Section 3

Environmental Consequences

3. ENVIRONMENTAL CONSEQUENCES

This section discusses the environmental consequences of the proposed Liberty (SDI) Project and alternatives. The MMS updated the information and expanded on the information provided in the EIA, as needed. Consequences of the proposed project are discussed in terms of expansion of the Endicott Satellite Drilling Island (SDI), onshore construction, and drilling and oil production. Separate sections are provided on the impacts of oil spills, the effects of alternatives, and the cumulative effects of the project. Effects conclusions are summarized for the proposed action and alternatives in Tables 3.5-1 through 3.5-9.

3.1 SDI EXPANSION

3.1.1 Air Quality

The ambient air pollutant impacts due to construction of the SDI expansion are expected to be within the limits of the National and Alaska Ambient Air Quality Standards (AAQS). Pollutants will be emitted from temporary operations and/or mobile equipment such as diesel-fired construction equipment, and temporary electrical generators. Pollutant emissions from marine vessels are expected to be negligible because marine traffic, in general, will not be used to support construction of the SDI expansion. Fugitive particulate-matter emissions will result from gravel mining operations and gravel placement operations, but will be minimized through fugitive-dust abatement techniques such as road watering. As part of the air permitting process, the Alaska Department of Environmental Conservation (ADEC) will review the construction equipment inventory and the construction plans to ensure compliance with the National and Alaska AAQS. A dispersion modeling analysis of project emissions will be included in the air permit application and will demonstrate National and Alaska AAQS compliance. An ambient-air-quality monitoring station has been in operation on the SDI since February 2007 to provide data to support air quality permitting.

The following information was provided by BPXA to MMS on July 26, 2007, outlining the air permitting process:

- Liberty Prevention of Significant Deterioration (PSD) permit application submittal: April 25, 2007
- Ambient Air Monitoring (required before ADEC can determine application complete): (February 2007 to January 2008)

The following lists the estimated times from the date of ambient air monitoring completion:

- Compile ambient air data and submit to ADEC - 30 days (February 2008)
- Preliminary Permit and TAR - 30 days (March 2008)
- Public Notice - 30 days (April 2008)
- Final Permit and TAR Issued - 30 to 60 days (depending on comments received) (May to June 2008)
- Current estimate of Air Permit issuance: late June/early July 2008

3.1.2 Sediment Suspension and Transport

Expansion of the SDI requires the placement of approximately 860,000 cubic yards (yd^3) of gravel fill. The material will be placed progressively outward from the existing pad perimeter. The pad expansion footprint is approximately 704 by 1,394 ft**.** The gravel fill and slope protection will be placed through the ice during the winter, commencing after ice road construction and concluding prior to breakup.

It is anticipated that the placement of gravel fill will increase suspended sediment concentrations in the marine waters in the immediate vicinity of the construction site and create a turbidity plume that extends to nearby areas. The total suspended solids (TSS) concentrations and the nature of the plume depend on the properties of the gravel fill, water depth at the site, current speed, and current direction (BPXA, 1998).

Measurements of TSS concentrations attributable to gravel island construction are limited. During construction of Endeavor Island in the summer of 1980, suspended sediment concentrations were found to increase by about 70 mg/l above ambient levels within 30 m of the island and to increase by about 10 mg/l at a distance 1,830 m from the site (NORTEC, 1981; as reported in BPXA, 1998). Results from turbidity monitoring performed in summer 2003 during replenishment of the Northstar Island gravel berm indicate that turbidity increased approximately 20% on average relative to the baseline condition in the near field (Coastal Frontiers, 2003b). The associated plume rarely was detectable beyond 500 m from the site and typically dissipated within 2 hours.

During the winter construction of BF-37, a gravel island located about 3 km north of the Endicott Main Production Island (MPI), the concentration of suspended sediments near the island did not increase significantly (Toimil and England, 1982; Toimil and Dunton, 1983 and 1984; as reported in BPXA, 1998). Suspended sediment concentrations were measured during the first 7 days after fill placement commenced at radial distances of 140 and 170 m from the island. The maximum TSS concentration increase relative to ambient conditions was 3 mg/l. It was speculated that the sediment plume was limited by low under-ice current speeds, ice bonding of fine-grained material, and formation of silt/ice agglomerates.

Suspended sediment concentrations and turbidity plume characteristics were estimated previously for the original Liberty offshore island concept (Ban et al., 1999). The methods and assumptions used for this analysis are employed here to assess the worst-case impact of gravel-fill placement operations for expansion of the SDI pad. The key assumptions are given below:

- Gravel placement rate: 15,500 m^3/day
- Fines content in gravel fill: 10%
- % resuspension of fines: 12%
- Particle size of fines fraction: 5-100 microns (μ)
- Density of gravel fill:2600 kg/m^3
- Density of fine particles: 1,784 kg/m^3
- Under-ice current speed: 2 cm/sec

Applying the above assumptions for the worst-case scenario yields a release of fine-grained material to the marine environment of 186 m^3/day. This equates to a mass flux (M) of 5.6 kg/sec. The resulting concentration of suspended sediments in the immediate vicinity of the site is estimated by the following relationship:

$$C_o = M/Q \qquad (1)$$

where:

C_o = concentration of suspended sediments
M = mass flux of suspended fines (5.6 kg/sec, derived above)
Q = flow rate (Eq. 2)

The flow rate is defined by the following relationship:

$$Q = vDH \quad (2)$$

where:

v = under-ice current speed (2 cm/sec)
D = width of pad expansion (215 m)
H = water depth (≈3 m, as discussed in Section 2.3.2)

Using the variables given above and applying Equations 1 and 2, yields TSS concentrations at the immediate project site of about 430 mg/l for the worst-case scenario. These values are higher than those estimated for the Liberty offshore island concept due to the shallower water depths at the SDI site. Although the estimated turbidity is high by winter standards, the concentrations are only slightly higher than the range previously reported for Foggy Island Bay during the summer (Section 2.5.3). The increased turbidity is anticipated to be a short-lived impact, with most of the suspended material settling out within or adjacent to the footprint of the pad expansion.

The extent of the turbidity plume can be estimated by applying Stokes' Law (Equation 3 below) to calculate the fall velocity of the suspended particles and then determining the travel distance required for those particles to reach the seafloor as a function of the water column below the ice canopy and the current speed (Equation 4). Stokes' Law is given below:

$$w = g\, d^2\, (\rho_p - \rho_{sw})/18\mu \quad (3)$$

where:

w = particle fall velocity
g = acceleration due to gravity (9.8 m/sec^2)
d = particle diameter (5 to 100 microns)
ρ_p = density of particle (1,784 kg m^3)
ρ_{sw} = density of seawater (1,026 kg/m^3)
μ = dynamic viscosity of seawater (0.0014 kg/m^3)

Applying Stokes' Law for particle sizes between 5 and 100 microns yields fall velocities ranging from 0.00074 cm/sec to 0.29508 cm/sec.

The suspended particles will be transported under the ice canopy by currents until they settle to the seafloor. Assuming gravel placement operations commence on January 1 when the average ice thickness is 0.9 m (Section 2.4.7), the height of the water column below the ice would be approximately 2.1 m. The travel distance for a given particle size is given by the following relationship:

$$D = v\, H_{under\text{-}ice} / w \quad (4)$$

where:

D = travel distance
v = under-ice current speed (2.0 cm/sec)
H = height of the water column below the ice (2.1 m)
w = particle fall velocity (given by Stokes' Law)

The predicted travel distance for various particle sizes is shown in Table 3.1-1. Fine sands (>75 µm) will settle out of suspension almost immediately, migrating only about 20 m before reaching the seafloor. Silts (75 to 5 µm) are predicted to settle between 25 and 5,700 m from the project site. Finer particles (clays and colloids) would travel greater distances; however, these fractions are not anticipated in substantial quantities.

