrecks]…including artifacts, records, and remains which are related to such a district, site, building, structure, or object" (National Historic Preservation Act (NHPA), Sec. 301 as amended, 16 U.S.C. 470). Significant archaeological resources are either historic or prehistoric and generally include properties of >50 years that: (1) are associated with events that have made a significant contribution to the broad patterns of our history; (2) are associated with the lives of persons significant in the past; (3) embody the distinctive characteristics of a type, period, or method of construction; (4) represent the work of a master; (5) possess high artistic values; (6) present a significant and distinguishable entity whose components may lack individual distinction; or (7) have yielded, or may be likely to yield, information important in history. It is the policy of the BOEMRE to consider the effects on historic properties in all aspects of planning, leasing, permitting, operations, and regulatory decisions. To do this, an assessment of archaeological resource potential within the area to be affected by a proposed action must take place (MMS, 2008a).

4. ENVIRONMENTAL CONSEQUENCES

The BOEMRE conducts effects analyses based on a number of guiding principles and necessary assumptions. Before an effects analysis can be completed, the scope of the analysis must be defined, the general principles identifying direct and indirect effects and cumulative effects described, the reasonably foreseeable activities and events over the proposed activity period outlined, and all potential impact-producing factors that could arise from the proposed action identified.

4.1. Scope of the Analysis

The scope of this analysis includes oil and gas development, other human activities, and environmental trends on the North Slope and adjacent offshore areas over the 6-month life of the proposed project. Activities and trends occurring closer geographically and in time to the proposed activity area and that were more certain were weighed more heavily to focus the cumulative effects analysis on effects in the proposed action.

Table 3 Impact producing factors in the area of, and at the time of, the proposed action considered during this analysis.

Resource	Impact Producing Factors[1]					
	Seismic & Underwater Noise	Vessel Presence & Noise	Aircraft Presence& Noise	Seafloor Disturbance	Small Diesel Fuel Spill	Invasive Species
Water Quality		X		X	X	X
Air Quality		X	X		X	
Marine Mammals (except polar bear)	X	X	X		X	
Polar Bear		X	X		X	
Polar Bear Critical Habitat		X	X		X	
Marine and Coastal Birds	X	X	X		X	
Fish	X	X		X	X	X
Essential Fish Habitat	X	X		X	X	X
Terrestrial Mammals			X		X	
Lower Trophic Organisms		X		X	X	
Employment		X	X		X	
Subsistence Activities[2]	X	X	X	X	X	
Sociocultural Systems						
Environmental Justice						
Archeological Resources				X		

Notes: [1]Past, Present and Reasonably Foreseeable Activity Related
[2]Resource affected to the extent subsistence resources are affected.
X = Resource affected, Blank = Resource not affected

In accordance with the Council on Environmental Quality (CEQ) NEPA regulations (40 CFR 1502.16), the level of potential direct, indirect, and cumulative effects on physical, biological, and human social resources are discussed in this analysis. The analysis considered the "context" and

"intensity" of an impact as defined by the CEQ in characterizing "significantly" (40 CFR 1508.27). The context considers the setting of the proposed action, what an affected resource may be, and whether the effect on this resource is local or regional in extent. The intensity addresses the severity of the impact, taking into account such factors as whether the impact is beneficial or adverse; the sensitivity of the resource (e.g., threatened or endangered species); effects on public health or safety; and whether Federal, State, or local laws may be violated.

4.1.1. General Principles

Direct and Indirect Effects. The use of readily available abiotic standards (e.g., air and water quality) to determine environmental quality often provide good indicators for the quality of biological and cultural resources. As the analysis moves from abiotic to biotic to the human condition, the number of variables increase, making it more difficult to determine cause-and-effect relationships.

Similarly, when moving from a terrestrial environment to the offshore environment, the number of variables defining environmental quality also increase. Migratory species present additional variables that reflect habitat and species condition outside the primary area of analysis in northern Alaska. As the analysis progresses from abiotic to biotic, from freshwater to marine, or from ecological to sociocultural effects, it becomes more complicated and less conclusive.

Cumulative Effects. Regulations implementing NEPA (40 CFR 1508.7 and 1508.25(a)(2)) requires BOEMRE to complete a cumulative effects analysis as part of this assessment to determine the full scope of effects to be addressed. A cumulative effect is the impact on the environment that results from the incremental impact of the proposed 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. Section 4.1.2.2 of the Draft Arctic Multiple-Sale EIS describes more detail on the process BOEMRE uses to assess cumulative effects.

4.1.2. Reasonably Foreseeable Activities and Events

Activities that may produce effects to the Beaufort Sea region are discussed in the Draft Arctic Multiple-Sale EIS. The EIS considered a 20-year time-span, however this EA covers a very limited time period of the 2010 open water season. The following is a summary of the type of activities applicable to this EA. These activities either occurred in the past, are currently occurring or likely to occur during the period of the proposed action. These activities and their effects will be discussed under individual resources in the Affected Environment (Section 3) and Environmental Consequences (Section 4) sections.

Presence and Sound of Vessels including cargo barges, oil and gas support vessels, cruise ships, research vessels, spill response, military vessels and smaller vessels used for hunting and between-village transportation during the open-water period. Most vessel traffic and seismic surveys occur during the summer open-water season between June and November, although some vessel activity occurs year round. This type of vessel traffic is expected to continue during the 2010 open water season. For this EA, it is assumed that no more than six concurrent seismic survey operations would occur in the Beaufort Sea during the 2010 open water season.

Presence and Sound of Aircraft in the region include fixed wing propeller-driven aircraft, helicopters and jet aircraft. The activities using aircraft include: intercommunity travel, freight hauling, and charters for research and industry. It is expected that existing recent trends in aircraft traffic will continue during the 2010 open water season.

Emissions to the Air from support-vessel traffic; construction machinery; and production equipment, including compressors, generators, boilers, and various types of internal combustion engines are expected to continue to occur during the life of the proposed activity.

Discharges to the Marine Environment from permitted discharges, nonpoint land and vessel runoff, accidental crude and refined onshore and offshore oil leaks and spills (see below), deposition of aerosol pollution, and import of contaminants through water currents and ice from other areas.

Risk of Introduction of Marine Invasive Species from fouled ship hulls and equipment placed in the water (e.g., anchors, seismic survey apparatus, ocean-bottom cables).

Small Oil Spills. (Alternative 1: No Action). Based on small spill rates and volumes (MMS, 2008a), the BOEMRE estimates 34 refined (24 bbl) and 14 (43 bbl) small crude oil spills could occur offshore and onshore during the cumulative 121 days of the proposed action. Based on the proportion of offshore to onshore production BOEMRE estimates 1 small refined spill (0.7 bbl [29 gal.]) and no small crude oil spills could occur from offshore production activities on a gravel island or causeway.

Small Refined Oil Spills from Proposed Activities. (Alternative 2: Proposed Action). Refueling operations in the Beaufort Sea likely would occur at Prudhoe Bay's West Dock facility or if necessary at sea for the vessel *M/V Ocean Pioneer*. The BOEMRE considered 3 vessel transfer diesel fuel spill scenarios; a hose leak (0.6 gal.), hose decoupling (6 gal.) and hose rupture (13 bbl [535 gal.]). For purposes of analysis, the BOEMRE assumed the spill occurs and the BOEMRE chose the largest size scenario, a 13 bbl hose rupture, as a conservative estimate of the volume spilled given that 95% of vessel transfer spills are 300 gallons (~7 bbl) or less and 65% are 10 gallons or less (Etkin, 2006). Based on the SINTEF Oil Weathering Model (OWM) Version 3.0, the BOEMRE estimates 21% of the diesel fuel evaporates and 79% disperses within 48 hours at a temperature of 0° C and a wind speed of 5 m/s (11 mph). Based on the size of the diesel fuel spill and its weathering characteristics the persistence of diesel fuel would be short term and temporary (48 hrs).

Changing Climate (e.g. warming temperatures and changes in total coverage and distribution of sea ice) has been ongoing in the Arctic and is expected to continue during the 2010 open water season.

4.1.3. Issues Not Considered for Further Analysis

Three resource categories, air quality, terrestrial mammals, vegetation and wetlands, were considered for their potential to be affected by the proposed action and were removed from further analysis in this EA. These categories are either not present in the area at the time of the proposed action or the potential for the proposed action to result in a significant effect is so small that it cannot effect BOEMRE's outcome in making a reasoned choice between the alternatives. A brief discussion of each of these resources is provided below:

4.1.3.1. Air Quality

The EPA established National Ambient Air Quality Standards (NAAQS) for six "criteria pollutants" to provide protection from adverse effects on human health and welfare. The standards set a limit to the concentration of these pollutants in ambient air.

The air quality of the Arctic OCS and adjacent coastal areas is relatively pristine with criteria pollutant concentrations well under the limits established by the NAAQS and State of Alaska Ambient Air Quality Standards (18 AAC 50).

Air emissions from ancillary activities arise primarily from exhaust from the main engines and generators of survey vessels. Previous analysis of a typical assortment of seismic survey vessels considered the potential for causing an increase in pollutants that:

- exceeds half the increase permitted under the prevention of significant deterioration (PSD) criteria or the NAAQS for nitrogen dioxide, sulfur dioxide, or particulate matter <10 microns in diameter; or
- exceeds half the increase permitted under the NAAQS for carbon monoxide or ozone.

The analysis concluded that the predicted increase in pollutant concentrations for marine seismic work at distances greater than 1 - 2 km (0.6 - 1.2 mi) from the seismic source vessel, and associated support vessels, would be appreciably below the significance threshold (MMS, 2006a).

By comparison, marine operations from the proposed ancillary activities would contribute fewer emissions than those analyzed in the Seismic PEA. The net result of the emissions contributed by the proposed activity would be a short-term, localized increase in the concentration of criteria pollutants which would still be within NAAQS. The emissions would originate from mobile sources which would effectively spread pollutants over a large area where they would be further dispersed by prevailing winds. The potential impacts to air quality from the proposed ancillary activities in the Beaufort Sea are therefore considered negligible.

4.1.3.2. Terrestrial Mammals

Terrestrial mammals present in the vicinity of the area of the proposed ancillary activities include caribou, muskox, grizzly bear, and Arctic fox. Other species which can be present but whose populations are so small or whose distribution is so sparse include common small mammals (hares, ground squirrels, microtine rodents, lemmings, mustelids, etc.) and large mammals, such as moose, wolves and wolverine.

Aircraft operations associated with the marine mammal monitoring and mitigation plan are the only components of the proposed action which would occur in the vicinity of terrestrial mammals and their habitat. All aircraft will maintain a minimum flight level of 1000 ft (300 m) as specified in the 2010 LOA and 2010 IHA except during take off or landing to minimize potential effects on terrestrial mammals.

The Seismic PEA, determined that seismic activities, similar to those in the Proposed Action, are not likely to have any adverse effect on terrestrial mammals and there has been no new information since the Seismic PEA was published which would indicate that the situation has changed. Effects to terrestrial mammal resources are therefore considered negligible and will not be considered further in this EA.

4.1.3.3. Vegetation and Wetlands

Vegetation along the Beaufort Sea coastline consists primarily of tundra biotypes mantling permafrost layers that dominate the coastline (Mars and Houseknecht, 2010). Tundra vegetation includes sedges, lichens, mosses, and dwarf willows that provide cover throughout the flat plains ranging inland. Permafrost layers extend to within 12 in to 18 in (30 cm to 50 cm) of the surface, and are comprised of as much as 75% ice and 25% sediment in the upper 5 m (16 ft) of the coastal plains (Reimnitz et al, 1985).

Estuarine wetland systems are found inshore of the coastal barrier islands on the Beaufort Sea coastline, and are associated with river and delta plains throughout coastal embayments (Mars and Houseknecht, 2010). The coastal plain sediment includes narrow, low relief sandy beach ridges separated by broad areas of low-lying silt and mud marine deposits. The shoreline consists primarily of 3-20 ft (1 m - 6 m) permafrost bluffs, influenced by thermokarst inclusions, with wind-driven wave energy undercutting the permafrost blocks. These blocks fall directly into the sea and rapidly melt. Wave action then transports the muddy sediment offshore (Lantuit and Pollard, 2008). Shorelines are

dominated by landfast ice during the winter seasons from October through late May, and exposed to wind-driven waves through the open water months from May through October (Dunton et al, 2006).

Although seismic airgun energy may extend as far as the coastal zone during nearshore operations, the study area of the proposed action would not affect the described shore zones. Potential small diesel fuel spills associated with vessel refueling (see section 4.1.2), due to the small quantity of fuel involved and the distance from sensitive resources, would result in negligible effects on estuarine and coastal environments. Therefore, vegetation and wetlands will not be considered further in this analysis.

4.2. Alternative 1: No Action

Under the No Action Alternative, the activities proposed by Shell's ancillary activity notice would not be undertaken (see Section 2.1.). All impact producing factors evaluated are, therefore, associated with past, present or reasonably foreseeable future activities and the anticipated levels of effects would occur without any contribution associated with the Proposed Action.

4.2.1. Water Quality

Activities in the Arctic that are ongoing which may currently or in the near-future affect water quality and the aquatic environment in the U.S. Arctic region include: petroleum spills, permitted and non-permitted discharges, long-distance aerosol-transported pollutants, climate warming and ice melt, ship groundings, and risk of invasive species from hulls and equipment. The cumulative effect of the activities in the No Action Alternative is minor. The effects levels and definitions used in the water quality analysis are included in Appendix A-2.1.

4.2.2. Marine Mammals – Cetaceans and Pinnipeds

Summary. The following analysis addresses the effects of actions described as occurring under the existing environment in Section 3.2 of this EA.

Issues and concerns applicable to this analysis include:

- protection of marine mammal subsistence resources and the Inupiat culture and way of life
- disturbance to bowhead whale migration patterns
- harassment and potential harm of other marine mammals by seismic survey operations
- impacts to threatened and endangered species

In evaluating potential adverse effects to marine mammals from OCS activities BOEMRE examines both the magnitude and duration of action causing effects. BOEMRE used levels of effects ranging from negligible to major (Appendix A-2.2).

4.2.2.1. Effects Without Mitigation

Multiple pathways exist through which endangered whales (cetaceans) and other marine mammals, could be affected by human activities, including oil and gas exploration, development and production, in the Beaufort Sea and Chukchi Sea Planning Areas.

Noise and Disturbance. Noise and energy emitted from seismic survey sound sources, especially airguns, have potential to cause physical injury (hearing loss) and behavior modification in sea mammals experiencing exposure. Principal sources of noise with a potential to adversely effect marine mammals in the Beaufort Sea include:

- 2D/3D deep penetration seismic airgun underwater noise-
- high-resolution seismic-survey airgun, bathymetric sonar, sparker, sub-bottom profiler, and similar technologies noise and disturbance;
- vessel traffic and noise and disturbance;
- aircraft traffic and noise and disturbance;
- production noise and disturbance;

Potential effects of noise and disturbance to endangered whales and other marine mammals is discussed at length in the following documents which are incorporated by reference in this EA:

- Beaufort EIS, Sections IV.A.3.b., IV.C.5.(1)(a), and IV.C.7.a(1)(a)
- Lease Sale 195 EA Section IV.C1.d. and e(1), (MMS, 2004)
- Draft Arctic Multiple-sale EIS, Sections 4.4.1.6.1.1 and 4.4.1.8.1.
- Seismic PEA Sections III. F.3.f.

These analyses indicate that the listed noise sources potentially would result in adverse, but not significant, impacts to marine mammals with appropriate mitigation measures in place. Additional measures imposed by an IHA ensure only "negligible impacts" on marine mammals. In the context of new information that has become available since the publication of the documents noted above, these conclusions remain consistent. Biological Opinions issued by NMFS (2006, 2008) conclude:

> "After reviewing the current status of the endangered bowhead whale, the environmental baseline for the action area, the proposed action, and the cumulative effects, it is NMFS's biological opinion that individual bowhead whales within the action area may be adversely affected, but that the proposed action is not likely to jeopardize the continued existence of Western Arctic Bowhead whales. No critical habitat has been designated for this species, therefore, none will be affected."

The NMFS Supplemental EAs (SEAs) (NMFS, 2008; NMFS, 2007) regarding the issuance of IHAs notes the following:

> "Additional measures may be required by NMFS pursuant to its authority under the MMPA to ensure that the proposed activities will result in the least practicable adverse impact on marine mammal species or stocks in the Beaufort and Chukchi Seas. These mitigation and monitoring measures could appear as stipulations in any seismic survey authorizations granted by NMFS. These mitigation and monitoring requirements contained in the MMPA IHAs will ensure that takings are of small numbers, potential impacts to marine mammals will be negligible, and there will be no unrnitigable adverse impacts to subsistence uses. All mitigation and monitoring measures, especially those related to avoiding impacts to subsistence hunting under the MMPA authorizations will be followed."

NMFS issued an IHA for substantially similar activities as the proposed action in 2009 including 40 in^3 airguns for seismic operations in the Chukchi Sea. The terms and conditions complied with the monitoring and mitigation measures identified in previously noted EA's (NMFS 2008, 2009).

After a review of existing NEPA analyses completed by BOEMRE and NMFS, existing IHAs for similar activities, and reviewing new information, BOEMRE considers impacts of noise upon marine mammals as result of Alternative 1: No Action to be negligible.

Vessel and Air Traffic. The Seismic PEA and the Draft Arctic Multiple-Sale EIS discuss the risk of vessel strikes and conclude that individual animals would adjust their individual swim paths to avoid approaching vessels. Existing data do not indicate that marine mammal strikes in the Beaufort Sea are an important source of mortality. Although collision risk is expected to increase with increased vessel traffic, there is no expectation that a substantial increase in vessel traffic would occur over the July 1 to October 30, 2010 period considered in this analysis. Therefore effects of vessel traffic and collision are considered negligible and will not be analyzed further for Alternative 1: No Action.

Aircraft traffic, especially low altitude (less than 1500 ft (457 m)) or aircraft passes at near (less than 300 meters) can cause temporary avoidance or flight responses by marine mammals. If such disturbance to individual animals or groups is frequent or chronic displacement from preferred habitats can occur. Walrus can be stampeded from haul outs on ice or land which may result in mortality of calves and yearlings. The effects of aircraft traffic on walrus for Alternative 1: No Action, are potentially major.

Small Diesel Fuel Spills. Section 4.1.2 describes the refined oil spill scenario for the No Action Alternative. Extensive review and discussion of potential impacts of oil spills on endangered species is provided in BOEMRE's Biological Evaluation of Oil and Gas Activities in the Chukchi Sea and Beaufort Sea Program Areas on Bowhead, Fin and Humpback Whales (MMS, 2006b).

Alternative 1: No Action could result in a single offshore small refined oil spill. BOEMRE concludes that such a spill would have negligible effects on bowhead whales and other marine mammals given the small volume, location and limited opportunity for spilled material to enter the marine environment.

Subsistence Hunting. The FEIS For Issuing Annual Quotas to the Alaska Eskimo Whaling Commission for a Subsistence Hunt on Bowhead Whales for the Years 2008 Through 2012 (NMFS, 2008) evaluated the effects of authorizing a continuing level of subsistence harvest comparable to the 2003 through 2007 period. Given the magnitude, extent and duration of direct mortality, NMFS summarized the effects as negligible to the population of bowhead whales and minor in effects caused by noise and disturbance for the bowhead population. BOEMRE concurs with the finding; however, the BOEMRE definition for level of effect would be a moderate effect for bowhead whales and other marine mammals harvested for subsistence due to the unavoidable targeted mortality resulting from harvest activities.

4.2.2.2. Mitigation Measures

Some existing projects and programs have mitigation measures designed to avoid or minimize adverse effects to marine mammals while many day-to-day operations on the North Slope are unregulated, have no mitigation measures, and will continue to have adverse effects on marine mammals.

4.2.2.3. Effects of Alternative 1: No Action

Impact analysis for Alternative 1: No Action, remains the same as described in Section 4.2.2.1. Mitigation measures that are in place are expected to remain and prior NEPA analysis has concluded the same level of impact.

Direct and Indirect Effects. There would be no direct or indirect effects to marine mammals from Alternative 1: No Action.

Cumulative Effects. Impact analysis for Alternative 1: No Action, remains the same as described in Section 4.2.2.1. Mitigation measures that are in place are expected to remain and prior NEPA

analysis has concluded the level of impact on marine mammals (cetaceans and pinnipeds) will be negligible.

4.2.3. Marine Mammals - Polar Bears

Summary: Alternative 1: No Action would not influence the current status and natural history of the polar bear in the Beaufort Sea. Primary considerations affecting polar bear include environmental change and continuing subsistence harvest.

4.2.3.1. Potential Effects

An explanation of the potential for a number of activities to affect polar bears is in Section 4.4.1.6.3.1 of the Draft Arctic Multiple-Sale EIS.

4.2.3.2. Mitigation Measures

Some existing projects and programs have mitigation measures designed to avoid or minimize adverse effects to polar bears while many day-to-day operations on the North Slope are unregulated, have no mitigation measures, and will continue to have adverse effects on polar bears. Existing mitigation measures for on-going activities are described in Section 4.4.1.6.3.2 of the Draft Arctic Multiple-Sale EIS.

4.2.3.3. Effects of Alternative 1: No Action

The following effects analysis considered other important factors (timing, residence time and periodicity, spatial extent, environmental factors, etc.) as described in Section 4.4.1.6.3.3 of the Draft Arctic Multiple-Sale EIS. Definitions for level of effect terms used for polar bears are contained in Appendix A-2.2.

Direct and Indirect Effects. There would be no direct or indirect effects to polar bears from Alternative 1: No Action.

Cumulative Effects. The abundance, distribution and ESA-status of the polar bear are not anticipated to change during the time-period covered by the proposed action. Polar bears would continue to be hunted and could experience changing sea-ice conditions. Human-bear encounters in communities or during oil and gas industry activities would still be managed under plans that minimize encounters and avoid lethal takes of polar bears. Due to the possibility of continued polar bear mortality resulting from hunting and human-bear encounters, the effect of Alternative 1: No Action on polar bears is moderate.

4.2.4. Polar Bear Critical Habitat

Summary. The proposed critical habitat would remain unchanged from its existing condition.

4.2.4.1. Potential Effects

An explanation of the potential for vessel and aircraft traffic, and spills to affect polar bear critical habitat is described in 74 *FR* 56058 (2009).

4.2.4.2. Mitigation Measures

Consultation with the FWS would be required for certain projects or activities to avoid destruction or adverse modification of proposed critical habitats.

4.2.4.3. Effects of Alternative 1: No Action

The following effects analysis considered the same factors and level of effect terms as described in Alternative 1: No Action.

Direct and Indirect Effects. There would be no direct or indirect effects to proposed polar bear critical habitat from Alternative 1: No Action.

Cumulative Effects. The proposed critical habitat would remain unchanged from the existing condition described in 74 *FR* 56058 (2009). Consultation with the FWS would be required for certain projects to avoid destruction or adverse modification of proposed critical habitats.

4.2.5. Marine and Coastal Birds

Summary. In the following analysis, BOEMRE concluded that there would be no direct or indirect effects if the proposed action were not completed. However, there would be a negligible cumulative level of effect from seismic; and a continued minor cumulative level of effect from vessel presence and noise, aircraft presence and noise, and collisions with structures.

This section describes the impact to marine and coastal birds resulting from the direct and indirect effects of past, present, and reasonably foreseeable future activity in the area of the proposed action, regardless of what agency or person undertakes such other actions. Past and present actions that affect marine and coastal birds are described in Section 3.5

4.2.5.1. Potential Effects

An explanation of the potential for vessel and aircraft traffic, collisions, seismic airgun noise, and spills to affect marine and coastal birds is in Section 4.4.1.6.2.1 of the Draft Arctic Multiple-Sale EIS.

4.2.5.2. Mitigation Measures

Some existing projects and programs have mitigation measures designed to avoid or minimize adverse effects to marine and coastal birds while day-to-day operations on the North Slope are unregulated, have no mitigation measures, and will continue to have adverse effects (described in Section 4.4.1.7.3.2 of the Draft Arctic Multiple-Sale EIS).

4.2.5.3. Effects of Alternative 1: No Action

The following effects analysis considered other important factors (timing, residence time and periodicity, spatial extent, environmental factors, etc.) as described in Section 4.4.1.6.2.3 of the Draft Arctic Multiple-Sale EIS. Appendix A-2.3 contains definitions for level of effect terms (negligible, minor, etc.).

4.2.5.3.1. Direct and Indirect Effects

There would be no direct or indirect effects to marine and coastal birds for Alternative 1: No Action.

4.2.5.3.2. Cumulative Effects

Marine and coastal areas of the Alaska North Slope are commonly perceived to be a pristine environment, yet there are a number of past and existing sources of harm that may negatively affect marine and coastal birds in the project area..

The anticipated level of effects on marine and coastal birds for Alternative 1: No Action include:

- Uncontrolled vessel and aircraft disturbance could continue to harm marine and coastal birds in nearshore broodrearing or molting areas. Chronic stress during sensitive lifestages, especially the molt, likely would lead to long-term changes in survival and productivity. As marine and coastal birds are seasonal residents of the Beaufort Sea and vessels and aircraft are widespread at relatively low levels, vessels and aircraft presence and noise are currently having a negligible level of effect on marine and coastal birds.
- Collisions with existing structures, including vessels, in coastal areas could continue at a low rate. Preventive measures were not required for most structures, and special lighting protocols likely would not be implemented on existing developments. While collision mortality seems rare and does not appear to be a significant source of mortality, any mortality is considered to have a minor level of effect on marine and coastal birds.
- Spills, particularly in offshore areas, pose the greatest threat to birds in marine areas. Existing and anticipated future increases in vessel traffic, especially from tourism or shipping, could increase the chance of a marine accident. Barring these events, deliveries of bulk fuel to coastal communities pose the greatest chance of a large noncrude oil spill in the marine environment. While spill-related mortality seems rare and does not appear to be a significant source of mortality, any mortality from a hypothetical small spill would be considered a minor level of effect on marine and coastal birds.

4.2.6. Fish

Activities in the Arctic that are ongoing which may affect fish currently or in the near-future in the U.S. Arctic region include: petroleum spills, permitted and non-permitted discharges, long-distance aerosol-transported pollutants, climate warming and ice melt, reduction of ice habitat, research sampling, risk of invasive species from ship hulls and equipment deployment into the sea, noise from vessels, acoustic survey signals and noise from onshore and offshore construction. The cumulative effect of these activities in the area and at the time of the proposed action is minor. The effects levels and definitions used are included in Appendix A-2.4.

4.2.7. Essential Fish Habitat

Activities in the Arctic that are ongoing which may affect Arctic cod and saffron cod EFH currently or in the near-future in the U.S. Arctic region include: petroleum spills, permitted and non-permitted discharges, long-distance aerosol-transported pollutants, climate warming and ice melt, ship groundings, research sampling, risk of invasive species from vessel hulls and equipment, noise from vessels, acoustic survey signals and noise from onshore and offshore construction. The cumulative effect of these activities in the area and at the time of the proposed action is minor. The effects levels and definitions used are included in Appendix A-2.4.

4.2.8. Lower Trophic Organisms

Summary. In the following analysis, BOEMRE concluded that there would be no direct or indirect impacts to lower trophic-level organisms from Alternative 1: No Action. There would be a minor cumulative level of effect associated with past, present and reasonably foreseeable future activity occurring on the Alaska North Slope and the adjacent marine waters.

4.2.8.1. Potential Effects

Potential effects from activities occurring within the area of proposed action from Alternative 1: No Action are limited to refined petroleum spills, anchor deployment, benthic sampling and net trawls conducted by research vessels, vessel traffic associated with other OCS projects, and supply barges for village and ongoing industry activities. A detailed explanation of the factors which have a potential for adversely affecting lower trophic organisms is in Section 4.4.1.3 of the Draft Arctic Multiple-Sale EIS.

4.2.8.2. Mitigation Measures

Some existing projects and programs require mitigation that avoids or minimizes adverse effects to the lower trophic organisms essential to the survival of marine mammals and marine and coastal birds. Many day-to-day operations on the Alaska North Slope and the adjacent OCS waters are unregulated, have no mitigation measures, and will continue to have adverse effects on lower trophic organisms (described in Section 4.4.1.3 pages 4-36 through 4-38 of the Draft Arctic Multiple-Sale EIS). Mitigation measures in effect include the stipulation "Protection of Biological Resources". The U.S.C.G. Vessel Inspections, including oil transfer procedures or procedures and equipment to manage fuel transfer spills outlined in the Vessel Response Plans, are in effect to mitigate vessel transfer fuel spills.

4.2.8.3. Effects of Alternative 1: No Action

Refined Oil Spills. Based on small spill rates and volumes in MMS (2008a) the BOEMRE estimates 34 refined (24 bbl) and 14 (43 bbl) small crude oil spills could occur offshore and onshore during the 2010 open-water season in the Beaufort Sea (Section 4.1.2). These spills would result in negligible, localized and temporary effects to localized phytoplankton, zooplankton, and meroplankton populations.