A large portion of the suspended material will settle to the seafloor within or adjacent to the footprint of the SDI pad expansion. The finer fractions (<50 µm) are expected to be transported as a plume to either the northwest or southwest by the prevailing currents. The predominant under-ice current direction is westerly/northwesterly (occurring 60 to 70% of the time on average). Under these conditions, the turbidity plume is predicted to migrate along the Endicott Causeway between the SDI and the MPI. Particles greater than 5 µm likely will be deposited on the seafloor within 6 km of the project site in a narrow band near the junction of the seafloor and the landfast ice (1- to 2-m water depth). During the more infrequent periods of easterly flow, the plume is anticipated to migrate southeasterly along the bathymetric contours.

The plume migration estimates are believed to be conservative in that:

- Gravel placement operations are anticipated to be conducted when the ice thickness is >0.9 m and the corresponding water column height under the ice canopy is less than the assumed 2.1 m;
- The turbidity plume will be migrating toward shallower waters under the predominate northwest currents;
- The speed of easterly directed currents may be less than the estimated 2 cm/sec due to sheltering effects of the Endicott Causeway; and
- The sheet pile wall will be installed simultaneously with gravel placement in winter, thus reducing plume migration.

Minor reshaping of the south and west pad sideslopes is anticipated shortly after breakup or during the open-water season. This activity may result in a slight increase in TSS concentrations for a short period of time. The naturally occurring turbidity levels are generally high during this time of the year due to river discharge and wave-induced suspension of fine material. Under the predominantly easterly winds, the turbidity plume associated with this activity is anticipated to migrate northwest along the Endicott Causeway. The shelter provided by the causeway would limit the ability for the plume to migrate towards the Boulder Patch during westerly wind events. During periods of high river discharge, the turbidity plume will be entrained with the river plume and dispersed into Foggy Island Bay.

3.1.3 Oceanography

The proposed SDI pad expansion is not expected to have any major impact on regional oceanography during the construction period. Minimal localized and short-term impacts can be anticipated, such as potential changes in water movement and sediment deposition around Duck Island 1 & 2, leading to alteration of the oceanographic processes that have shaped these abandoned exploration pads. The exploration islands might be reshaped by an erosion channel between the SDI and the islands.

The primary impacts are expected to occur at the time of river breakup, when the overflood may be partially diverted by the ice road. The expanded SDI pad footprint is anticipated to have a limited and localized influence on the river overflood. There also may be an increased propensity for strudel scouring at the project site due to removal of the ice sheet around the pad perimeter during construction. Currents in the immediate vicinity of the pad expansion will be

affected during the breakup and open-water periods, but the current patterns and velocities are not expected to be substantially different from those at the existing SDI facility.

3.1.4 Marine Water Quality

As discussed in Section 3.1.2, TSS concentrations in the immediate vicinity of the project site may increase by up to 430 mg/l during gravel placement operations. While the estimated turbidity is high by winter standards, the concentrations are only slightly greater than the range previously reported for Foggy Island Bay during the summer. A large portion of the suspended material is predicted to settle within or adjacent to the footprint of the SDI pad expansion. The finer fractions will create a turbidity plume along the Endicott Causeway, likely dissipating within 6 km of the project site. These conditions will exist temporarily when gravel is placed in the water. Because the amount of material placed below water is less than half of the projected gravel fill volume required for the expansion, the increased turbidity should not persist through the entire winter construction period. In addition, the sheet pile wall will be installed in the winter, further reducing plume migration. These conditions are not anticipated to exceed previously documented TSS concentrations in Foggy Island Bay.

A potential for small equipment spills (oil, diesel fuel, and hydraulic fluid) exists during the construction period. Any spills on the gravel pad or ice surface will be cleaned up immediately. A release to marine waters is unlikely. During the winter, such a spill would be confined within the perimeter of the excavated ice sheet and cleaned up immediately.

3.1.5 Benthic and Boulder Patch Kelp Communities

The SDI expansion will cover a bottom area of approximately 20 acres. Although this represents permanently lost habitat to benthic invertebrates, the area is miniscule compared to the total habitat available in coastal waters. The habitat loss would have no measurable effect on lower trophic organisms. The SDI extension is sited entirely outside of the Boulder Patch kelp habitat, and no kelp habitat will be lost directly.

The SDI expansion is located near the perimeter of the Boulder Patch kelp community (Figure 2.7-1a), which begins a short distance offshore and east of the Endicott Causeway. The community is defined as the area with more than 10% coverage of boulders, but that area is surrounded by a limited area with <10% coverage of boulders. Kelp grows under the ice in dim light during spring. If there is a springtime turbidity plume during the SDI expansion, the plume is likely to drift alongshore (Sections 3.1.2 and 3.1.5.3), temporarily affecting only a small portion of the kelp in the Boulder Patch and adjacent area (see Figure 2.5-1).

A large segment of the Liberty oil reserves lay beneath the Boulder Patch. Movement of the original Liberty offshore island development, located directly in the Boulder Patch, to the SDI is facilitated by the use of uERD technology. The technology enables subterranean access to oil and gas reserves within several lateral miles of the wellhead. Moving the primary well site outside the Boulder Patch greatly reduces the risk of impact to this unique community.

3.1.5.1 Marine Access

Substantial marine access is not expected to be required to support Liberty(SDI) construction and operation. A sealift by barge is planned to transport the ***LoSal™*** EOR process and power generation modules to the existing MPI dock. A dock will be provided at the SDI as a

contingency for providing limited marine access in support of rig mobilization and demobilization.

The two predominant ways in which barge traffic could adversely affect biological communities of the Boulder Patch are through physical disturbance associated with propeller wash, and from barge and tug discharges (see below). Water depths in the Boulder Patch range from 3 to 9 m. Most of the Boulder Patch consists of rocks and gravel <20 mm in size. Large rocks are scarce but may reach diameters of 1 m. At these depths, excessive propeller downwash could disturb epilithic fauna and cause the braking or detachment of kelp. Barge traffic will be routed around Boulder Patch to mitigate the potential for physical damage.

3.1.5.2 Refined-Oil Spills

Small refined-oil spills (diesel fuel, engine lube, fuel oil, gasoline, and grease) can occur whenever machinery is in use. Small refined-oil discharges from boat traffic or operations on the SDI would not mix deep enough in the water column to affect the Boulder Patch and other deep-water benthos. Discharges in shallow docking areas or in the immediate vicinity of the SDI could contaminate nearby benthos, but the effect would be highly localized and temporary. Overall, small oil discharges from boat traffic and construction activities are not expected to have measurable effects on benthic biota or the biota of the Boulder Patch.

3.1.5.3 Water Quality (Suspended Sediments)

A detailed discussion of the potential effects of turbidity and sediment settlement on the Boulder Patch community can be found in the Liberty FEIS (USDOI, MMS, 2002). Expansion of the SDI will increase suspended sediment concentrations in the marine waters in the immediate vicinity of the construction site and create a turbidity plume that extends to nearby areas. The turbidity is expected to be high by winter standards but well within the range reported for Foggy Island Bay during summer. The increased turbidity during construction is expected to be a short-lived impact, with most of the suspended material settling out immediately adjacent to the SDI expansion area (see Section 3.1.2). It is projected that large grain (≥15µ) suspended sediments will settle to the seafloor within 300 m of the SDI and will not reach the Boulder Patch. Finer particles 5µ in size will deposited on the seafloor within 3 km of the site. Any settlement within the Boulder Patch would be temporary. Settlement occurs on the seafloor and kelp beds naturally during late summer and early fall, but late fall storms regularly resuspend the sediments and transport it away from the Boulder Patch (Dunton and Schonberg, 2000). Because water currents are so slow during winter, sediments from the SDI expansion could settle on kelp or could freeze into the ice cover, thereby reducing light penetration for kelp growth under the ice during spring. The effect would again be temporary, being limited to the initial winter of construction.

Overall, increased turbidity and sediment from construction is not expected to have a measurable effect on the Boulder Patch community. The general benthos could be impacted in the immediate vicinity of the SDI, but the area affected would be minor relative to the size of the overall nearshore benthic community. Any effect during construction would be temporary. The effect of turbidity and suspended sediments during long-term abandonment of the facility is discussed later in Section 3.3.2.

3.1.5.4 Oceanography

The proposed SDI expansion is not expected to have any impact on regional oceanography. Currents in the immediate vicinity of the pad expansion will be affected during the open-water period but will not differ much from patterns associated with the present SDI pad. No effect on either the Boulder Patch or the overall benthic community is expected.

3.1.6 Fish and Essential Fish Habitat

3.1.6.1 Noise/Activity Disturbance

The expansion of the SDI will occur during winter when most of the surrounding waters will be frozen to the bottom. Fish presence in the immediate vicinity will be nominal and restricted to marine species in waters deeper than 6 ft beginning seaward of the SDI. Because marine fishes are widely distributed in their range and largely unrestricted in their movements, noise and activity associated with the SDI expansion would not have a measurable effect on marine populations. Adult and sub-adult anadromous and amphidromous fishes range far up and down the coast, and any noise disturbance would be localized and unlikely to interfere with coastal distributions. If noise and activity from the SDI expansion were stressful, fish would merely avoid them. Juvenile broad whitefish, least cisco, and arctic cisco are more restricted to the Sagavanirktok Delta in summer, but there is sufficient habitat for them to avoid noise in the immediate area of the SDI. Overall, noise and activities associated with the SDI expansion are likely to have only minimal, short term impacts on local fish populations. Essential Fish Habitat (EFH) will not be adversely impacted.

3.1.6.2 Habitat Loss

The SDI extension will cover a bottom area of approximately 20 acres. This represents permanently lost habitat to fish, but the area is a small fraction of the total habitat available in coastal waters. The habitat loss should have no meaningful effect on local fish populations. Infrastructure support such as causeways, bridges, permanent roadways, and culverts are already in place in support of the Endicott facilities. Except for the upgrade to the existing West Sagavanirktok River Bridge, no additions are planned. No additional fish habitat in the project area will be affected, and there will be no adverse effects to EFH.

3.1.6.3 Ice Road Construction

The ice road that will support winter expansion of the Liberty (SDI) Project will run from the proposed mine site to the SDI, and will parallel the existing Endicott Road. The ice road will cross under one of the Endicott bridges and run across grounded sea ice to the south side of the SDI. There are presently no indications that deepwater fish overwintering habitat exists anywhere along the proposed route. Although tundra ponds are a dominant feature of the Arctic Coastal Plain, water depths in most cases are insufficient for overwintering, and most are not accessible to fish (Hemming, 1995). The possible exception would be where the roadway crosses under the middle breach. Both the inner and outer breaches contain centerline channels of up to 4,000 m^2 in area where depth exceeds 2 m and which have maximum depths of about 5 m (Dewey, Morehead, and Wilson, 1993). At these depths they more than likely provide some overwintering habitat for fish. It is further likely that the middle breach also contains some overwintering area the extent of which is unknown.

A second 3-mi-long ice road may be built on the lagoon side of the Endicott Causeway between the MPI and SDI. In addition to running along the length of the causeway, the ice road will parallel a scour channel that also runs along the lagoon side of the causeway. In places, channel depth can reach 2.5 m and be approximately 100 m wide (Davis, Petrillo, and Parker, 1992). Although not excessively deep, the channel may be up to 3,000 m in length. Assuming maximum winter ice thickness of 2 m, under-ice free water only 0.5 m in depth would still translate into 150,000 m^3 of potential fish overwintering habitat. A mild winter with a maximum ice thickness of 1.5 m could provide 300,000 m^3 of potential fish overwintering habitat. Such a volume of overwintering area is considerable. Of 22 fish overwintering sites surveyed in the lower Sagavanirktok River and Delta, under-ice free-water habitat ranged in volume from 4,000 to 57,000 m^3 (Adams and Cannon, 1987; Schmidt, Griffiths, and Martin, 1989).

The construction of an ice road over shallow overwintering habitat can cause additional freezing. Overwintering habitat could be lost, oxygen levels could decrease, and overwintering fish could be adversely affected. However, the extent to which fish use the Endicott Causeway channel as overwintering habitat is unknown, as are the actual winter dimensions of the channel. Even if this potential habitat were lost for a winter, the long-term effects on fish stocks would be minimal. North Slope fishes regularly endure population fluctuations associated with especially harsh winters. If the ice roads are limited to the grounded-ice area along their route, damage to any potential fish overwintering habitat would be minimized. BPXA confirmed via email to MMS on October 23, 2007, that hydrology field work was performed in the summer of 2007 for potential fish over-wintering areas. The areas included the potential ice road routing locations. EFH will not be adversely affected by ice road construction.

It is projected that ice roads will require 22 million gallons of freshwater per year during the peak construction season. The primary source of freshwater for ice roads will be the Duck Island Mine Site, which is believed to hold on the order of 600 million gallons of water. The mine site has never been breached (Hemming, 1988) and is therefore assumed not to contain fish.

Following completion of the SDI expansion, should BPXA continue to use similarly designed and located ice roads in support of Liberty-related activities, effects are anticipated to be similar for each phase of the project.

3.1.6.4 Gravel/Mine Site Development

The proposed mine site will be located in the eastern operating area of the Prudhoe Bay Unit, approximately 7.5 mi northeast of the Deadhorse Airport in the Sagavanirktok River delta. The proposed mine site is adjacent to the existing Duck Island Mine Site at South ½ Section 6, North ½ Section 7, Township 10 North, Range 16 East, Umiat Meridian. The extension of the SDI will require 860,000 yd^3 of gravel to be mined from the proposed site.

In January 2009, gravel will be removed from an area of approximately 21 acres, with the primary excavation area developed as a single cell, and the entire development mine site, including a stockpile area for overburden, will be approximately 50 acres in size. The Liberty Mine Site Mining and Rehabilitation Plan has been revised since submittal of the DPP in April 2007, and incorporates post-application comments from various regulatory agencies (e.g., ADNR, Office of Habitat Management and Permitting (OHMP) and the Division of Mining, Land and Water; U.S. Army Corps of Engineers, and the State Pipeline Coordinator's Office. The following gravel/mine site volumes/design were submitted by BPXA to MMS on October 15, 2007 as a component of the DPP modification:

- Shorelines with slopes of 3H:1V (or shallower) on three of the four sides of the site and 5H:1V (or shallower) on the other side resulting in:
    - Excavation Area increase from 18 to 21 acres (+3 acres)
    - Organic overburden stockpile volume increased from 60,000 yd^3 to 65,000 yd^3 (+5,000 yd^3)
    - Inorganic overburden stockpile volume increased from 215,000 yd^3 to 240,000 yd^3 (+25,000 yd^3)
    - Water diversion berm (April 2007 DPP refers to this as a Safety Berm) volume increased from 15,000 yd^3 to 20,000 yd^3 (+5,000 yd^3)
    - Access road footprint decreased from 2 to 1.4 acres
    - Access road volume decreased from 15,000 to 12,000 yd^3
- Incorporation of an approximate 300-ft long rip-rap breach in the western portion of the water diversion berm into the rehabilitation plan. The purpose of the breach is to enhance filling the mine while mitigating scour during periods of flood events.

Refer to Appendix I, Gravel Site Mining and Rehabilitation Plan, of this EA for complete details.

Although located within the floodplain, the proposed mine site does not appear to occur in a deep-water area where large-scale fish overwintering might take place. The excavation would eliminate some shallow water areas that are likely used by freshwater fish during summer, but the amount of loss would be small relative to the summer freshwater habitat available within the Sagavanirktok River delta.