Benthos Disturbance. Anticipated effects to the benthic environment caused by disturbance include natural factors of ice melt and seasonal influx of sediments from the Canning, Colville, and Sagavanirktok Rivers causing sedimentation potentially depositing over benthic environments. Anticipated anthropogenic effects include anchor deployment for vessels and data collection buoys, benthic sampling including fish trawls, van Veen grabs, vibracore, and CPT tests conducted for biological, chemical and geological analysis, vessel traffic associated with other OCS projects, and supply barges for village and ongoing industry activities. These activities present a potential for adverse environmental effects, however the fine sand, silt, and mud substrate and low biomass of the benthic environment would make the effects negligible, localized and temporary.

4.2.8.4. Cumulative Effects

The cumulative effects of Alternative 1: No Action would be those effects, summarized in Section 4.4.1.3 of the Draft Arctic Multiple-Sale EIS, that are associated with past, present, and foreseeable future activities occurring in the project area during the period of open-water in 2010. The factor most likely to impact lower trophic organisms during this period would be the accidental discharge of refined oil by normal vessel traffic in the area which would affect phytoplankton (and associated zooplankton and meroplankton stocks). The effect of an accidental spill of the size described in Section 4.1.2 would be localized and temporary and would have a negligible effect on the described environment.

4.2.9. Employment

Summary. In the following analysis, BOEMRE concluded that there would be few direct or indirect effects to employment from Alternative 1: No Action. There would be no net increase in employment and therefore no impact. Cumulative impacts would be the same as those described in the Draft Arctic Multiple-Sale EIS.

This section describes the impact to employment resulting from the direct and indirect effects of the No Action Alternative and adding it to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Past and present actions are described in Section 3.9.

4.2.9.1. Potential Effects

Changes in local employment may affect community sociocultural systems. The levels of effects for impacts to sociocultural systems are described in Appendix A-2.5. Although the prospective number of local residents that would be employed is expected to be relatively small and the effect to be negligible at the community level, any proposed activities not undertaken during the 2010 season would have a considerable adverse effect on individuals who lost an employment opportunity. With Alternative 1: No Action, there would be no net increase in employment or increase in goods and services purchased locally and therefore a negligible impact on employment would be anticipated.

4.2.9.2. Mitigation Measures

No specific mitigation measures related to employment have been identified.

4.2.9.3. Effects of Alternative 1: No Action

Direct and Indirect Effects. The direct impact from the Alternative 1: No Action would be no net increase in employment. Potential economic benefits to the communities and residents of the North Slope would be either delayed or not realized. Although the number of local residents potentially employed for the proposed survey activities is expected to be relatively small, with a negligible effect at the community level, any proposed activities not undertaken during the 2010 season would have a considerable adverse impact on individuals who lost an employment opportunity.

Cumulative Effects. The cumulative effects of Alternative 1: No Action would be those effects summarized in Section 4.5.1.11 of the Draft Arctic Multiple-Sale EIS that are associated with past, present, and foreseeable future activities occurring in the project area during the period of open water in 2010. The factor most likely to impact employment during this period would be ongoing seismic operations that would employ MMOs on survey vessels and subsistence advisors (SAs) in local communities to participate in Com Center communications, a net increase, yet still a minor impact on local employment.

4.2.10. Subsistence Activities

Summary. In the following analysis, we concluded that there would be no direct or indirect effects to subsistence activities from the Alternative 1: No Action. There would be no incremental contribution to cumulative effects from Alternative 1. There would be a minor cumulative level of effect associate with noise and disturbance with past, present and reasonably foreseeable future activity occurring on the Alaska North Slope and adjacent marine waters--the same as those described in the AMS Draft EIS (USDOI, MMS, 2008).

This section describes the impact to subsistence activities resulting from the direct and indirect effects of the No Action Alternative and adding it to other past, present, and reasonably foreseeable future

actions, regardless of what agency or person undertakes such other actions. Past and present actions are described in Section 3.10.

4.2.10.1. Potential Effects

Potential effects from activities within the proposed study area for Alternative 1: No Action are limited to refined petroleum spills, vessel traffic associated with other OCS projects, supply barges for village and ongoing industry activities. These activities create a potential for adverse environmental effects although they would be considered minor and temporary. A detailed explanation of the impact factors that could potentially affect subsistence activities is discussed in Section 4.4.1.12.1. of the AMS (MMS, 2008).

4.2.10.2. Mitigation Measures

Some existing projects and programs require mitigation designed to avoid or minimize adverse impacts to marine mammals and subsistence resources and harvests. Specifically, key provisions of required IHA and LOA documents specify that no unmitigable adverse impacts may occur to subsistence harvests.

4.2.10.3. Effects of Alternative 1: No Action

Direct and Indirect Effects. There would be no direct or indirect effects to subsistence activities from Alternative 1: No Action.

Cumulative Effects. The cumulative effects of Alternative 1: No Action would be those effects summarized in Section 4.4.1.12.7 of the Draft Arctic Multiple-Sale EIS that are associated with past present and foreseeable future activities occurring in the project area during the period of open water 2010. The factor most likely to impact subsistence activities during this period would be an accidental discharge of refined oil by normal vessel traffic in the area which could disrupt the subsistence hunt or taint resources. An accidental spill of the size described in Section 4.1.2 would be localized and weathering of the oil would result in a temporary and no more than minor impact on the resource.

4.2.11. Sociocultural Systems and Environmental Justice

Summary. In the following analysis, BOEMRE concluded that there would be no direct or indirect effects to sociocultural systems or environmental justice because no direct or indirect impacts are expected on subsistence activities from Alternative 1: No Action. There would be a minor to moderate cumulative level of effect associate with noise and disturbance associated with past, present and reasonably foreseeable future activity occurring on the Alaska North Slope and adjacent marine waters--the same as those described in the Draft Arctic Multiple-Sale EIS.

This section describes the impact to subsistence activities resulting from the direct and indirect effects of the No Action Alternative combined with other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions (Section 3.11).

4.2.11.1. Potential Effects

Potential effects from activities within the proposed study area not associated with the proposed action are limited to refined petroleum spills, vessel traffic associated with other OCS projects, supply barges for village and ongoing industry activities. These activities create a potential for adverse environmental effects although they would be considered minor and temporary. A detailed explanation of the impact factors that could potentially affect sociocultural systems and

environmental justice is discussed in Sections 4.4.2.13.3. and 4.4.2.15.3, respectively of the Draft Arctic Multiple-Sale EIS.

4.2.11.2. Mitigation Measures

Some existing projects and programs require mitigation designed to avoid or minimize adverse impacts to marine mammals and subsistence resources and harvests. Specifically, key provisions of required IHA and LOA documents specify that no unmitigable adverse impacts may occur to subsistence harvests. To the extent that impacts on subsistence resources and harvest activities are mitigated, impacts on sociocultural systems and environmental justice will be mitigated, as well.

4.2.11.3. Effects of Alternative 1: No Action

Direct and Indirect Effects. There would be no direct or indirect effects to subsistence activities if the proposed action does not occur.

Cumulative Effects. The cumulative effects of Alternative 1: No Action would be those effects summarized in Section 4.4.1.14.3 of the Draft Arctic Multiple-Sale EIS that are associated with past, present, and foreseeable future activities occurring in the project area during the period of open water 2010. The factor most likely to impact sociocultural systems and environmental justice would be adverse impacts on subsistence resources and practices resulting from an accidental discharge of refined oil by normal vessel traffic in the area which could disrupt the subsistence hunt or taint resources. The impact of an accidental spill of the sized described in Section 4.1.2 would be localized, and weathering of the oil would make its impact temporary, a negligible to minor impact on subsistence resources and harvests, having consequent negligible to minor impacts on sociocultural systems and environmental justice.

4.2.12. Archaeological Resources

Summary. In the following analysis, BOEMRE concluded that there would be no direct or indirect effects to archaeological resources from the Alternative 1: No Action. There would be a negligible level of effect associate with past, present and reasonably foreseeable future activity occurring on the Alaska North Slope and adjacent marine waters--the same as those described in the Draft Arctic Multiple-Sale EIS.

This section describes the impact to archaeological resources resulting from the direct and indirect effects of the No Action Alternative and adding it to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Past and present actions are described in Section 3.12.

4.2.12.1. Potential Effects

Past, present and reasonably foreseeable future effects from activities within the proposed study area during the period of the proposed action are limited to refined petroleum spills, anchor deployment, benthic sampling, and net trawls conducted by research vessels associated with other OCS projects and ongoing industry activities. These activities create a potential for adverse environmental effects although they would be considered minor. A detailed explanation of the impact factors that could potentially affect archaeological resources is discussed in Section 4.4.2.14. of the Draft Arctic Multiple-Sale EIS.

4.2.12.2. Mitigation Measures

Some existing projects and programs require mitigation designed to avoid or minimize adverse impacts to archaeological resources. For example, key provisions of NTL 05-A03, Archaeological Survey and Evaluation for Exploration and Development Activities, require a determination of effect on historic properties by BOEMRE and consultation with the Alaska SHPO under provisions of the National Historic Preservation Act for past, present and reasonably foreseeable future activity that may occur on a BOEMRE lease.

4.2.12.3. Effects of Alternative 1: No Action

Direct and Indirect Effects. There would be no direct or indirect effects to archaeological resources for Alternative 1: No Action.

Cumulative Effects. The cumulative effects of Alternative 1: No Action would be those effects summarized in Section 4.4.2.14.3 of the Draft Arctic Multiple-Sale EIS that are associated with past, present, and foreseeable future activities occurring in the project area during the period of open water 2010. Cumulatively, proposed oil and gas projects in the region likely would disturb the seafloor, but remote sensing surveys made before approval of any Federal or State lease actions should keep these effects to a negligible level. Federal laws would preclude effects to most archaeological resources from these planned activities.

4.3. Alternative 2: The Proposed Action

Under Alternative 2, the activities proposed by Shell's ancillary activity notice would take place as described in Section 2.2. The impact producing factors (IPF) evaluated in this section are associated with the Proposed Action and the anticipated levels of effects (Table 5) associated with each IPF are the incremental contribution, by specific resource, associated with the Proposed Action. The cumulative effects represent the effects of the No Action Alternative combined with the effects of the Proposed Action.

4.3.1. Water Quality

The following ancillary activities, proposed for July through October, 2010, could affect water quality in the vicinity of the project: seafloor coring, seafloor grab-sampling, buoy deployment and attachment to seafloor, and vessel activities, including vessel re-fueling at sea and AUV and ROV deployment.

The potential direct and indirect effects on water quality from the activities associated with Alternative 2: The Proposed Action include:

- Temporary water quality degradation at localized marine and estuarine seafloor sampling sites and anchoring sites from suspended sediment causing increased turbidity
- Temporary water quality degradation due to a vessel transfer fuel spill as described in Section 4.1.2 (13 bbl spill estimated to disperse and evaporate within 48 hours)
- Temporary water quality degradation at localized sites due to contaminants from vessel discharge and deck runoff
- Temporary degradation of underwater aquatic environment from vessel noise (including AUV and ROV), dispersed over space and time (4-months)
- Temporary risk of introducing invasive species through deployment of acoustic equipment, anchors and ROV / AUVs brought in from other seas (see Section 3.1.2).

4.3.1.1. Mitigation Measures

Mitigation measures affecting water quality include the requirement to obtain applicable permits under the Clean Water Act and inspection for invasive species. These measures would mitigate some of the potential effects of the proposed activities on water quality and the aquatic environment.

4.3.1.2. Cumulative Effects

The proposed ancillary activities could cause temporary, negligible effects to the water quality and the aquatic environment from July through October, 2010. The effects would be localized (individual seafloor core samples).

Overall, the cumulative effects of the proposed activities would be minor in a regional context; there would also be cumulative localized and temporary adverse effects to water quality.

4.3.2. Marine Mammals – Cetaceans and Pinnipeds

Summary. The following analysis addresses the effects of the proposed open water marine survey program in the Beaufort Sea from July 2010 through October 2010. Cetaceans and pinnipeds have been combined for this analysis due to the similarities in effects. A separate analysis is provided for polar bears and polar bear critical habitat. BOEMRE concluded that the proposed action would result in a negligible level of direct, indirect and cumulative effects to marine mammals from the proposed site clearance and shallow hazard seismic airgun noise; vessel and aircraft noise; vessel and aircraft traffic and disturbance; and hypothetical fuel transfer spills.

This section discuses the impact to marine mammals resulting from the direct and direct effects of the proposed action and describes the cumulative effects to the past, present and foreseeable future actions by all other parties. Past and present actions affecting marine mammals are discussed in Section 3.2 of this EA and the description of the potential effects of the no action alternative on marine mammals is found in Section 4.2.2.

4.3.2.1. Mitigation Measures

Seismic vessels will conduct sound verification testing and data analysis to establish exclusion zones for 160 dB (baleen whale concentration and Level B Harassment), 180 dB (whales) and 190 dB (pinnipeds) re 1 μ radii for Marine Mammal Observer monitoring and subsequent initiation of mitigation measures for power downs and shutdowns. The proposed action is subject to the stipulations or other mitigation measures identified in the Beaufort EIS, the Lease Sale 195 EA (MMS, 2004), conditions required by a current NMFS IHA for substantially similar activities in the Chukchi Sea (NMFS, 2009) and the FWS LOA (FWS, 2010a). An IHA for the proposed action was applied for but had not been issued at the time of this analysis.

4.3.2.2. Effects of the Proposed Action

The following analyses considers the factors and definitions of terms for levels of effect as described in Appendix A-2.2.

4.3.2.2.1. Direct and Indirect Effects

The proposed actions include seismic airgun noise, vessel and aircraft operations, vessel traffic with potential for marine mammal strikes, and the potential for an offshore small fuel transfer spill.

Seismic Airgun Noise. Marine mammals could experience airgun noise from the 40 in^3 airgun proposed for the site clearance and shallow hazard surveys on Harrison Bay leases. The relatively

small safety radii for the 180 and 190dB re 1 µPa rms for the 40 in² airgun was estimated by modeling at 125 and 35 meters respectively. This calculates to very small areas exposed to sound at the 190 and 180 dB levels of .38 hectares (0.95 acres or 0.0014 mi²) and 4.9 hectares (12.1 acres or 0.018 mi²) respectively. The 160 dB zone where behavior response could occur, has an approximate ensonified radii of 1525 m (5000 ft), a maximum area of 730 hectares (1805 acres or 2.8 mi^2). These zones around the active airgun operation are miniscule compared to the tens of thousands of square miles in the Beaufort Sea or the exclusions zones associated with large 3 - 4,000 in³ airgun used for deep penetration geologic and geophysical seismic surveys analyzed in the Seismic PEA. Marine mammal observers on board the seismic vessels will be actively monitoring these zones for marine mammal presence and ordering the appropriate power down, start up and shut down mitigation action to prevent potential temporary or permanent hearing damage to marine mammals at the 190 and 180 db levels and minimize displacement of bowhead whales from feeding sites. The low densities of marine mammals at the activity areas, timing of surveys to minimize period when bowhead whales are migrating and the small footprint of the seismic operation result in negligible effects to marine mammals.