When properly rehabilitated, abandoned and flooded gravel mine sites in or near river beds and floodplains can serve as suitable habitat for fish year-round. A detailed discussion of mine site reclamation and fish enhancement studies on the North Slope is provided in USDOI, MMS (2002). The utility to fish and wildlife of reclaimed, flooded mine sites depends on the mine's permanent access to surrounding stream or river channels, the contour and profile of the rehabilitated shoreline, depth, sufficient oxygen concentration, and sufficient primary and invertebrate production to sustain summer populations. A permanent connection to surrounding streams and rivers allows fish to move in and out of a site throughout the open-water season. In the absence of a direct connection, sites can be seasonally or sporadically connected to the surrounding drainages. Seasonally connected waterbodies are flooded during breakup, while sporadically connected waterbodies are flooded only during high-water years (U.S. Army Corps of Engineers, 1997; USDOI, MMS and BLM, 1998). To serve as viable overwintering habitat, mine-site water must be deep enough to provide sufficient under-ice-free water during winter, and be of a volume sufficient enough to prevent oxygen depletion during the long period of winter ice cover.

No EFH will be adversely affected by development of the gravel mine site.

3.1.6.5 Refined-Oil Spills

Nonpoint source pollution can have deleterious effects on salmonids, particularly growth in juveniles. Petroleum hydrocarbons damage developing salmon eggs, larvae, and fry at extremely low concentrations. Sculpin eggs and larvae and juvenile Pacific cod, which may occur in nearshore areas, likely would experience similar effects. Refined-oil spills associated with machinery operations tend to be quite small and could be cleaned up before reaching surrounding waterbodies. Mandatory safety measures and protocols designed to limit the occurrence and frequency of refined-oil spills are an integral part of industry operations on the North Slope.

During winter operations, ice cover would prevent spills from reaching fish habitat. If small spills associated with summer construction work on the SDI were able to leach into surrounding waterbodies, the affected area would be highly localized and would not affect feeding grounds and migratory corridors within the lower Sagavanirktok River delta.

Because they tend to be small in volume, any discharge reaching surrounding waters would affect only a small portion of fish habitat. Small refined-oil spills associated with the SDI expansion are not expected to have any measurable effect on arctic fish populations in the project area, and EFH will not be adversely affected. Small refined-oil spills that might occur during the on-shore construction and development phases of the Liberty (SDI) Project are expected to have similarly negligible effects on fish and EFH.

3.1.6.6 Water Quality (Suspended Sediments)

Expansion of the SDI will increase suspended sediment concentrations in the marine waters in the immediate vicinity of the construction site and create a turbidity plume that extends to nearby areas. The turbidity is expected to be high by winter standards but well within the range reported for Foggy Island Bay during summer. The increased turbidity is expected to be a short-lived impact and would affect only a tiny portion of the habitat used by marine fish.

3.1.6.7 Oceanography

The proposed SDI expansion is not expected to have any impact on regional oceanography. Currents in the immediate vicinity of the pad expansion will be affected during the open-water period but will not differ much from patterns associated with the present SDI pad. These minor changes in oceanography will have no measurable effects on marine or anadromous fish, and EFH will not be adversely affected.

3.1.7 Marine Mammals

Marine mammals are a large component of the Beaufort Sea ecosystem in the vicinity of the SDI. Three species of seals are native to the region: ringed seal (*Phoca hispida*), spotted seal (*Phoca largha*), and bearded seal (*Erignathus barbatus*). The Pacific walrus (*Odobenus rosmarus divergens*) may occasionally occur in the development area. Beluga whales (*Delphinapterus leucas*) are common offshore during the open-water season. Polar bears (*Ursus maritimus*) inhabit marine environments throughout the year and may use habitats near the project area for denning. Because polar bears have recently been nominated for listing as a threatened species under the Endangered Species Act, discussions of this species are included in the Threatened and Endangered Species sections of this EA. The bowhead whale (*Balaena mysticetus*) is also listed as endangered under the Endangered Species Act and is addressed in the Threatened and Endangered Species section.

3.1.7.1 Noise/Activity Disturbance

Noise and activity associated with the SDI expansion will not cause disturbance to beluga whales because the expansion will occur during winter when beluga whales are absent from the area. Activities related to facility installation that occur during the summer are not likely to affect beluga whales because they migrate well offshore from the barrier islands and are not common in the SDI area.

Noise and activities during the SDI expansion could affect seal behavior and distribution in the area, but the extent of disturbance is likely to be minimal. Underwater noise is unlikely to travel more than 2 km because of the rapid attenuation of industrial sounds in shallow waters (Blackwell and Greene, 2001). Blackwell, Greene, and Richardson (2004) reported underwater broadband sound levels from Northstar Island activities during winter reached background levels at distances of 3 to 4 km from the island. In addition, some seals may become habituated to industrial sounds, thus minimizing potential disturbance. Blackwell, Lawson, and Williams (2004) reported that 23 ringed seals showed little to no reaction to industrial noises during 55 hours of observation, and some seals were as close as 46 m to the island. Two of the 23 ringed seals looked at the island, 10 seals looked at a helicopter, and 1 seal returned to the water from the ice as a helicopter approached. Helicopters would be used during emergency situations only and would not be likely to disturb seals near the SDI. Moulton et al. (2002, 2003, and 2005) reported that limited winter industrial activity at Northstar Island did not appear to significantly affect ringed-seal density in the spring. Williams et al. (2006b) reported no relationship between ringed seal use of subnivean structures and the distance of those structures from Northstar Island. It is unlikely that large numbers of seals would be impacted by noise and activity disturbances during the SDI expansion and facility installation.

3.1.7.2 Small Spills or Leaks

It is unlikely that small spills (<200 bbl of crude oil) or leaks of oil, chemicals, or wastewater arising from the Liberty (SDI) Project will impact marine mammals. Such discharges would likely be contained and cleaned up immediately and are unlikely to enter the marine environment. Spill-prevention measures are required to be implemented during expansion of the SDI to keep small releases of pollutants from entering the marine environment.

3.1.7.3 Marine Access

The sealift required to transport Liberty (SDI) Project facilities has the potential to temporarily displace marine mammals adjacent to the route. Disturbances are most likely to arise when a barge passes near swimming beluga whales, walruses, or seals, or near seals, and walruses hauled out on ice. Underwater noise from vessel traffic was detected up to 27 km from the source by Blackwell and Greene (2006) during monitoring work near Northstar Island, but the radii in which marine mammals would be displaced is likely to be much smaller. Any disturbance to marine mammals from a sealift would be temporary (USDOI, MMS, 2002). There is the potential for a vessel to strike a marine mammal causing injury or death, but a strike would be very unlikely with currently only one sealift proposed for the project.

3.1.7.4 Loss of Habitat

Expansion of the SDI will increase the current footprint on the seafloor by 20 acres, which will be lost as seafloor habitat for marine mammals. Small numbers of seals might use this area to feed. Frost et al. (2004) reported that ringed-seal densities on landfast ice in the Alaska Beaufort Sea from 1996 to 1999 ranged from 0.57 to 1.14 seals/km^2 and were highest in water depths from 5 to 35 m. Moulton et al. (2002) reported that ringed-seal densities on landfast ice in the Alaskan Beaufort Sea from 1997 to 1999 were 0.39, 0.35, and 0.56 seals/km^2, respectively, with the highest densities occurring in 5 to 15 m of water. Seal densities were significantly lower in shallow water <3 to 5 m (Moulton et al., 2002; Frost et al., 2004). Water depths surrounding

the SDI are generally 3 m or less, and it is unlikely that large numbers of seals use this habitat. Based on the larger seal density of 1.14 seals/km^2 in deeper water reported by Frost et al. (2004), habitat that might support approximately 0.10 seals could be lost due to gravel placement for the SDI expansion. Habitat loss for seals and other marine mammals from the SDI expansion is likely to be negligible.

3.1.7.5 Water Quality (Suspended Sediments)

The SDI working surface and seafloor footprint will be expanded from 11 to 31 acres through gravel placement. Suspended sediments resulting from construction activities during gravel placement will increase water turbidity in the area immediately around the expansion.