Vessel and Aircraft Noise. Four different vessels are proposed to conduct the marine survey program and transit to and from offshore survey sites during the open water season. Each vessel will have on board MMOs. Each survey vessel will be subject to sound verification testing and establishment of radii for exclusion zones for monitoring and mitigation for bowhead whales hearing protection at 180 db, pinnipeds at 190 db and to minimize disturbance and displacement of large numbers of whales from feeding and resting areas out to 160 dB. Very few individual marine mammals are expected to be encountered within the exclusion zones which again are anticipated to be very small compared to the airgun noise radii analyzed in the Seismic PEA. Negligible effects are anticipated due to low marine mammal densities.

Vessel and Aircraft Traffic. Proposed vessel and aircraft traffic would cause an avoidance response by marine mammals. Such responses would be temporary and non-lethal during the period of the proposed action and within the action area. Mitigation includes slowing marine vessel speed when within 300 m (1000 ft) of marine mammals and taking avoidance actions to avoid marine mammals or to prevent the division of groups of marine mammals. Aircraft will maintain a minimum altitude of 1000 ft (300 m) except when taking off and landing.

The speeds of marine vessels engaged in survey activities are normally less than 10 knots. Mortality and serious injury of marine mammals generally occurs at or above this speed. Few encounters are anticipated and effects on marine mammals (cetaceans and pinnipeds) are anticipated to be negligible.

Small Diesel Fuel Spills. A small diesel fuel transfer spill at sea could occur under the proposed action (Section 4.1.2). A spill of 535 gallons (13 bbl) would be subject to booming requirements and the volume dissipates rapidly and would not cover an area large enough to cause prolonged inhalation of aromatic hydrocarbons. An opportunity for other than temporary contact or ingestion via contaminated food items is not likely. Negligible effects from a small at-sea diesel fuel transfer spill would be expected.

4.3.2.2.2. Cumulative Effects

Summary. Previous analyses indicate that vessel and seismic noise sources potentially could result in adverse but not significant impacts to marine mammals. With appropriate mitigation measures in place and any other measures imposed under MMPA authorizations granted to ensure "negligible impacts" on marine mammals. A review of information that has been published since the documents noted above, indicates that these conclusions remain unchanged. Biological Opinions issued by NMFS (2006; 2008) regarding endangered bowhead, fin and humpback whales in relation to oil and

gas Leasing and Exploration Activities in the U. S. Beaufort and Chukchi Seas, Alaska: and authorization of Small Takes Under the marine mammal Protection Act conclude:

> "After reviewing the current status of the endangered bowhead whale, the environmental baseline for the action area, the proposed action, and the cumulative effects, it is NMFS's biological opinion that individual bowhead whales within the action area may be adversely affected , but that the proposed action is not likely to jeopardize the continued existence of Western Arctic Bowhead whales. No critical habitat has been designated for this species, therefore, none will be affected."

The NMFS Supplemental EAs (NMFS, 2008; NMFS, 2007) and EA (NMFS, 2009) regarding the issuance of IHAs notes the following:

> "Additional measures may be required by NMFS pursuant to its authority under the MMPA to ensure that the proposed activities will result in the least practicable adverse impact on marine mammal species or stocks in the Beaufort and Chukchi Seas. These mitigation and monitoring measures could appear as stipulations in any seismic survey authorizations granted by NMFS. These mitigation and monitoring requirements contained in the MMPA IHAs will ensure that takings are of small numbers, potential impacts to marine mammals will be negligible, and there will be no immitigable adverse impacts to subsistence uses. All mitigation and monitoring measures, especially those related to avoiding impacts to subsistence hunting under the MMPA authorizations will be followed."

NMFS issued an IHA for substantially similar activities as the proposed action in 2009 including 40 in^3 airguns for seismic operations in the Chukchi Sea. The terms and conditions complied with the monitoring and mitigation measures identified in the previously noted Supplemental EA (NMFS 2008).

BOEMRE concurs with these findings as applied to the proposed Shell 2010 marine survey activities relative to marine mammals. Cumulative effects would not add substantially to the baseline effects of past, existing and reasonably foreseeable activities in the Beaufort Sea on or adjacent to the proposed action area and are considered negligible to marine mammals.

Seismic Airgun Noise. Marine mammals in the proposed activity area could be exposed to airgun noise and disturbance from the sound energy produced by the proposed action as well as from other seismic sources which may be present.

The Plans of Cooperation with subsistence whalers, Communication Plan and communication between the various survey parties would minimize the temporal and spatial overlap, protect the majority of the bowhead migration period and subsistence hunts. The level of airgun operation has been analyzed in previous BOEMRE and NMFS NEPA and ESA consultations and does not exceed the levels analyzed in those situations which concluded there would be negligible impacts to marine mammals in the Beaufort Sea. Marine mammals avoidance behavior, MMO monitoring and mitigation functions, and the very small contribution to the marine noise environment in the proposed action area minimize the cumulative additive effects of the proposed airgun operations. The cumulative effect of the proposed action would be negligible.

Vessel and Aircraft Noise. The proposed operation of one sound source vessel in the Harrison Bay leases and of three vessels in the Camden Bay activity area do not constitute a substantial increase in vessel associated noise and traffic in these areas. Further these vessels have very small noise related footprints and are operating in areas where low marine mammal densities and temporary avoidance behaviors would indicate few adverse encounters with noise produced by these vessels. Aircraft noise related effects are similar to those noted below in Cumulative Effect of Vessel and Aircraft Traffic

and Disturbance. The additive contribution of the traffic and operations of the proposed four vessels and the aircraft operations to the baseline noise and disturbance from past, existing and reasonably foreseeable future activity would be negligible.

Vessel and Aircraft Traffic. The proposed action would involve four vessels conducting various activities in the Beaufort Sea. As stated in Shell's Ancillary Activity Notice, these vessels would operate under an IHA which require mitigation measures to avoid or minimize adverse effects to marine mammals. While limited Level B (non-lethal) take is authorized, this take was determined to have a negligible effect on individual marine mammals and is not likely to result in immitigable adverse effects on the subsistence harvest of marine mammals. Operation of these four vessels under the IHA is anticipated to result in a negligible level of effect on marine mammals.

Collisions with marine vessels and marine mammals could occur, causing serious injury or mortality although existing data do not indicate that marine mammal strikes are an important source of mortality in the Beaufort Sea. While vessel traffic in the Beaufort Sea is projected to increase over the next 20 years, there is no expectation that a substantial increase in vessel traffic would occur as result of the four vessels associated with Alternative 2: The Proposed Action would occur during the July 1 to October, 2010 period of analysis. The vessels operating in the Beaufort Sea during the proposed operations period would not exceed levels of vessel traffic that have been analyzed in the past which resulted in a conclusion of negligible effects to marine mammals (MMS, 2006a). In general marine mammals avoid vessels and experience temporary and non-lethal effects including changes in swim speed, direction, and route of travel. The low rate of encounters, generally low speeds of travel of many of the vessels operating in the Beaufort Sea (barges, research vessels, tugs, etc.), and MMOs stationed on many minimize the additive effects of the proposed action's to the baseline. BOEMRE concludes the cumulative effects of vessel traffic would be negligible.

Small Diesel Fuel Spills. The cumulative effects of one small refined product spill on a gravel island (Section 4.1.2) would be added to the potential for a small volume (535 gallon, 13 bbl) diesel fuel transfer spill occurring as a result of Alternative 2: The Proposed Action. Any potential fuel transfer spill would occur in the immediate vicinity of vessels in the open ocean and would be subject to booming, relatively rapid weathering and evaporation rates, and on site cleanup. The incremental contribution for Alternative 2: The Proposed Action to the cumulative effect is minimal. The general avoidance response of marine mammals to vessels, the presence of MMOs on board the survey vessels and use of mitigation measures further minimize the effects of a small spill. BOEMRE anticipates the additive effects of a small diesel fuel spill on marine mammals (cetaceans and pinnibeds) to be negligible.

Conclusion. The net effect of the activities listed above, and their potential effect on cetaceans and pinnipeds, from Alternative 2: The Proposed Action, is negligible.

4.3.3. Marine Mammals - Polar Bears

Summary. Implementing Alternative 2 would not change the current status of the polar bear in the Beaufort Sea. Mitigation measures will avoid or minimize adverse effects to polar bears from vessel, aircraft, and potential spills in the project area.

4.3.3.1. Mitigation Measures

Shell received a Letter of Authorization (LOA) from the FWS to conduct its proposed activities (FWS, 2010a). Mitigation measures incorporated into the LOA to protect polar bears require Shell and its agents to:

- Avoid polar bears on land or ice. Operators of support vessels should, at all times, conduct their activities at the maximum distance possible from known or observed concentrations

of animals. Under no circumstances, other than an emergency, should vessels operate within 800 meters (1/2 mile) of polar bears observed on land or ice.

- Take every precaution to avoid harassment of polar bears in water when a vessel is operated near these animals. Maintain an 800 meter (1/2 mile) distance, when practicable. Vessels must reduce speed when polar bears are observed in water and vessels capable of steering around these animals must do so. Vessels may not be operated in such a way as to separate members of a group of polar bears from other members of the group. Vessels should avoid multiple changes in direction and speed when polar bears are present.
- Avoid restriction of polar bear movements, by any means, in sea or on land. Separation distances must be maintained until animals have left the area.
- Operate in full compliance with the terms identified in:

(a) *Marine Mammal Monitoring and Mitigation Plan for Proposed Open Water Marine Survey Program in the Beaufort and Chukchi Seas, Alaska, During 2010* (Appendix A, Application for Incidental Harassment Authorization for the Non-Lethal Taking of Whales and Seals in Conjunction with a Proposed Open Water Marine Survey Program in the Beaufort and Chukchi Seas, Alaska, During 2010; May 2009, page 12) states:

> "For marine mammal monitoring flights, aircraft will be flown at ~120 knots ground speed and usually at an altitude of 1000 ft."

This condition appears to apply to fixed-wing aircraft conducting marine mammal surveys starting in late August.

(b) *Polar Bear Interaction Plan* (Polar Bear and Pacific Walrus Awareness and Interaction Plan, North Slope and Chukchi Sea, Alaska, April 2008).

4.3.3.2. Effects of the Proposed Action

The following effects analysis considered other important factors and used a level of effect terms as described in Appendix A-22.

Direct and Indirect Effects

The proposed action includes vessel and aircraft operations and seismic airgun noise. As with the operation of any vessel, there is some potential for a maritime accident and any one of the project vessels could experience an accidental spill. An explanation of the potential for vessel and aircraft traffic, seismic airgun noise, and spills to affect polar bears is described in the Section 7 consultation documents (MMS 2009a, FWS 2009). The timing and specific location of the proposed activities influence how polar bears could be affected.

Seismic Airgun Noise. Polar bears generally swim with their heads above water. They dive below the surface when hunting. Polar bears are not be likely to have their heads underwater near an active airgun and no adverse effects from seismic airgun noise to polar bears are anticipated.

Vessel and Aircraft Traffic. Polar bears are known to run when hearing noise or seeing an aircraft. Their response to vessels are more variable and range from approach, to ignore, or avoid. The effects of fleeing from aircraft may be minimal if the event is short and the animal is otherwise unstressed. However, on a warm day, even a short run may cause stress for a well insulated polar bear.

During the open-water season, most polar bears remain offshore on the pack ice and are not typically present in the area of vessel traffic. If there is any encounter between a vessel and a bear, it would most likely result in short-term behavioral disturbance only.

Air traffic associated with the proposed action could disturb polar bears. Behavioral reactions of non-denning polar bears would be limited to short-term changes in behavior and would have no long-term impact on individuals and no impacts on the polar bear population (FWS, 2010, page 36). Mitigation measures, such as maintaining a minimum flight distance and elevation over polar bears or areas of concern, could reduce the likelihood that bears are disturbed by aircraft.

Hydrocarbon Spills. Section 4.1.2 describes the oil spill scenario for the proposed action. The persistence of diesel fuel would be short term and temporary near the location of the vessel. Because few, if any, polar bears are expected to be in the immediate vicinity of the vessel, few could be affected by a spill, depending on current and wind patterns. Using this hypothetical spill, there is a limited, but conceivable, potential for spilled materials to contact a swimming polar bear. In this case a minor level of effect would be anticipated, but it is most likely that spill prevention, booming requirements, the small volume of a single spill and response measures would minimize adverse effects to polar bears.

The LOA also serves as an "Incidental Take Statement" (ITS), required under section 7 of the Endangered Species Act of 1973 (ESA) (see FWS 2008: Programmatic Biological Opinion for the Chukchi Sea Incidental Take Regulations for Polar Bear). Issuance of the LOA ITS for Shell's proposed action fulfills BOEMRE consultation requirement for the polar bear (FWS 2008).

Cumulative Effects

The abundance, distribution and ESA-status of the polar bear are not anticipated to change during the July through October 2010 time-period covered by the proposed action. Polar bears would continue to be hunted and could experience changing sea-ice conditions. Human-bear encounters in communities or during oil and gas industry activities would still be managed under specific plans (including Shell's Polar Bear and Pacific Walrus Awareness and Interaction Plan, North Slope and Chukchi Sea provisions incorporated by reference for the proposed action), that minimize encounters and avoid lethal takes of polar bears. The proposed action takes place during the open water season when few, if any, individual bears are likely to be encountered. The proposed action is not anticipated to contribute substantially to additive effects of past, existing, or reasonably foreseeable activities or environmental conditions to polar bears and therefore we conclude that negligible cumulative effects to polar bears would occur.

4.3.4. Polar Bear Critical Habitat

Summary. The proposed action would not destroy or adversely modify critical habitat because it would not alter the Primary Constituent Elements (PCEs) to an extent that appreciably reduces the conservation value of critical habitat for polar bear populations in the United States.

4.3.4.1. Mitigation Measures

The same mitigation measures described in Section 4.3.3.1 would avoid or minimize adverse effects to proposed polar bear critical habitat.

4.3.4.2. Effects of the Proposed Action

The following effects analysis considered the same factors and level of effect terms as described in Section 4.3.3.2.

Direct and Indirect Effects. The LOA does not cover consultation requirements for proposed critical habitat for the polar bear (74 *FR* 56058). The BOEMRE must determine whether the proposed action could result in the destruction or adverse modification of proposed critical habitat. The key factor related to applying the adverse modification standard is whether the proposed action would affect the

ability of the affected critical habitat to continue to serve its intended conservation role for the species, or would retain its current ability for the PCEs to be functionally established. Activities that may destroy or adversely modify critical habitat are those that alter the PCEs to an extent that appreciably reduces the conservation value of critical habitat for polar bear populations in the United States.