3.1.7.6 Summer Erosion

The SDI is located in the Sagavanirktok River delta. Large river deltas naturally experience pulses of erosion and turbidity from rain and runoff events. Increased turbidity from SDI expansion is anticipated to be short-lived, and most suspended material is expected to settle to the seafloor within or adjacent to the footprint of the pad expansion (see Section 3.1.2 for greater detail). Erosion from the expansion of the SDI should not be substantial enough to create changes in the water quality that will be likely to affect marine mammals. The after-abandonment effects on turbidity of the SDI addition and whole causeway are discussed further in Section 3.3.2.

3.1.8 Marine and Coastal Birds

Among the marine and coastal birds within the Liberty (SDI) Project area, the species most likely to be affected by the expansion of the SDI are species that are abundant in the vicinity of the project (snow geese), species with small total population sizes (red-throated loon, jaegers, tundra swan, brant, buff-breasted sandpiper), and species with declining population trends (long-tailed ducks, dunlin, phalaropes, and sandpipers).

3.1.8.1 Noise/Activity Disturbance

Gravel excavation and hauling from the newly developed mine site will occur during winter when most birds do not remain on the Arctic Coastal Plain. Noise from installation of sheetpile slope protection during January to March would not affect migratory birds.

Noise from grading and compaction activities during July to December could disturb and displace small flocks of molting long-tailed ducks and a few foraging red-throated loons and Pacific loons in the vicinity of the SDI. Disturbance could decrease foraging efficiency of long-tailed duck, common eider, and loons, negatively affecting their energetics. Disturbance due to gravel pad grading and compactions would be short-term, limited to one summer.

Nesting common eiders (~16 nests) and glaucous gulls (~4 nests) on the exploration pad for Duck Island 1 & 2, located west of the expanded SDI pad, could also be disturbed by expansion-related activities at SDI. Disturbance could interrupt nesting behaviors. Disturbance during nesting could lead to nest abandonment with subsequent death of eggs or young (Johnson, 2000b).

3.1.8.2 Water Quality (Suspended Sediments)

Erosion of the expanded SDI during the summer would increase turbidity in the vicinity of the expansion. Increased turbidity would hinder capture of prey by marine birds such as long-tailed ducks, common eiders, red-throated loons and Pacific loons, which dive for fish and invertebrate prey. Reduced water quality would be considered a temporary source of displacement if coastal and marine birds were forced to forage elsewhere.

3.1.8.3 Oceanography

The SDI expansion would potentially change water movements and sediment deposition around Duck Island 1 & 2, leading to alteration of the oceanographic processes that have shaped this abandoned exploration pad that is presently used by nesting common eiders and glaucous gulls. The exploration island could either become attached to the expanded SDI, or could be reshaped by an erosion channel between the SDI and the island. In either case, it is possible that access by arctic fox and bear may be enhanced by its proximity to the expanded SDI, thereby making this habitat unsuitable for nesting, as has been observed at the Endicott Causeway (Johnson, 2000b). Should loss of this nesting habitat occur, approximately 16 common eider and 4 glaucous gull nests would be displaced. If eider nesting habitats are limited, the nesting capacity of the eider population would be reduced. It may be possible to monitor the situation and either retain an effective separation between the expanded SDI and Duck Island 1 & 2 or create/replace similar nesting opportunities elsewhere.

3.1.8.4 Bird Strikes

Increased traffic on the access road during expansion of the SDI could limit the ability of some tundra-nesting birds and their broods to access coastal habitats. Some of these broods (particularly snow geese and brant) could be struck by vehicles when attempting to cross the roadway or could avoid crossing the road and experience increased predation. The present level of mortality from roadkill is unknown. BPXA informed FWS that speed limits on the Endicott road system are reduced from 45 miles per hour (mph) to 35 mph between July 1 and August 15 to protect snow geese. The reduced speed limit for vehicles during the nesting and/or broodrearing period could help reduce the negative effects of increased construction traffic. These negative effects are difficult to estimate, but the reporting of roadkill birds could help evaluate whether this is a substantial form of mortality to some coastal and marine bird species.

Increases to existing bird strike mortality is assumed to be low (<20 birds/year), however mortality could be larger due to episodic events such as a flock of birds colliding with structures (especially during periods of darkness or inclement weather) or entire broods could be struck by one vehicle. The removal of a hen would guarantee the death of an entire brood. Overall, expansion of the SDI will increase the potential for bird mortality, but this increase is not anticipated to be major. Per the FWS Final Biological Opinion (BO), BPXA must report all avian mortalities and collisions (including vehicle collisions) and their circumstances. The transmission of these data will help verify the assumption that collision mortality is low and negative effects are small.

3.1.8.5 Marine Access

Late-summer barge traffic to the MPI and/or SDI could cause short-term displacement of molting and foraging long-tailed ducks, common eiders, red-throated loons and Pacific loons. As

the barges are generally slow-moving, these birds have an opportunity to move away from the approaching vessel before any direct harm occurs. The infrequent disturbance to these birds is not expected to result in a major impact.

3.1.8.6 Small Spills or Leaks

Minor spills (<200 bbl of crude oil)and leaks of oil, chemicals, or wastewater could affect the quality and abundance of prey species for diving seabirds. However, chronic discharges of small amounts of petroleum compounds could reduce water repellency of bird feathers, compromising their insulative capacity, resulting in hypothermia and death/drowning. The most abundant species (long-tailed ducks, common eiders, red-throated loons and Pacific loons) would experience the largest collective mortality, but smaller populations would be impacted to a disproportionately greater degree. Preventive measures are required to be implemented during construction to keep small releases of pollutants from entering the marine environment where they could impact a large number of birds prior to an active spill response.

3.1.8.7 Increased Bird-Predator Populations

Wildlife access to human-use foods during expansion of the SDI could increase the abundance and distribution of predatory birds (ravens, gulls) and mammals (foxes, bears) in the area. Per the FWS Final BO (see Appendix C of this EA), BPXA intends to implement techniques to prevent wildlife accessing anthropogenic food and waste. These techniques include installation of predator-proof dumpsters, new refuse-handling techniques; and educating their workforce on problems associated with feeding wildlife. If these techniques are effective, increased bird mortality from enhanced predator populations should not affect coastal and marine birds.

3.1.8.8 Habitat Effects

Some tundra-nesting and foraging habitats (~39 acres) temporarily would be unavailable during the spring following ice road construction. The ice road and associated snowdrifts likely would not melt before shorebirds and other migrants establish breeding territories and nesting sites.

Snow geese use wet meadows along the north side of the Endicott Road to grub for rhizomes during early spring, prior to nesting on Howe Island. The proposed ice road, north of the Endicott Road, crosses through early-spring foraging habitats and summer broodrearing habitats used by snow geese, tundra swans, and brant. Late melting of the ice road would delay the development of sedges and other forage species. The delay in forage maturation decreases the fiber content and increases the nutritional value as forage for brood-rearing geese in July and August (Gadallah and Jefferies, 1995; Piedboeuf and Gauthier, 1999). Ice road construction would alter local nesting distributions and habitat usage during spring and summer. These changes would be short-term (1 to 2 years), and localized, and minimal habitat impacts are anticipated.

3.1.9 Terrestrial Mammals

Among the terrestrial mammals that occur in the Liberty (SDI) Project area are, caribou, muskoxen, grizzly bear, arctic fox, arctic ground squirrels, and lemmings. These are the species potentially affected by development.

3.1.9.1 Noise/Activity Disturbance

Noise in the outer delta may displace caribou from coastal insect-relief habitats such as mud flats, nearshore islands such as Howe Island, and coastal spits. Prolonged displacement of caribou from these insect-relief habitats is not likely from the intensity and duration of activity proposed, and no population-level impacts are anticipated. Muskoxen are seldom observed in the project area; therefore, very few individuals would be affected, and no population-level impacts are anticipated.