These activities include actions that would render critical habitat areas unsuitable for use by polar bears, including human disturbance that could displace polar bears from, or adversely modify, habitat free from disturbance (such as barrier islands). Female polar bears and their cubs emerge from dens in March or April and must be free from disturbance during critical feeding periods following den emergence.

Any denning polar bears will have left their dens by the time the proposed activities are conducted, therefore no effects to denning polar bears are anticipated.

The BOEMRE considered the duration and areal extent of aircraft activity associated with Alternative 2: The Proposed Action. Mitigation measures incorporated into the related plans and authorizations would reduce adverse effects to a minimal level of temporary, short-term disturbances and a few polar bears in the barrier island habitats could be affected. These short-term effects would be to individual bears which would have no reason to avoid the area after the surveys are completed. The effects would not modify the habitats because they would not persist from one season to the next. The BOEMRE concludes that the measures and related conditions of the LOA would protect the PCEs for which the critical habitats were proposed and the proposed actions are not likely to result in adverse modification of proposed polar bear critical habitats. Further consultation with the FWS for this project is not required.

Cumulative Effects. The existing condition of the proposed polar bear critical habitat would remain unchanged because the proposed action would not affect the ability of the proposed critical habitat to continue to serve its intended conservation role for the species. Negligible cumulative effects would be anticipated.

4.3.5. Marine and Coastal Birds

Summary. In the following analysis, BOEMRE concluded that there would be few direct or indirect effects to marine and coastal birds from the proposed action. However, there would be a negligible cumulative level of effect from seismic surveys and potential minor effect from a hypothetical accidental petroleum spill; and a continued minor cumulative level of effect from vessel presence and noise, aircraft presence and noise, and collisions with structures.

This section describes the impact to marine and coastal birds resulting from the direct and indirect effects of the Alternative 2: The Proposed Action. The cumulative effects are those effects connected with the proposed action combined with the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Past and present actions that affect marine and coastal birds are described in Section 3.5

4.3.5.1. Mitigation Measures

Seismic vessels will reduce their use of high-intensity lighting during periods of darkness and inclement weather (i.e., rain, fog) to minimize the potential for birds to become disoriented and strike these vessels.

4.3.5.2. Effects of the Proposed Action

The following effects analysis considered other important factors and definitions for level of effect terms as described in Appendix A-2.3.

Direct and Indirect Effects.

The proposed action includes vessel and aircraft operations, seismic airgun noise, and the potential for birds to strike a vessel. As with the operation of any vessel, there is some potential for a maritime accident and any one of the vessels could experience a small accidental spill.

Vessel Disturbance. Shell anticipates using four different vessels to complete its work. These vessels will transit between survey and sampling sites throughout the open-water season. Most of the vessel activity would occur in offshore areas where bird densities are typically lowest. Many birds early in the season are moving to nesting areas. Other non-breeders are taking advantage of seasonal productivity in the Arctic. Birds on the sea surface typically fly or paddle away from a moving vessel, each according to its individual tolerance level.

During the post-breeding season, some birds are molting in coastal lagoons or in other protected waters. These birds could periodically be disturbed by occasional vessel transit, but these transits are not expected to affect birds in concentration areas, such as molting long-tailed ducks behind barrier islands, on a repeated basis. Other birds migrate west to molting or wintering areas outside the Beaufort Sea. Any vessel disturbances would be short-term, localized and would have a minimal effect on a relatively small proportion of any population in the project area. No effects to ESA-listed birds are anticipated because of their low density and extremely limited distribution in the project area.

Aircraft Disturbance. Shell's Communication Plan, 2010 Marine Surveys Beaufort Sea, Alaska (Attachment B, Application for Incidental Harassment Authorization for the Non-Lethal Taking of Whales and Seals in Conjunction with a Proposed Open Water Marine Survey Program in the Beaufort and Chukchi Seas, Alaska, During 2010; May 2009) states:

> "… flight restrictions will be in place to prohibit aircraft from flying within 1,000 ft (300 m) of marine mammals or below 1,500 ft (457 m) altitude, (except during takeoffs and landings, or in emergency situations), while over land or sea. If flights need to deviate from this path due to emergency landings or other unavoidable reasons, the new flight information will be immediately shared, as outlined by Shell HSSE requirements, with Com Centers so area subsistence users can be notified."

These mitigation measures will minimize adverse effects to marine and coastal birds using pelagic, nearshore, or other coastal habitats during the open-water season and a negligible level of effect to marine and coastal birds is anticipated from aircraft operations. No effects to ESA-listed birds are anticipated because of their low density and extremely limited distribution in the project area.

Seismic Airgun Noise. Marine and coastal birds could be affected by airgun noise, but only if they were in very close proximity to an active seismic array. As most birds move away from vessels, few are expected to dive under the seismic survey operation in a manner where they could be injured. The BOEMRE is unaware of any incidents of a bird being injured by a seismic airgun and there is a long history of seismic surveys in the Arctic and around the world. The noise from a single 40 in^3 airgun or seismic array is expected to result in negligible effects on coastal and marine birds. No effects to ESA-listed birds are anticipated because of their low density and extremely limited distribution in the project area.

Bird Collisions. Migrating birds, particularly seaducks that fly low and fast over the ocean surface during their westward migration, can strike vessels. The further vessels operate from shore, the

further east the vessels operate, and the later in the open-water season all the lower the potential for migrating birds to strike vessels associated with the proposed action. Vessels will minimize activities that require high-intensity lighting that could disorient birds, especially during periods of darkness or inclement weather. Vessels are required to document and report any bird strikes. These measures will avoid or minimize adverse effects to marine and coastal birds using pelagic, nearshore, or other coastal habitats during the open-water season and a minor level of effect is anticipated from bird collisions. A minor level of effect is expected because, while collisions are an infrequent occurrence, a low number of bird strike fatalities could occur to a variety of waterfowl despite the best of efforts to minimize the hazard. No effects to ESA-listed birds are anticipated because of their low density and extremely limited distribution in the project area.

Small Refined Fuel Spills. Section 4.1.2 describes the oil spill scenario for the proposed action. A small number of birds in the immediate vicinity of the vessel could be affected, depending on current and wind patterns. As there is some potential for a limited amount of individual bird mortality from this hypothetical spill (all birds contacted are assumed to die), a minor level of effect would be anticipated, but it is most likely that spill prevention and response measures would minimize adverse effects to marine and coastal bird populations.

Cumulative Effects

There would be a negligible cumulative level of effect from seismic surveys and potential minor effect from a hypothetical accidental petroleum spill; and a continued minor cumulative level of effect from vessel presence and noise, aircraft presence and noise, and collisions with structures.

4.3.6. Fish

The proposed activities are projected for a near-future time frame of July through October, 2010. Some of the individual activities, such as seafloor core sampling would have direct, localized effects on fish, their habitat and prey. The acoustic profiling activities would have direct and more dispersed effects in the project area (Table 4). There is a temporary risk of introducing invasive species through deployment of acoustic equipment, anchors and ROV / AUVs brought in from other seas (see Section 3.1.2). Each individual activity would have negligible effects on fish, their prey and habitat in the project area. Across the project area and across the 4-month activity period, however, the combined effects of the activities would have a minor level of effect.

Table 4 Anticipated direct and indirect effects from proposed ancillary activities on fish in the Beaufort Sea marine environment, July-October, 2010.

Type of Activity	Potential Effects	Time to Recover From Potential Effects[1]			
		Temporary	Short-term	Long-term	Permanent
Seafloor coring Seafloor grab-sampling Buoy deployment and attachment to seafloor	Benthic habitat alteration at sampling sites; direct and localized;	X			
	Epifauna and infauna disturbance and loss; direct and localized	X			
	Sediment suspension, decreased visibility in immediate vicinity of seafloor sampling, direct and localized	X			

Type of Activity	Potential Effects	Time to Recover From Potential Effects[1]			
		Temporary	Short-term	Long-term	Permanent
Side scan sonar Single beam echo sounder Multibeam echo sounder Deep penetration profiler (airgun)Medium penetration profiler (airgun) Sub-bottom profiler Single beam bathymetric sonar Vessel noise	Esonification effects from acoustic instruments on the physical and physiological characteristics of fish and their prey; effects vary dependent on species and their life history strategies (pelagic, sedentary, planktonic, etc.); direct, effects dispersed over area from various sources	X			
	Airgun effects (short pulse, high pressure) on the physical and physiological characteristics of fish and their prey; direct, dispersed effects	X			
	Noise disturbance to adults and juveniles; temporary cessation of behavior, startle response, movement away, or avoidance swim responses; noise disturbance to planktonic, sedentary and attached prey species that are not free-swimming; direct, dispersed effects from noise sources	X			
Vessel re-fueling at sea; accidental release estimated up to 13 bbl of fuel Vessel discharge and deck runoff	Runoff or discharged contaminants into water; fish and prey swimming and feeding in waters; planktonic, sedentary and attached prey exposed to contaminants; fish and prey exposed to oil; direct, and localized or dispersed	X			
Vessel passage, anchoring, deployment of equipment to sea ROV and AUV activity	Potential for introduction of aquatic invasive species from hulls or equipment deployed to sea; indirect	X			

Note: [1]Time to recover from potential effects: temporary-days to weeks; short-term-less than 3 years; long-term-from 3-20 years; permanent-longer than 20 years.

4.3.6.1. Mitigation

Some of the mitigation measures listed in Section 2.2.6, such as the stipulation "Protection of Biological Resources" and spacing of seismic surveys and airgun ramp-up, would mitigate some of the effects of the proposed activities on fish.

4.3.6.2. Cumulative Effects

There are several factors that are currently influencing the Arctic environment (see Section 3), such as cargo barges, cruise ships, research vessels and ongoing oil and gas industrial activities. These activities could cause vessel fuel spills, petroleum spills and nonpoint runoff to the sea.

In light of the baseline of these activities, the proposed ancillary activities over a 4-month period described in this document would contribute a minor effect to the current overall cumulative effects on fish and their habitat. The effect of Alternative 2: The Proposed Action, when combined with

past, present and reasonably foreseeable future activities, would be minor for fish and fish habitat dispersed through the region.

4.3.7. Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act requires an analysis of the potential adverse effects on managed species (in this case, Arctic cod and Pacific salmon) and their designated Essential Fish Habitat, which includes both waters and substrate.

The following ancillary activities are proposed (July–October, 2010) in the Beaufort Sea marine and estuarine environments: seafloor coring, seafloor grab-sampling, side scan sonar, single beam echo sounder, multibeam echo sounder, deep penetration profiler (airgun), medium penetration profiler (airgun), sub-bottom profiler, single beam bathymetric sonar, AUV and ROV deployment, buoy deployment and attachment to seafloor, vessel activities, including vessel re-fueling at sea (Table 4).

The potential direct and indirect effects from these proposed activities on Arctic cod (juvenile and adult) and Pacific salmon (adult and juvenile), their habitat and their prey include:

- Temporary exposure of Arctic cod and Pacific salmon marine and estuarine EFH and their prey to acoustic profiling instruments (including air-guns) causing temporary disturbance and displacement, cessation of normal behaviors, startle responses, avoidance swim responses, and associated physiologic effects to juvenile and adult Arctic cod and Pacific salmon
- Temporary water quality degradation at localized marine and estuarine seafloor sampling sites from suspended sediment, causing decreased visibility for prey-finding and navigation for EFH species
- Temporary exposure of Arctic cod and Pacific salmon marine and estuarine habitat and prey to a vessel transfer fuel spill at sea (13 bbl spill estimated to disperse and evaporate with in 48 hours)
- Temporary exposure of Arctic cod and Pacific salmon habitat and prey to contaminants from vessel discharge and surface runoff in the marine and estuarine environments
- Vessel noise (including AUV and ROV) causing disturbance or displacement of juvenile and adult Arctic cod and Pacific salmon in the marine and estuarine environments
- Temporary risk of introducing invasive species through deployment of acoustic equipment, anchors and ROV / AUVs brought in from other seas (see Section 3.1.2.

The proposed activities could cause temporary effects from July-October, 2010 to juvenile and adult Arctic cod and late juvenile and adult life history stages of Pacific salmon in their marine and estuarine EFH. Depending on the activity, the effects would be localized (individual seafloor core samples) or dispersed (acoustic and air gun signals over a series of track lines).

The following were considered in reaching a determination on the effects of the proposed actions on Arctic cod and Pacific salmon EFH:

- Arctic cod has a wide range and is abundant in the range in which they occur.
- Arctic cod adults and juveniles are pelagic-swimmers or demersal-swimmers (commonly schooling) that are capable of avoiding some activities
- Pacific salmon are at the northern edge of its range and is rare in the marine and estuarine area of the region where the project will occur

- The proposed activities will not occur in or near designated Pacific salmon freshwater spawning and rearing EFH

4.3.7.1. Mitigation

Mitigation measures are presented in Section 2.2.6. Some of these measures, such as requirements of the Clean Water Act, the lease stipulation "Protection of Biological Resources," airgun ramp-up and equipment inspection for invasive species would mitigate some of the effects of the proposed activities on fish habitat through avoidance of unique habitats, reduction of waste water discharged, and decrease in likelihood of introducing invasive species deleterious to fish.

4.3.7.2. Cumulative Effects

The proposed activities will affect individual Arctic cod, Pacific salmon, their prey and associated habitat in the area of proposed activities; the activities however, are not expected to affect these species at the population level or to affect the overall designated EFH of these species in the Arctic.

There are several factors that are currently influencing the Arctic environment (see Section 3.7), such as cargo barges, research vessels and ongoing oil and gas industrial activities. These activities could cause vessel fuel spills, petroleum spills and nonpoint runoff to the sea. Climate change is currently having an effect on the Arctic environment including warming sea surface, reduction in sea ice and increased acidity. These types of changes affect EFH in the Arctic. Overall, the cumulative effects of the proposed activities over a four month period, in combination with the existing activities, would be minor and dispersed in a regional and population context; there would, however, also be localized adverse cumulative effects to fish and fish habitat from the proposed action.

4.3.7.3. Determination

Based on this EFH analysis BOEMRE has determined that there would be temporary adverse effects to Arctic cod, Pacific salmon and their designated EFH.

4.3.8. Lower Trophic Organisms

Summary. In the following analysis, BOEMRE concluded that there would be negligible direct or indirect effects to lower trophic level organisms from Alternative 2: The Proposed Action. The cumulative effect of the proposed action, in combination with past, present and reasonably foreseeable future activities in the project area over the four month duration of the proposed action, would be minor.

4.3.8.1. Mitigation Measures

Some existing projects and programs require mitigation that avoids or minimizes adverse effects to the lower trophic organisms essential to the survival of marine mammals and marine and coastal birds. Many day-to-day operations on the Alaska North Slope and the adjacent OCS waters are unregulated, have no mitigation measures, and will continue to have adverse effects on lower trophic organisms (described in Section 4.4.1.3 pages 4-36 through 4-38 of the AMS). Mitigation measures in effect include the lease stipulation "Protection of Biological Resources." U.S.C.G. vessel inspections, including oil transfer procedures or procedures and equipment to manage fuel transfer spills outlined in the Vessel Response Plans, are in effect to mitigate vessel transfer fuel spills.

4.3.8.2. Effects of the Proposed Action

Direct and Indirect Effects

Refined Oil Spills. Refueling operations in the Beaufort Sea likely would occur at Prudhoe Bay's West Dock facility or, if necessary, at sea for the vessel *M/V Ocean Pioneer*. The BOEMRE considered 3 vessel transfer diesel fuel spill scenarios (see section 4.1.2). Fuel spills of this nature would likely result in short-term effects (1 day to 1 week) to local phytoplankton, zooplankton, and meroplankton populations. Thus, the combined effects of these potential spills would result in negligible and temporary effects on the described environments.

Benthos Disturbance. Anticipated effects to the benthic environment caused by the proposed action include: anchor deployment, benthic sampling and net trawls conducted by research vessels, benthic sampling, vibracore, and CPT tests conducted for biological, chemical and geological analysis of lease sites. These activities present a potential for adverse environmental effects. However, the fine sand, silt, and mud environment and low biomass of the benthic environment of the proposed study sites would result in negligible, localized and temporary effects.

Cumulative Effects

Cumulative effects of the proposed action consist of accidental small spills of refined oil by normal vessel traffic in the area potentially affecting phytoplankton (and associated zooplankton and meroplankton stocks) in the area, and would be localized with negligible and temporary effects on the described environments. Anchor deployment and biological or chemical sampling regimes by vessel traffic would result in negligible and temporary effects on the described environments

4.3.9. Employment

Summary. In the following analysis, we concluded that there would be few direct or indirect effects to employment from the Alternative 2: Proposed Action. There would be little net increase in employment and therefore a negligible impact. Cumulative impacts would be the same as those described in the Draft Arctic Multiple-Sale EIS.

This section describes the impact to employment resulting from the direct and indirect effects of the action and adding it to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Past, present and reasonably foreseeable future actions are described in Section 3.9.

4.3.9.1. Mitigation Measures

Provisions of the IHA and LOA are important factors influencing employment in that they require marine mammal observers on survey vessels and of SAs from local communities proximate to survey activities.

4.3.9.2. Effects of the Proposed Action

The following effects analysis considered other important factors and definitions of effect as described in Section 4.4.1.11 of the Draft Arctic Multiple-Sale EIS.

Direct and Indirect Affects. Direct and indirect effects would involve changes in local employment and income that could have consequent impact on community sociocultural systems. The levels of effects for impacts to sociocultural systems as described in the Appendix A-2.5.

Shell's proposed survey activity would offer employment to a small number of local NSB residents. The MMO program would employ local Inupiat residents to monitor and document marine mammals in the survey areas. The SA program would recruit a local resident from each village to communicate

local concerns and subsistence issues from residents to Shell. Shell's Communication Center program would involve hiring one or two individuals from each of the Beaufort Sea villages. Although the number of local residents employed for the proposed activities is expected to be small and the effect to be negligible at the community level, qualitatively the loss of employment due to delay or deferral of survey activities during the 2010 season would be significant to a particular individual at risk of losing his or her job. The proposed activities are short term and temporary, and are expected to have a negligible effect on the economies of Kaktovik, Nuiqsut, and Barrow.

Cumulative Effects. The cumulative effects of Alternative 2: Proposed Action would be those effects summarized in Section 4.4.1.11, Economy of the AMS that are associated with past, present, and foreseeable future activities occurring in the project area during the open water period of 2010. The factors most likely to impact employment and the local economy during this period would be a slight increase in NSB property taxes, local employment and personal income (MMS, 2008).

4.3.10. Subsistence Activities

Summary. In the following analysis, BOEMRE concluded that there would be few direct or indirect effects to subsistence resources and activities from the proposed action. However, there would be a negligible cumulative level of effect from seismic surveys, a potential minor effect from an accidental oil spill, and a continued minor cumulative effect from vessel and aircraft disturbance.

This section describes the impact to subsistence resources and activities resulting from the direct and indirect effects of the action and adding it to other past, present, and reasonably foreseeable future actions, regardless of what agency or entity undertakes the action. Past and present actions that affect subsistence resources and activities are described in Section 3.10.

4.3.10.1. Mitigation Measures

Shell incorporated extensive mitigation in their proposed activities to lessen or alleviate the impacts associated with its surveys on subsistence activities. These measures are summarized in Section 2.2.6 of this EA. Shell describes their proposed mitigation measures in their IHA application to NMFS (Shell, 2009a). Shell would implement the following measures to ensure coordination of its activities with local subsistence users and to minimize further risk of impacting marine mammals and interfering with the subsistence hunt:

- Shell has developed a Communication Plan and will implement it before initiating survey operations to coordinate activities with local subsistence users as well as Village Whaling Associations in order to minimize the risk of interfering with subsistence hunting activities, and keep current as to the timing and status of the bowhead whale migration, as well as the timing and status of other subsistence hunts. The Communication Plan includes procedures for coordination with Communication and Call Centers (Com Centers) to be located in the Beaufort Sea coastal villages of Kaktovik, Nuiqsut, and Barrow during Shell's proposed activities in 2010;
- Shell will employ local SAs from theses villages to provide consultation and guidance regarding the whale migration and subsistence hunt. A SA will be hired to work approximately 8-hours per day and 40-hour weeks through 2010. The SA will provide advice on ways to minimize and mitigate potential negative impacts to subsistence resources during survey activities. Responsibilities include reporting any subsistence concerns or conflicts; coordinating with subsistence users; reporting subsistence related comments, concerns, and information; and advising how to avoid subsistence conflicts. A SA handbook will be developed prior to the operational season to specify position work tasks in more detail;

- Shell will implement flight restrictions prohibiting aircraft from flying within 1,000 ft (300 m) of marine mammals or below 1,000 ft (300 m) altitude (except during takeoffs and landings, in emergency situations or for MMO overflights) while over land or sea.

4.3.10.2. Effects of the Proposed Action

The following effects analysis considered other important factors and definitions of effect as described in Section 4.4.1.12 of the AMS (USDOI, MMS, 2008).

Direct and Indirect Affects. The areas of subsistence use by the communities of Kaktovik, Nuiqsut and Barrow are discussed in Section 3.10.2. An important consideration in assessing potential effects on subsistence activities is that Shell activities involving airguns would occur in the summer from July through October. This is the time when the Iñupiat from Kaktovik, Nuiqsut, and Barrow go subsistence whaling, hunt terrestrial mammals, and fish, but the primary concern is bowhead whaling which occurs in all three communities during this time period.

Potential impacts from airgun use associated with Shell's planned site clearance and shallow hazards surveys in eastern Harrison Bay would have no or negligible effect on the availability of bowhead whales for the Kaktovik, Nuiqsut, and Barrow subsistence whaling harvests. Bowhead whales are expected to be in the Canadian Beaufort Sea during the time prior to subsistence whaling and, therefore, are not expected to be affected by the site clearance and shallow hazards surveys that occur before August. In addition, site clearance and shallow hazards surveys will be conducted from 50 - 100 mi (80 – 160 km) west of the furthest west boundary of Kaktovik's traditional bowhead whaling area. For Nuiqsut, surveys will occur 10 - 50 mi (16 – 80 km) west of Cross Island, Nuiqsut hunters traditional harvest base camp, and surveys will occur over 35 mi (56 km) east of the furthest east boundary. No to negligible impacts are expected on the Kaktovik and Barrow bowhead fall whale harvest due to the relatively small sound source (and the resulting ensonified area) from airguns used for the site clearance and shallow hazards surveys and the long distances of the survey areas from Kaktovik and Barrow bowhead whaling areas. Site clearance and shallow hazards surveys will occur 10 - 50 mi (16 – 80 km) "downstream" and west of Nuiqsut's Cross Island traditional bowhead whaling area mitigating to some extent the prospect of proximate impacts to Nuiqsut whaling.

Shell will follow an established communication plan and use communication and call centers located in coastal villages of the Beaufort Sea to communicate activities and routine vessel traffic with subsistence users in order to minimize the risk of interfering with subsistence hunting activities during the period when surveys are conducted. As a result of the distance and spatial location of site clearance and shallow hazards surveys from traditional bowhead whale subsistence harvests in Kaktovik and Barrow, and the location of the surveys downstream from the Nuiqsut harvest, as well as coordinating and implementing these specific surveys with Nuiqsut through a communication plan, effects on the subsistence hunts in Kaktovik, Nuiqsut, and Barrow are expected to be negligible.

Activities associated with Shell's planned ice gouge surveys in Camden Bay are expected to have no or negligible effect on the availability of bowhead whales for the Kaktovik, Nuiqsut, and Barrow subsistence whaling harvests. Mitigation of the impact from ice gouge surveys includes the possible use of either an AUV or other conventional survey methods that would not use airguns. In addition the survey locations would be 40 mi (64 km) east of Cross Island, and the timing and location of these surveys would be implemented only after coordination with these communities through communication plan protocols. Ice gouge surveys will be timed to avoid locations east of Mary Sachs Entrance in Camden Bay during Kaktovik's bowhead whale hunt. Survey locations through Mary Sachs Entrance and into Camden Bay are over 40 mi (64 km) east of Cross Island and their low-level sound sources would be expected to mitigate impacts to the Nuiqsut bowhead whale harvest. Timing of activities will be coordinated via the nearest Com Center operating in the Beaufort Sea, presumably in Kaktovik or Deadhorse. Timing and location mitigations and the fact that no airguns

will be used for the ice gouge surveys are expected to have negligible impacts on the bowhead whale subsistence hunt.

Beluga whales are not a prevailing subsistence resource in the communities of Kaktovik and Nuiqsut and, given the long distances of the site clearance, shallow hazards, and ice gouge surveys from Barrow's traditional beluga whale hunting areas, impacts on subsistence beluga whale hunts in the Beaufort Sea would be expected to be negligible.

Seals are an important subsistence resource and ringed seals make up the bulk of the seal harvest of Kaktovik, Nuiqsut, and Barrow. Seals can be hunted year-round, but are taken in highest numbers in the summer months in the Beaufort Sea (MMS, 2008). Barrow's primary hunting areas are more oriented toward the nearshore Chukchi Sea (Stephen R. Braund & Associates, 2009: Maps 29 and 30). Seal-hunting trips can take Nuiqsut hunters many miles offshore; however, the majority of seal hunting takes place commonly in nearshore areas. The mouth of the Colville River is considered a productive seal hunting area (Stephen R. Braund & Associates, 2009: Maps 133 and 134), as well as the edge of the sea ice. Lease blocks where site clearance and shallow hazards surveys will occur are located over 15 mi from the mouth of the Colville River, so there is less chance for impact on subsistence hunting for seals. Ice gouge surveys in Mary Sachs Entrance in Camden Bay will be conducted over 30 mi from the westernmost extent of seal hunting by Kaktovik hunters. The remainder of ice gouge lines will be much further offshore than where Kaktovik seal hunts typically occur which is inside the barrier islands (Stephen R. Braund & Associates, 2009: Maps 80 and 81). It is assumed that effects on subsistence seal harvests would be negligible given the distances between Shell's proposed site clearance and shallow hazards and ice gouge surveys and the subsistence seal hunting areas of Kaktovik, Nuiqsut, and Barrow.

All survey activities will be operated in accordance with the procedures of Shell's Marine Mammal Monitoring and Mitigation Plan (4MP), established under IHA and LOA monitoring requirements, and potential impacts should be mitigated by application of the procedures established in the 4MP and detailed in the any future Plan of Cooperation (POC). Shell has developed a POC pursuant to a BOEMRE stipulation, which requires that all exploration operations be conducted in a manner that prevents unreasonable conflicts between oil and gas activities and the subsistence activities and resources of residents of the North Slope. This stipulation also requires adherence to NMFS and FWS regulations, which require an operator to implement a POC to mitigate the potential for conflicts between the proposed activity and traditional subsistence activities. Shell's POC meets the requirements of the stipulation and commits to reasonable measures to avoid conflicts with subsistence uses in the subject area. Moreover, Shell has stated that the POC may be supplemented to reflect additional engagements with local subsistence users and any additional or revised mitigation measures that are adopted as a result of those engagements. The BOEMRE will direct Shell to include, in its training material and handouts, instructions for the SAs to call BOEMRE if there are issues that are not being resolved to the satisfaction of the SA. The BOEMRE will also notify the communities that BOEMRE can be contacted directly.

The POC, proposed mitigation, and coordination and communication with local coastal subsistence communities (as dictated by the Communication Plan) are expected to keep impacts on the subsistence hunts in Kaktovik, Nuiqsut, and Barrow at a negligible level.

Overall Conclusion on Effects to Subsistence Resources. With the mitigation incorporated by Shell, effects on subsistence undertaken by Kaktovik, Nuiqsut, and Barrow residents are expected to be negligible.

Mitigation measures include:

- Timing and locating survey activities to avoid interference with the annual fall bowhead whale hunts of Kaktovik, Nuiqsut (at Cross Island), and Barrow;

- Adherence to communication protocols and the use of SAs. The Com and Call Center protocols enable industry to inform residents daily of industry activities and planned movements. The SA provides residents of local communities a way to communicate where and when subsistence activities occur so that industry can avoid conflicts with planned subsistence activities;
- The use of marine mammal observers (MMOs) on-board vessels;
- Deploying booms during refueling to contain any small fuel spills.

Cumulative Effects. The cumulative effects of Alternative 2: Proposed Action would be those effects summarized in Section 4.4.1.12, (Subsistence) of the Draft Arctic Multiple-Sale EIS that are associated with past, present, and foreseeable future activities occurring in the project area during the period of open water. There would be a negligible cumulative effect from seismic surveys, a potential minor effect from an accidental oil spill, and a continued minor level of effect from vessel and aircraft disturbance on subsistence resources and practices (MMS, 2008).

4.3.11. Sociocultural Systems and Environmental Justice

Summary. Because we conclude that there would be negligible direct or indirect effects to subsistence resources and activities from the proposed action; we conclude that there would be few consequent direct and indirect effects on sociocultural systems and environmental justice.

This section describes the impact to subsistence resources and activities resulting from the direct and indirect effects of the action and adding it to other past, present, and reasonably foreseeable future actions, regardless of what agency or entity undertakes the action. Past and present actions that affect subsistence resources and activities are described in Section 3.11.