3.1.9.2 Oceanography

Alteration of longshore currents, sediment deposition patterns, or Sagavanirktok Delta circulation patterns could lead to increased sediment deposition around Howe Island or Duck Island, perhaps connecting the islands to the SDI and causeway, thereby facilitating predator access to these islands and their colonial-nesting snow geese, brant, and glaucous gulls. Easy access across shallow water or ice to these areas with high concentrations of readily accessible forage, eggs, goslings, and adults would have a positive effect on local bears and foxes.

3.1.9.3 Increased Road Traffic

Construction traffic along the Endicott Road would be heaviest during installation of well pad facilities, the drilling rig, and the ***LoSal™*** enhanced oil recovery (EOR) process plant and drilling operations during summer and fall. Traffic levels of more than 15 vehicles/hour would hinder crossing of the Endicott Road by large groups of caribou, which may exclude them from some coastal insect-relief habitats (Murphy and Lawhead, 2000). Caribou do not usually calve in the Sagavanirktok River delta; therefore, changes in calving-caribou habitat use or distribution due to project construction are not anticipated. Oil field policies give caribou the right-of-way when crossing roads. Large groups of caribou crossing the road may cause traffic delays of up to several hours.

Many caribou in the vicinity of the North Slope oil fields are habituated to typical construction traffic levels. Collision mortality would likely increase with the increasing traffic levels and the increasing size of the Central Arctic Caribou Herd. However, mortality would likely remain low, with no population-level effects anticipated.

Increased traffic would lead to increased collision mortality for arctic ground squirrels and arctic foxes. Grizzly bears and muskoxen rarely occur in the project area and are not likely to be hit by trucks. A few collisions may occur over the life of the project resulting in injury or death of a few individuals. Speed limits and driver safety programs are designed to reduce collisions of vehicles with large mammals, and population effects are not anticipated.

3.1.10 Wetlands and Vegetation

Expansion of the SDI will greatly reduce the impact to wetlands and vegetation associated with the Liberty development compared to the other alternatives. The major impacts to wetlands and vegetation will occur during development of the gravel mine site (discussed in Section 3.2.7) and transportation of materials and personnel to and from development areas.

3.1.10.1 Small Spills or Leaks

It is unlikely that minor spills (<200 bbl of crude oil) or leaks of oil, chemicals, or wastewater arising from activities at the SDI will impact wetlands and vegetation. The SDI is composed of

gravel fill deposited to support Endicott development and is largely barren of vegetation. Such minor discharges would likely be contained and cleaned up immediately.

3.1.10.2 Increased Road Traffic to Site

Traffic along the Endicott Road would increase to accommodate Liberty development and construction activities. Fallout from dust plumes associated with vehicle traffic has the potential to alter wetland characteristics and vegetation communities. The highest levels of traffic would likely occur during facility installation and infrastructure construction. Xeric, prostrate shrub-dominated communities and nonvascular species of moss and lichen are the most susceptible to impacts. Potential thinning of the vegetative canopy and altering of species composition would be the most common result of increased traffic and associated dust fallout (Auerbach, Walker, and Walker, 1997; Everett, 1980; Walker and Everett, 1987).

3.1.11 Threatened and Endangered Species

Three species listed as threatened or endangered under the Endangered Species Act occur in the Liberty (SDI) Project area: the bowhead whale (endangered), spectacled eider (threatened), and Steller's eider (threatened). The Kittlitz's murrelet (a candidate species) likely occurs in the Beaufort Sea and could be found in the Liberty (SDI) Project area.

Two other species—the polar bear (proposed for listing as threatened) and the yellow-billed loon (a draft 90-Day Finding has been released for public review)—are included in this section, as they may receive protection under the ESA during the life of the Liberty (SDI) Project.

The MMS completed consultation with FWS and NMFS as required by Section 7 of the ESA. The FWS completed a BO on October 3, 2007, that concluded the current Liberty (SDI) Project would not jeopardize populations of Steller's eiders, spectacled eiders, or Kittlitz's murrelets. The NMFS completed informal consultation on October 19, 2007, resulting in concurrence with MMS and the U.S. Army Corps of Engineers determination that the Liberty (SDI) Project is not likely to adversely affect the bowhead whale.

3.1.11.1 Noise/Activity Disturbance

Bowhead Whale

The noise and disturbance related to gravel deposition for the SDI expansion that will take place during the winter months of January through March will have no impact on bowhead whales that are wintering in the Bering Sea during these months. Following breakup, the newly deposited gravel will be machine-graded and vibra-compacted, a technique that uses a vibratory roller to condense gravel substrate. Noise from the compaction that may occur during the bowhead migration will not be likely to affect bowhead whales that are migrating offshore.

Any potential impacts will be mitigated by (1) the distance of migrating bowheads from the sound source, (2) the timing of the bowhead migration in the offshore waters of the project area, and (3) the rapid attenuation of sound likely to occur in the shallow waters of the project area. During the westward autumn migration bowhead whales are generally seaward of the barrier islands with annual variability in the mean distance offshore (Treacy, 2002a). The mean distance of migrating bowheads from shore in the Beaufort Sea west of Prudhoe Bay in 2000 (17.7 km) was less than for any single year (1982-2000) and much less than the cumulative mean (35.4 km; Treacy, 2002a). Blackwell et al. (2004) also reported interannual variability in the proximity of

migrating bowheads to shore in the southern portion of the bowhead migration corridor near Prudhoe Bay. The migration corridor tended to be closer to shore in 2003 than the previous 2 years.

Underwater acoustic measurements at nearby Northstar Island during the open-water period indicated that construction noise was inaudible beyond 1.85 km (Blackwell and Greene, 2001). This attenuation distance for construction noise is dramatically less than the distance (approximately 15 km) between the SDI and the bowhead whale fall migration corridor. The peak of the bowhead migration in the offshore waters of the project area occurs during August and September, thus, migrating bowheads will not be affected by activities associated with the SDI expansion proposed for June and July. Consequently, noise and activity disturbances related to SDI expansion would not be likely to affect bowhead whales. However, unforeseen events resulting in a delayed sealift during the bowhead whale migration could result in unanticipated disturbances to bowhead whales. Furthermore, seasonal variations in bowhead whale distribution could result in feeding aggregations of whales closer to shore than is typically noted. This scenario could also result in unforeseen disturbances to bowhead whales.

McDonald et al. (2006) noted subtle offshore displacement of the southern edge of the bowhead whale migration corridor ranging from 0.66 to 2.24 km during times of industrial activity on Northstar Island during the 2001-2004 migrations. However, Northstar Island is located about 5 km farther offshore than the SDI. Blackwell and Greene (2006) reported underwater industrial sounds from Northstar Island during the summer reached background levels at distances of 2 to 4 km from the island. The SDI lies landward of the barrier islands approximately 15 km from the bowhead whale fall migration corridor. Water depth near the SDI is shallower than near Northstar Island, and underwater noise would likely attenuate more rapidly in the SDI area. Additionally, the barrier islands act as another impediment to industrial sounds originating in nearshore areas (USDOI, MMS, 2002). Per the informal consultation dated October 19, 2007 (refer to Appendix D of this EA), NMFS stated "…while the Liberty project may affect these whales, our assessment…finds any such effects are insignificant (such effects could not be meaningfully measured or detected) or discountable (such effects would not reasonably be expected to occur)."

Polar Bear

Ice road construction that is scheduled to begin in January could disturb polar bears in nearby maternal den sites, because denning is typically initiated during November and December. Bears leaving den sites with cubs during March and April also could be disturbed by noise and activity. Newborn polar bears are among the most undeveloped of placental mammals; therefore, undisturbed maternal dens are critical in protecting them from the rigors of the arctic winter for the first 2 months of life (Amstrup, 2000). Denning females are particularly sensitive to disturbance, and any cubs driven from their dens at this time likely would die. Substantial changes in cub survival and physical stature would have population-level effects (Regehr et al., 2006). For example, in other regions, declines in cub survival and physical stature were documented before statistically substantial declines in population size were confirmed. Therefore, protecting core maternity denning areas per the existing FWS Letter of Authorization (LOA) mitigation measures is important to the long-term conservation of polar bears.

Food and associated odors could attract polar bears during the SDI expansion. This could result in hazing to drive bears from the area, or in destruction of problem bears. Current North

Slope practices are designed to minimize or eliminate the potential for polar bear attraction to developed areas.

ESA-protected Birds

Much of the SDI expansion work is scheduled to take place during the winter when eiders, murrelets, and loons are absent from the project area. Noise and activity disturbances continuing into the spring nesting season at the SDI site likely will have minimal effects on eiders nesting on inland tundra habitats. Noise and human activity may displace male eiders, female eiders with broods, murrelets, and yellow-billed loons from marine habitats in the immediate area of the SDI during the postbreeding period. However, these temporary impacts should be minimal due to the large amount of similar habitat in the surrounding area and the low density of these species in the project area.

3.1.11.2 Water Quality (Suspended Sediments)

The SDI working surface and seafloor footprint will be expanded from 11 to 31 acres through gravel placement. Suspended sediments resulting from construction activities during gravel placement will have the potential to increase water turbidity.

ESA-protected Birds

As with noise and human activity, the alteration of water quality may render habitats in the immediate area of the SDI useless to birds. However, these temporary impacts to eiders, murrelets, and loons should be minimal due to the large amount of similar habitat in the surrounding area and the low density of these species in the project area.

3.1.11.3 Summer Erosion

Erosion of fine sediment and increased turbidity in waters surrounding the SDI is very unlikely to impact bowhead whales. The main migratory corridor used by bowhead whales during their annual migration is outside the barrier islands nearly 15 km offshore from the SDI. This corridor makes bowhead occurrence near the SDI very unlikely. Furthermore, summer erosion and increased turbidity occur naturally and are properties inherent to large river deltas like the Sagavanirktok River.

ESA-protected Birds

As with noise and human activity, the alteration of water quality may render habitats the immediate area of the SDI useless to birds. However, these temporary impacts to eiders, murrelets, and loons should be minimal due to the large amount of similar habitat in the surrounding area and the low density of these species in the project area.

3.1.11.4 Small Spills or Leaks

It is unlikely that minor spills (<200 bbl of crude oil) or leaks of oil, chemicals, or wastewater during SDI expansion will impact bowhead whales and polar bears. Such minor discharges would likely be contained and cleaned up immediately and are unlikely to enter the marine or terrestrial environments used by them.

ESA-protected Birds

Minor spills and leaks of oil could affect the quality and abundance of prey species for diving seabirds. Chronic discharges of small amounts of petroleum compounds during SDI expansion ultimately could reduce water repellency of bird feathers, compromising their insulative capacity, resulting in hypothermia and death/drowning when these materials melt out of ice and snow. The greatest potential for impacts are to migrating flocks of spectacled eiders (during the spring and fall), but the loss of fewer yellow-billed loons could result in a disproportionately greater impact. Spill prevention measures are required to be implemented during expansion of the SDI to keep small releases of pollutants from entering the marine environment where they could impact a large number of birds.

3.1.11.5 Increased Road Traffic to Site

Increased road traffic during SDI expansion is not expected to have any effects on bowhead whales in the offshore, marine environment.

Much of the SDI expansion is scheduled to take place during the winter when eiders, murrelets, and loons are absent from the project area.

3.1.11.6 Bird Strikes

There is the potential for spectacled and Steller's eider mortality to result from collisions with infrastructure at the SDI and MPI because eiders fly at relatively low altitudes over the water. Day, Prichard, and Rose (2005) reported the mortality of 36 common and king eiders as a result of collisions with facilities at Northstar Island and Endicott over a 4-year period. Collisions can occur with the sheetpile bulkhead and slope barrier protection.

Spectacled eider density is typically greater in the Liberty (SDI) Project area than Northstar Island (at the eastern extent of its range) and Steller's eiders are rare in the area. Nevertheless, spectacled eiders, in particular, are most susceptible to collisions with Liberty (SDI) Project facilities. The low numbers of these two listed eider species in the area should result in a lower potential for collisions with Liberty facilities at the SDI. Conservation measures are required to decrease the potential for spectacled eiders being killed via collisions with infrastructure on the SDI and the MPI. Per the FWS Final BO, BPXA must work with the FWS to design, install, and operate strobe warning lights for the Liberty (SDI) Project.

3.1.11.7 Increased Bird-Predator Populations

Access to human-use foods during facility construction could help increase the abundance and distribution of ravens, bears, or arctic foxes in the area. Efforts to eliminate wildlife access to human-use foods/garbage will be implemented at the beginning of facility construction. Per the FWS Final BO, BPXA intends to implement techniques to prevent wildlife accessing anthropogenic food and waste. These techniques include installation of predator-proof dumpsters, new refuse-handling techniques, and educating their workforce on problems associated with feeding wildlife. If these techniques are effective, increased predation from enhanced bird-predator populations should not affect ESA-listed birds.

3.1.11.8 Habitat Effects

Gravel for the SDI expansion would be mined from the Duck Island Mine Site. While this activity would occur during the winter, the gravel pit is in spectacled eider nesting habitat, and at

least 65 acres of this habitat would be affected. As presently described, all of this nesting habitat would be permanently lost. The Mining and Rehabilitation Plan (Appendix I of this EA) implements suggestions made by the ADNR regarding slope configuration and breaching of the water-diversion berm to enhance flooding of the abandoned mine site. The mine site rehabilitation could restore eider nesting habitats, and/or once the mine site completely fills and is connected to the ephemeral Duck Island Creek, it may potentially support nesting yellow-billed loons with fish from the creek.

Gravel mining would have the potential to result in a loss of habitat for spectacled eiders. Spectacled eiders have been observed in this area along the Sagavanirktok River delta during aerial surveys (TERA, 1996). Density estimates for spectacled eiders in this area have ranged between 0.04 and 0.32 eiders/km^2 (TERA, 1996) and 0.01 to 0.61 eiders/km^2 (Larned et al., 2006). Spectacled eider density at the mine site could be up to 0.61 individuals/km^2; however, the surrounding areas have lower estimated densities of spectacled eiders. Due to the low density of spectacled eiders in the general area of the proposed mine site, few spectacled eiders would likely be displaced by mine site development. Based on the greater density of 0.61 eiders/km^2 reported by Larned et al. (2006), the 35 acres of disturbed land at the mine site might represent habitat loss for approximately 0.09 spectacled eiders.

Ice from ice roads has the potential to linger over tundra after the surrounding snow has melted in spring. Lingering ice on the ice-road footprint could prevent this strip of tundra habitat from temporarily being used as nesting habitat for spectacled eiders. Tundra compaction beneath ice roads can result in structural changes to the plant community following melting of the ice (Walker, 1996), which could temporarily affect eider use within the ice road footprint. The compacted tundra may not recover for many years, making it unsuitable as eider habitat. This potential impact could be minimized by selecting an ice road route which avoids tundra near known eider-nesting locations and favors habitat not preferred by eiders, but it is unclear if BPXA would complete this work or whether it would prove successful in retaining eider nesting habitat. This is partially due to the likelihood that eiders would not nest near (within 200 m) the roadway due to traffic noise and other activity. Because road activity likely precludes nesting by eiders near the road, alterations of these habitats are not considered to have more than minimal effects.