4.3.11.1. Mitigation Measures

Applicable mitigating measures for sociocultural systems, environmental justice, and community health would be similar to those discussed above in Section 4.3.10.1 for subsistence resources and activities.

4.3.11.2. Effects of the Proposed Action

The following effects analysis considered other important factors and definitions of effect as described in Sections 4.4.1.13 and 4.4.1.15 of the Draft Arctic Multiple-Sale EIS.

Direct and Indirect Affects. Shell's project activities are offshore, of limited duration, and would be performed according to all applicable statutes and regulations from a number of Federal, State, and local jurisdictions and agencies. More specifically, the terms of the IHA issued by NMFS and the LOA issued by FWS would mitigate industry conflicts with subsistence activities by: specifying: (1) that Marine Mammal Observers (MMOs) will be aboard all Shell vessels to monitor for marine mammals and lessen exposure to project noise sources; (2) MMOs will be in direct contact with community SAs at local community Com Centers who are in direct contact with Shell's emergency response team to resolve potential conflicts with subsistence activities; and, (3) flight restrictions that prevent aircraft from flying within 1,000 feet of marine mammals or flying below 1,000 feet in altitude over land and sea. In addition, provisions of the IHA (as authorized by the Marine Mammal Protection Act) require activities to have no unmitigable adverse effects on subsistence harvests. The provisions of the IHA and its required communication plan would insure that no adverse impacts on the health of NSB residents, and specifically on the health of residents in the communities of Kaktovik, Nuiqsut, and Barrow would occur. In terms of Environmental Justice, planned activities because of their expected negligible impact on subsistence resources, subsistence practices, and

sociocultural systems would be expected to have no disproportionate adverse impacts on low-income or minority populations.

The following analysis addresses the factors most likely to affect community health:

All activities associated with these surveys would be staged from existing infrastructure located in Barrow, Deadhorse, and West Dock areas. Goods and services could be obtained from local village contractors in Barrow, when available, during the duration of the project. Such business interactions are not expected to adversely affect community health. Local hire would occur through the MMO and SA programs.

Existing water quality of the OCS is good due to the remoteness, active ecological system, and the limited presence of human (anthropogenic) inputs. Existing contaminants occur at very low levels in Arctic waters and sediments and do not pose an ecological risk to marine organisms in the OCS. Vessel discharges from the proposed activities are not expected to have any effect on the health of nearby coastal villages (MMS, 2009).

Cumulative Effects. The cumulative effects of Alternative 2: Proposed Action would be those effects summarized in Sections 4.4.1.13 (Sociocultural Systems) and 4.4.1.15 (Environmental Justice) of the Draft Arctic Multiple-Sale EIS that are associated with past, present, and foreseeable future activities occurring in the project area during the period of open water 2010. With negligible cumulative effects from seismic surveys, a potential minor effect from an accidental oil spill, and a continued minor level of effect from vessel and aircraft disturbance on subsistence resources and practices, similar levels of effect would be expected on sociocultural systems, environmental justice, and community health (MMS, 2008).

4.3.12. Archaeological Resources

The Shell survey proposes three phases of activity in the Beaufort Sea in 2010: (1) a site clearance and shallow hazards survey, (2) an ice gouge survey, and (3) a strudel scour survey. Based on the maps provided in Shell's "Ancillary Activity Notice for Marine Surveys in the Beaufort Sea, Alaska, During 2010," all bottom-disturbing survey activities will avoid lease blocks with a high potential for shipwreck or cultural resource sites that have been identified by BOEMRE (see Figure 3.4.4-1 in the Draft Arctic Multiple-Sale EIS). Therefore, proposed survey activities would have no impact on historic properties and no further analysis will be included in this EA.

4.3.13. Alternative 2: The Proposed Action — Conclusion

This environmental assessment concluded that the activities proposed by Shell in the Ancillary Activity Notice for Marine Surveys in the Beaufort Sea, Alaska, During 2020 (Shell, 2010) could result in some level of impact to the environment. The factors which could generate these impacts include: seismic and underwater noise, vessel and aircraft presence and noise, seafloor disturbance, small diesel fuel spills and the introduction of invasive species. These factors were analyzed for their potential to impact resources present in the proposed survey area during the 2010 open-water season. This analysis found that the proposed activity is not likely to result in significant effects to the environment.

Seismic survey noise and the physical presence of marine vessels associated with the proposed activities could affect marine mammals by altering feeding patterns or deflecting migration routes. This effect would be temporary and limited to individuals in close proximity to the proposed activities with a negligible effect on the population. Short-term, local disturbances could affect subsistence-harvest resources, but no resource or harvest area would become unavailable and no resource population would experience an overall decrease.

Table 5 Impact producing factors considered when analyzing Alternative 2: The Proposed Action.

Resource	Impact Producing Factors[1]						Cumulative Effects
	Seismic & Underwater Noise	Vessel Presence & Noise	Aircraft Presence& Noise	Seafloor Disturbance	Small Diesel Fuel Spill	Invasive Species	
Water Quality	NG	NG		NG	NG	NG	MN
Marine Mammals (except Polar Bear)	NG	NG	NG	NG	NG		NG
Polar Bear	NG	NG	NG		NG		NG
Polar Bear Critical Habitat	NG	NG	NG		NG		NG
Marine and Coastal Birds	NG	NG	NG		MN	NG	NG
Fish	NG	NG		NG	NG		MN
Essential Fish Habitat	NG	NG		NG	NG	NG	MN
Lower Trophic Organisms				NG	NG	NG	NG
Employment		NG			NG		NG
Subsistence Activities	NG	NG	NG	NG	NG	NG	MN
Sociocultural Systems	NG	NG	NG	NG	NG	NG	MN
Environmental Justice	NG	NG	NG	NG	NG	NG	MN
Archeological Resources							NG

Notes: [1]Project related only
NG = negligible, MN = minor, MO = moderate, MJ = major, = not applicable

Marine and coastal birds could be affected by vessel traffic, including periodic, short-term, localized collisions. There could be disturbance events that could affect small numbers of migrating birds, but no population-level effects are anticipated.

No measureable effects on fish resources would be likely. Although some individual fish could be affected during the proposed activities, most fish in the immediate vicinity would avoid the activities and would otherwise be unaffected. The sound pressure from seismic surveys and turbidity caused by seafloor sampling could cause adverse effects to essential fish habitat, however the magnitude of these effects would be localized and temporary in the project area.

Effects to lower trophic level organisms from disturbances to the seafloor caused by placement of buoy anchors, collection of core samples and cone penetration testing would be confined to a small area and result in a negligible effect on local populations.

Sociocultural systems would not be altered by the proposed activities. The short duration of the proposed activities and the minimal interaction expected between project assets and the Native Alaskan communities will result in employment opportunities for a few individuals but the period of employment would be short-term and have a negligible effect on a local community or the region. Disturbance of archeological resources during the placement of buoy anchors or seafloor sampling is not anticipated.

5. LIST OF PREPARERS

As required by 40 CFR 1506.5(a),(b), the persons responsible for the review of Shell's ancillary activity notice including supporting information and the analysis and preparation of this EA are listed below:

Name	**Title**
James Lima	Supervisory Environmental Specialist
Gene Augustine	Interdisciplinary Biologist
Michael Burwell	Socio-cultural Specialist
Jeffrey Denton	Wildlife Biologist
Nancy Deschu	Fisheries Biologist
Dan Holiday	Biological Oceanographer
Mark Schroeder	Wildlife Biologist
Caryn Smith	Oceanographer / Oil Spill Analysis
Joseph Talbott	NEPA Coordinator, Technical Editor

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6. CONSULTATIONS AND PUBLIC INPUT

6.1. Endangered Species Act Consultation

Section 7(a)(2) of the ESA requires each Federal Agency to ensure that any action that 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. The BOEMRE consults with FWS and NMFS for listed species under each Service's jurisdiction. For ESA consultation on proposed lease sales, BOEMRE specifically requests incremental Section 7 consultation. Regulations at 50 CFR 402.14(k) allow consultation on part of the entire action as long as that step does not violate section 7(a)(2), there is a reasonable likelihood that the entire action will not violate section 7(a)(2), and the agency continues consultation with respect to the entire action, obtaining a biological opinion for each step. Thus, at the lease sale stage, BOEMRE consults on the early lease activities (seismic surveying, ancillary activities, and exploration drilling) to ensure that activities under any leases issued will not result in jeopardy to a listed species or cause adverse modification of designated critical habitat.

Consultation with NMFS for the proposed ancillary activities is covered by the July 17, 2008, BO for Oil and Gas Leasing and Exploration Activities in the U.S. Beaufort and Chukchi Seas, Alaska and Authorization of Small Takes Under the Marine Mammal Protection Act (NMFS, 2008). Subsequent to issuing an IHA, NMFS issues an Incidental Take Statement (ITS) which amends the NMFS 2008 BO.

Consultation with the FWS for the proposed ancillary activities to affect ESA-listed birds and the polar bear are covered by the September 3, 2009 Biological Opinion (FWS 2009). Shell requested a Letter of Authorization (LOA) from the FWS for incidental take of polar bears under the Marine Mammal Protection Act. Issuance of an LOA served as an Incidental Take Statement (ITS), required under Section 7 of the Endangered Species Act (see FWS 2008: Programmatic Biological Opinion for the Beaufort Sea Incidental Take Regulations for Polar Bear), and further consultation with the FWS is not required.

The FWS proposed critical habitat for the polar bear in 2009 (74 *FR* 56058). The evaluation of the proposed action to affect proposed critical habitat is in Section 4.3.4. This evaluation determined that the proposed action was not likely to destroy or result in adverse modification of proposed critical habitat and further consultation with the FWS is not required.

6.2. Essential Fish Habitat Consultation

The most recent EFH consultation for OCS exploration activities in the Beaufort Sea was conducted concurrently with the preparation and public review of the Arctic Multiple-Sale Draft EIS. The BOEMRE received NMFS' conservation recommendations in a letter dated June 26, 2009. On May 4, 2010, BOEMRE re-initiated consultation for Arctic cod, saffron cod, and opilio crab EFH in the Alaskan Beaufort and Chukchi Seas. On June 24, 2010 NMFS provided BOEMRE comments on the supplemental EFH analysis, but offered no further EFH conservation recommendations. BOEMRE responded to the NFMS comments on July 8, 2010.

6.3. Section 106 Consultation

Section 106 consultation, as required by the National Historic Preservation Act, is ongoing with the preparation of this EA. On June 16, 2010, BOEMRE initiated Section 106 consultation with the Alaska State Historic Preservation Officer (SHPO). The BOEMRE identified no lease blocks in the proposed work plan with high potential for shipwreck or cultural resource sites and asked for the SHPO's concurrence that "ancillary activities will have no effect upon known offshore historic and/or prehistoric resources" (MMS, 2010). Concurrence was received from SHPO on June 23, 2010.

6.4. Opportunities for Public input

Public participation regarding the proposed ancillary activities has been provided for through the BOEMRE announcement of preparation of an EA, community meetings held by the applicant, presentations at the 2010 NMFS Open Water and Scientific Review Committee (Peer Review) meetings in Anchorage, and the NMFS Incidental Harassment Authorization (IHA) process. In addition, opportunities for public input on seismic surveys in the Arctic OCS, including shallow hazards and site clearance surveys conducted as ancillary activities, and related issues have been provided during several prior NEPA processes. These opportunities for public input are briefly summarized below.

Notice of Preparation of an EA. Department of Interior Regulations for public involvement in the environmental assessment process (43 CFR 46.305(a)) state the bureau must, to the extent practicable, provide for public notification and public involvement when an environmental assessment is being prepared. However, the methods for providing public notification and opportunities for public involvement are at the discretion of the Responsible Official.

On July 2, 2010, the Bureau of Offshore Energy Management, Regulation, and Enforcement (BOEMRE) posted the Shell Exploration and Production Ancillary Activity Notice for Marine Surveys in the Beaufort Sea and supporting information, including a Notice of Preparation of an Environmental Assessment, to the Alaska OCS Region website. On the website, BOEMRE announced that "through July 8, 2010, this agency will accept additional public views that may inform the decision-making process, including issues or information regarding environmental impacts that should be considered in the preparation of the Environmental Assessment." BOEMRE had determined that the period for accepting input of July 2 through July 8, 2010 was practicable in light of the proposed activity. In response to the announcement, the BOEMRE received input from the Alaska Wilderness League (AWL), et. al., on July 8, 2010. Their comments, the only input received by BOEMRE in response to the announcement, included information on effects thresholds, reasonably foreseeable future activities, and effects of sound on marine mammals. The comments were considered in the development of the EA.

Applicant-Community Meetings. Shell met with leaders from the communities of Barrow, Wainwright, Point Lay, Point Hope, and Kotzebue over a two week period in late 2009 to introduce themselves and discuss the planned 2010 marine seismic program to community leaders and to discuss local concerns regarding subsistence activities, timing of operations, discharge, and local hire/workforce development. These meetings include:

- Presentation to Alaska Eskimo Whaling Commission; Alaska Ice Seal Commission; Eskimo Walrus Commission; and Alaska Nanuuq Commission in Anchorage, December 8, 2009.
- Presentation to the Inupiat Community of the Arctic Slope in Barrow, January 4, 2010.
- Public meetings to discuss proposed marine survey program and Plan of Cooperation in Barrow, February 24, 2010 and Kaktovik, February 26, 2010.

NMFS Open Water/Peer Review Meetings. Shell presented operational, environmental monitoring and a POC for the proposed seismic program at 2010 Open Water Meeting. The proposed seismic program was also presented and reviewed at the Peer Review meeting. The BOEMRE was present at these public meetings and took note of discussions among the participants regarding the proposed action.

NMFS IHA process. As described elsewhere in this EA, the applicant has applied for incidental harassment authorization issued under the MMPA by NMFS. The NMFS IHA review and decision process includes opportunities for public participation. The Open Water and Peer Review meetings

are part of IHA process. NMFS publishes draft authorizations in the Federal Register for public review and comment.

In addition to the public involvement opportunities related specifically to Shell's proposed action, the public has participated in the on-going discussion of post-lease activities, including ancillary activities, throughout preparation of the several environmental impact statement and related processes. A brief summary of the public input opportunities with previous BOEMRE NEPA processes is provided below. The environmental documents listed below are available at http://www.mms.gov/alaska/ref/EIS_EA.htm. The BOEMRE has considered the issues, alternatives, and mitigation measures identified from this ongoing process during preparation of this EA.

Beaufort Sea Planning Area Oil and Gas - Lease Sales 186, 195, and 202, Final Environmental Impact Statement (OCS EIS/EA MMS 2003-001); Proposed Oil & Gas Lease Sale 195, Beaufort Sea Planning Area and Finding of No Significant Impacts (OCS EIS/EA MMS 2004-028); Proposed Oil & Gas Lease Sale 202, Beaufort Sea Planning Area and Finding of No Significant Impacts (OCS EIS/EA MMS 2006-001). Public scoping meetings and Government-to-Government meetings were held in Barrow, Kaktovik, and Nuiqsut in October 2001. See Section I.C and Section VI of the FEIS for details of comments received during the scoping process. EA's for Lease Sale 195 and Lease Sale 202, which tier from the EIS, were distributed to the public.

Programmatic EA for Arctic Ocean Outer Continental Shelf Seismic Surveys (OCS EIS/EA MMS 2006-038). The BOEMRE and NMFS jointly prepared the PEA. A draft PEA was circulated for public review. The majority of comments received by BOEMRE addressed similar issues (e.g., EIS versus EA, significance criteria, potential mitigation measures, reasonable alternatives, data quality, and data gaps). A summary of the major categories of comments and our response to those comments can be found in Appendix D of the PEA. After careful consideration and evaluation, many of these substantive comments resulted in modifying the text in the PEA.

Draft Programmatic Environmental Impact Statement (Seismic PEA) Seismic Surveys in the Beaufort and Chukchi Seas, Alaska (OCS EIS/EA MMS 2007-001). BOEMRE and NMFS jointly initiated this Programmatic EIS. Publication of the notice of intent (NOI) began the official scoping period. In addition to the NOI, the NMFS and BOEMRE pursued other avenues for scoping seismic survey issues. At the October 2006 Open Water Meeting, industry representatives; the BOEMRE and NMFS and other federal and state agencies; tribal government representatives; subsistence stakeholders; and other interested parties participated in presentations and discussions about the 2006 open water seismic survey season. During public hearings for the BOEMRE Chukchi Sea Lease Sale 193 draft EIS and Draft Proposed Program for 2007-2012 OCS Oil and Gas Leasing (5-Year Program), BOEMRE personnel discussed how seismic surveys are conducted. Public hearings on the DPEIS were held in April 2007 in Anchorage, Nuiqsut, Point Hope, Point Lay, Wainwright, and Barrow. Based on verbal requests during the public hearings and two written requests, the DPEIS comment period was extended from May 14, 2007, to June 29, 2007 (72 FR 26788, May 11, 2007). At the request of the Alaska Eskimo Whaling Commission, the comment period was extended a second time, from June 29, 2007, to July 30, 2007 (72 FR 36427, July 3, 2007). NMFS withdrew the DPEIS in 2009 (74 FR 55539, October 28, 2009) and published a Notice of Intent to begin a new EIS process (75 FR 6175, February 8, 2010).

Draft Environmental Impact Statement - Beaufort and Chukchi Sea Planning Areas - Oil and Gas Lease Sales 209, 212, 217, and 221 OCS EIS/EA MMS 2008-055 (Draft Arctic Multiple-Sale EIS**).** Scoping meetings for the EIS were held in Barrow, Kaktovik, Nuiqsut, Wainwright, Point Hope, Point Lay, and Anchorage in September-November 2007. Government-to-Government meetings were held with the Nuiqsut Tribal Council, the Native Village of Point Hope, and ICAS in September and October 2007. The draft EIS was filed with the EPA and the Notice of Availability (NOA) was announced in the *Federal Register* on December 19, 2008. The NOA provided for a 90-

day public comment period, which was extended by 2 weeks. Public hearings were held in January-March 2009, in Barrow, Kaktovik, Nuiqsut, Wainwright, Point Hope, Point Lay, and Anchorage. Government-to-Government consultation meetings with the Native Villages of Nuiqsut and Barrow, and ICAS were also held during this period. The Government-to-Government meeting with the Native Village of Point Hope did not occur because of lack of a quorum. The BOEMRE requested Government-to-Government meetings with the Native Villages of Kaktovik, Point Lay, and Wainwright, but the requests were declined or no response was received. A number of comments received on the draft EIS related to seismic surveys and mitigation. Volume III, Chapter V of the DEIS, describes the public involvement process.

Environmental Impact Statement on the Effects of Oil and Gas Activities in the Arctic Ocean, February 2010. NMFS, with BOEMRE as a cooperating agency, is preparing an EIS to analyze the environmental impacts of issuing incidental take authorizations pursuant the Marine Mammal Protection Act to the oil and gas industry for the taking of marine mammals incidental to offshore exploration seismic surveying and exploration drilling activities in the Beaufort and Chukchi Seas including seismic surveys. The BOEMRE participated with NMFS in the public scoping meetings for this EIS in February and March, 2010, in Anchorage, Barrow, Kaktovik, Kotzebue, Nuiqsut, Point Hope, Point Lay, and Wainwright.

National Marine Fisheries Service Annual Open Water meetings in Anchorage, Alaska, 2006 through 2010. At the annual Open Water meetings, industry representatives, the BOEMRE and NMFS, other federal and state agencies; tribal government representatives, subsistence stakeholders, and other interested parties including the public participated in presentations and discussions about activities that occur during the open water season. Lessons-learned and opportunities to improve mitigation measures, as well as coordination and communication between all interested parties were highlighted in the presentations and discussions.

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APPENDIX A

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A-1. ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
AAQS	Alaska Ambient Air Quality Standards
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AEWC	Alaska Eskimo Whaling Commission
AFMP	Arctic Fishery Management Plan
AMS	Draft Arctic Multiple Sale EIS (MMS 2008-0055)
ANIMIDA	Arctic Nearshore Impact Monitoring in Development Area
ANWR	Arctic National Wildlife Refuge
APD	Application for Permit to Drill
ARBE	Arctic Region Biological Evaluation
ARBO	Arctic Region Biological Opinion
AS	Alaska Statute
ATV	all-terrain vehicle
bbl	barrel(s) (of oil)
BE	Biological Evaluation
BO	Biological Opinion
BOEMRE	Bureau of Ocean Energy Management, Regulation, and Enforcement (formerly MMS)
CAA	Clean Air Act
CAA	conflict avoidance agreement
cANIMIDA	continuation of the Arctic Nearshore Impact Monitoring in Development Area
CEQ	Council on Environmental Quality
CER	Categorical Exclusion Review
CFR	Code of Federal Regulations
cm	centimeter(s)
cm/sec	centimeters per second
CO	carbon monoxide
CO_2	carbon dioxide
COMIDA	Chukchi Offshore Monitoring in Drilling Area
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dB	decibel(s)
DPP	Development and Production Plan
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement

EP	Exploration Plan
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESI	Environmental Sensitivity Index
EWC	Eskimo Walrus Commission
FCMA	Fishery Conservation and Management Act
FMP	Fishery Management Plan
FR	*Federal Register*
ft	foot/feet
ft^2	square foot/feet
FWS	Fish and Wildlife Service
gal	gallon
h	hectares
Hz	Hertz
IHA	Incidental Harassment Authorization
in^3	cubic inch(es)
ITL	Information to Lessee clause(s)
kHz	kilohertz
km	kilometer(s)
km^2	square kilometer(s)
kn	knots
LOA	Letter of Authorization
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mi	mile(s)
mi^2	square mile(s)
mm	millimeter(s)
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service (see BOEMRE)
MOU	Memorandum of Understanding
mph	miles per hour
m/sec	meters per second
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
NAAQS	National Ambient Air Quality Standards
NANPCA	Non-Indigenous Aquatic Nuisance Prevention and Control Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act

NISA	National Invasive Species Act of 1966
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NO_2	nitrogen dioxide
NOx	dinitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NPFMC	North Pacific Fisheries Management Council
NSB	North Slope Borough
NSF	National Science Foundation
NTL	Notice to Lessees and Operators
OCS	Outer Continental Shelf
OSRA	Oil-Spill Risk Assessment
OSRP	Oil-Spill-Response Plan
O_3	ozone
PBR	Potential Biological Removal
PCB	Polychlorinated Biphenyl
PEA	Programmatic Environmental Assessment
POC	Plan of Cooperation
ppm	parts per million
PSD	Prevention of Significant Deterioration
rms	root-mean-square
RPM(s)	Reasonable and Prudent Measure(s)
RS/FO	Regional Supervisor/Field Operations (BOEMRE)
SAP	Subsistence Advisory Panel (BLM)
SEA	Supplemental Environmental Assessment
SEL	sound-exposure level
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
SPL	sound-pressure level
SPM	suspended particulate matter
SWZ	Subsistence Whaling Zone
U.S.C.	United States Code
USDOC	U.S. Department of Commerce
USDOI	U.S. Department of the Interior
USGS	U.S. Geological Survey
VOCs	volatile organic compounds
yd	yard
yd^3	cubic yard

2D	2-dimensional (seismic surveys)
3D	3-dimensional (seismic surveys)
4D	4-dimensional (seismic surveys)
ºC	degrees Celsius
ºF	degrees Fahrenheit
µPa	microPascal
§	section

A-2. LEVEL OF EFFECTS DEFINITIONS & ABBREVIATIONS

The terms negligible, minor, moderate, and major were used to describe the relative degree or anticipated level of effect of an action on specific resources. Following each term listed below for a specified resource are the general characteristics used to determine the anticipated level of effect. For all terms, best professional judgment was used to evaluate the best available data for estimated population size.

A-2.1. Water Quality

The impact levels used throughout this analysis are based on the four-level classification scheme for biological and physical resources outlined in the Cape Wind Energy Project Draft EIS (USDOI, MMS, 2008a).

These four impact levels are defined as follows:

Negligible: No measurable impacts.

Minor: Most impacts could be avoided with proper mitigation, or if impacts occur, the affected resource would recover completely without any mitigation once the impacting agent is eliminated.

Moderate: Impacts are unavoidable; the viability of the affected resource is not threatened although some impacts may be irreversible; or the affected resource would recover completely if proper mitigation is applied during the life of the proposed action or proper remedial action is taken once the impacting agent is eliminated.

Major: Impacts are unavoidable; the viability of the affected resource may be threatened; and the affected resource would not fully recover even if proper mitigation is applied during the life of the proposed action or remedial action is taken once the impacting agent is eliminated.

A-2.2. Marine Mammals

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. No mortality or detectable impacts to reproductive success or recruitment are anticipated. 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. For marine mammals, mortality might occur at or above the estimated Potential Biological Removal (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.

A-2.3. Marine and Coastal Birds

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.

A-2.4. Fish and Essential Fish Habitat

The basic unit of assessment is the metapopulation. A metapopulation consists of a group of spatially separated populations of the same species that interact at some level. A metapopulation generally is considered to consist of several distinct populations together with areas of suitable habitat, which currently are unoccupied. Although individual populations have finite life-spans, the metapopulation as a whole is often stable because immigrants from one population (which, for example, may be experiencing a population boom) are likely to recolonize habitat that has been left open by the extinction of another population. Immigrants also may join a small population and rescue that population from extinction.

The following level-of-effect terms are used throughout the analysis of impacts on fish resources: negligible, minor, moderate, and major. These are defined as:

Negligible: No measurable impacts. Mortality likely is limited to a few individuals from a large metapopulation. Localized, short-term disturbance or habitat effect experienced during one season that is not anticipated to accumulate across 1 year. Mitigation measures can be effectively implemented or are unnecessary.

Minor: Widespread annual or chronic disturbances or habitat effects that are not anticipated to accumulate across 1 year; or localized effects that are anticipated to persist for more than 1 year. Anticipated or potential mortality affects a localized aggregation estimated or measured in terms of hundreds or thousands of individual fish, but <1% of a region's metapopulation or <10% of a localized spawning 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: Impacts to the affected resource are unavoidable. Unmitigatable or unavoidable adverse effects are short term but more widespread. Widespread annual or chronic disturbances or habitat effects anticipated to persist for more than 1 year to up to a decade. Anticipated or potential mortality is estimated or measured in terms of tens of thousands of individuals or <20% of a local spawning population and <5% of a region's metapopulation, which may produce a short-term, localized population-level effect. The viability of the affected metapopulation is not threatened, although some localized impacts may be irreversible without mitigation or remedial action. The local population would recover completely, if proper mitigation is applied during the life of the Proposed Action or proper remedial action is taken once the impacting agent is eliminated.

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 of thousands of individuals or >20% of the local spawning population or >10% of a region's metapopulation, 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.

A-2.5. Economy

Negligible: No measurable impacts.

Minor: Impacts to the affected activity or community are unavoidable. Impacts would not disrupt the normal or routine functions of the affected activity or community. 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. 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 impacting agent is eliminated, the affected activity or community may retain measurable effects of the proposed action indefinitely, even if remedial action is taken.

A-2.6. Subsistence Harvest Patterns

Negligible: Periodic, short-term effects that have no consequent effects to subsistence resources or harvest.

Minor: Subsistence resources or harvests are affected for a period up to 1 year (1 harvest season), but none of these resources would become unavailable, undesirable, or experience population reductions and, therefore, would not alter subsistence harvests.

Moderate: Subsistence resources unavailable, undesirable for use, or experiencing population reductions for a period up to 1 year (1 harvest season), with subsistence harvests affected for that period. Affected subsistence resources and harvests would be expected to recover completely if proper mitigation is applied during the life of the proposed action or proper remedial action is taken once the impacting factor is eliminated.

Major: Affected subsistence resources and harvests would not be expected to fully recover even if proper mitigation is applied during the life of the proposed action or even if proper remedial action is taken once the impacting factor is eliminated.

A-2.7. Sociocultural Systems

Negligible: Periodic, short-term effects with no measurable effects on normal or routine community functions.

Minor: Sociocultural systems affected for a period up to 1 year. Effects would not disrupt normal or routine community functions and could be avoided with proper mitigation.

Moderate: Effects on sociocultural systems would be unavoidable for a period longer than 1 year. Affected normal or routine community functions would have to adjust somewhat to account for disruptions, but they would be expected to recover completely if proper mitigation is applied during the life of the proposed action or proper remedial action is taken once the impacting factor is removed.

Major: Effects on sociocultural systems would be unavoidable and normal or routine community functions would experience disruptions to a degree beyond what is normally acceptable. Once the impacting factor is removed, affected community functions may retain measurable effects, even if proper remedial action is taken.

A-2.8. Archaeological Resources

Negligible: Little damaging interaction occurs between an impact producing factor and an archaeological site.

Minor: An interaction occurs between an archaeological site and an impact producing factor and effects are temporary and reversible or results in the loss of archaeological data that are not significant.

Moderate: An interaction occurs between an archaeological site and an impact producing factor that results in the loss of significant, but not unique, archaeological data.

Major: An interaction occurs between an archaeological site and an impact producing factor that results in the loss of unique archaeological data.