Ice-road construction involves withdrawing water from deep lakes in areas adjacent to the Endicott Road. Bergman et al. (1977) reported that spectacled eiders at Point Storkersen used deep *Arctophila* lakes during prenesting, nesting, and postnesting periods. Deep *Arctophila* lakes also have been used by brood-rearing spectacled eiders in NPR-A (Derksen, Rothe, and Eldridge, 1981). In addition, spectacled eiders often select nest sites near the edge of lakes, often within 1m of the shore. Withdrawal for ice roads that lowers the water level of lakes could affect spectacled eider nesting habitat. Most lakes would likely return to pre-withdrawal levels during spring flooding (Rovansek, Hinzman, and Kane, 1996), but care should still be taken when selecting lakes for water sources for ice roads. Water taken from deep open and deep *Arctophila* lakes should be minimized or avoided as these lakes may be used by spectacled or Steller's eiders. However, these are the lake types most suitable as water sources for ice road construction from an industry perspective and BPXA has not committed to avoiding the use of lakes important to spectacled eiders.

Similarly, water drawn from deepwater lakes to create the ice roads could alter nesting habitats used by yellow-billed loons. While BPXA has stated they would survey these lakes for their use by loons prior to ice road construction, it remains unclear if BPXA would actually avoid withdrawing water from lakes used by loons. The temporary loss of nesting habitat for up to

three pairs of yellow-billed loons for up to 2 seasons would not be considered a major impact, but it is an impact that could be avoided.

3.1.12 Cultural Resources

In accordance with NHPA provisions of the November 24, 2006, Memorandum of Understanding among MMS, the U.S. Army Corps of Engineers, ADNR, and BPXA:

> The MMS, after consultation with the COE and other cooperating agencies, will notify BPXA if it determines that it is necessary to assess whether the Liberty (SDI) Project may affect archaeological resources within the project area. The MMS will request that BPXA provide archaeological and, if required, traditional cultural properties reports in accordance with the National Historic Preservation Act of 1966 (16 USC § 470 et seq.). The MMS will consult with the State Historic Preservation Officer and applicable Tribal Historic Preservation Officers, if necessary. This consultation will also cover the cooperating agency permit review requiring consultations.

The SHPO, in letters to BPXA on January 26, 2007, and the U.S. Army Corps of Engineers on June 8, 2007, requested that archaeological surveys be conducted in the Liberty (SDI) Project areas that previously had not been surveyed. These project areas would include locations where project activities such as ice road construction, gravel extraction, SDI expansion, West Sagavanirktok River Bridge upgrade, pipeline construction, facilities installation, and new drill rig construction could occur. BPXA notified MMS on July 2, 2007, that a cultural resources survey contract has been awarded to Reanier & Associates, with a final report expected in late 2007.

The MMS, after consulting the State of Alaska AHRS database, has identified no cultural and archaeological sites offshore, nearshore, or onshore within the area of potential effect of the Liberty Development Project. The SHPO concurred with the MMS determination of no effect to offshore historic or prehistoric resources. The U.S. Army Corps of Engineers agreed to the responsibility to conduct a separate consultation in accordance with NHPA for onshore resources. Refer to Appendix F for SHPO consultation correspondence.

3.1.13 Socioeconomics and Related Impacts

This section discusses the possible socioeconomic and related impacts (including subsistence-harvest resources, sociocultural, and environmental justice) associated with the SDI expansion. As noted in the above paragraphs, possible impacts of SDI expansion could arise from noise/activity disturbance, small operational spills of refined products (no large crude spills from drilling or production), and the temporary presence of construction workers in the area.

3.1.13.1 Economy and Sociocultural Systems

The Liberty FEIS (USDOI, MMS, 2002) estimated that the entire project would generate 870 full-time equivalent (FTE) construction jobs and an additional 1,248 indirect FTE jobs in Alaska during 14 to 18 months of construction. The new alternatives are likely to have smaller labor requirements, and only some of these jobs would be associated with SDI expansion. For example, the maximum annual number of workers required during SDI expansion (and associated onshore construction) is estimated to be 116. In principle, adverse sociocultural impacts could arise from either adverse impacts on subsistence-harvest resources or an influx of substantial

numbers of workers. However, neither impact is anticipated, and no major sociocultural impacts associated with the SDI expansion are expected.

3.1.13.2 Subsistence and Area Use Patterns

Subsistence-harvest data are presented in the affected environment section. These data indicate that (in terms of total subsistence harvest for the potentially affected communities) the major subsistence foods include caribou, bowhead whales, and various types of fish (e.g., cisco and broad whitefish). Conclusions on possible impacts of SDI expansion on important subsistence resources are addressed in this EA and is *summarized* as follows:

- Section 3.1.6, Fish and Essential Fish Habitat: Noise/activity disturbance; ice road construction; gravel/mine site development; refined oil spills; water quality; and oceanography are not expected to have any measurable effect on arctic fish populations in the project area, and EFH will not be adversely affected.
- Section 3.1.9, Terrestrial Mammals: Noise/activity disturbance; oceanography; increased road traffic will affect very few individuals, and no population-level impacts are anticipated.
- Section 3.1.11, Threatened and Endangered Species (bowhead whale, spectacled eider, Steller's eider, and polar bear [proposed]): No major impacts on any of these species are anticipated as a result of noise/activity disturbance. Food and associated odors could attract polar bears during the SDI expansion, which could result in hazing to drive bears from the area or in the destruction of problem bears. Polar bears are unlikely to be seriously impacted by noise and activity disturbances from the SDI expansion. Small spills or leaks of oil, chemicals, or wastewater from the Liberty (SDI) Project are unlikely to impact bowhead whales, polar bears, or spectacled eiders.

In addition to the above, potentially major impacts might occur on the subsistence bowhead harvest if the sealift occurred during critical migration and hunting periods. However, if the sealift were delayed into September for any reason, BPXA would coordinate the sealift activity with the AEWC and Barrow and Nuiqsut Whaling Captains Associations through a Conflict Avoidance Agreement (CAA) or other communication mechanisms. Consistent with safe navigation and ice conditions, the sealift may be routed inshore to avoid migrating bowhead whales and subsistence whaling.

There are not expected to be any major effects on possible subsistence-harvest resources resulting from noise/activity disturbance or small operational spills of refined products during SDI expansion. And, if the sealift were delayed, measures would be taken to mitigate any major effect.

3.1.13.3 Environmental Justice

Adverse sociocultural or subsistence resource impacts would raise environmental justice issues, because (as noted elsewhere in this EA) the majority of the population is a recognized minority. However, major impacts to subsistence resources and harvests, and sociocultural systems are not anticipated; therefore, disproportionate high adverse environmental justice impacts are not anticipated as a result of SDI expansion.

3.1.14 Waste Management

All waste from the Liberty (SDI) Project would be handled in accordance with State, Federal, and local regulations. Use of permitted disposal wells and other approved disposal methods will result in zero surface discharge of drilling wastes and, in conjunction with BPXA's waste minimization policy, will result in little or no impact from waste disposal. See Section 10 of the Liberty DPP for more information on waste handling.

3.2 ONSHORE CONSTRUCTION

To take advantage of the infrastructure at Endicott, BPXA proposes to drill the uERD wells from the SDI by expanding the island by approximately 20 acres to support Liberty (SDI) Project drilling. Water for waterflooding to maintain reservoir pressure will be provided via the existing produced-water injection system available at the SDI, augmented by the ***LoSal™*** EOR process supplied by a ***LoSal™*** facility constructed on the MPI.

Associated onshore facilities to support this project will include upgrade of the existing West Sagavanirktok River Bridge, ice road construction, and development of a new permitted mine site adjacent to the Endicott Road to provide gravel for expanding the SDI. Existing North Slope infrastructure will also be used to support the project. The proposal to construct a new bridge across the west channel of the Sagavanirktok River as discussed in the April 2007 DPP has been removed from the Project Description. Per the BPXA Design Basis and Preliminary Construction Plan, dated September 2007, the existing Sagavanirktok River Bridge will be upgraded by replacing the superstructure. The bridge capacity will match the capacity of the existing Endicott bridges at 175 tons.

This approach will require the existing bridge superstructure to be dismantled. New pile caps will be installed on the existing steel pipe pile supports, which are embedded into the river bed to approximately 60+ ft. The single lane (approximately 18± ft between the guard rails) box girder bridge will have prestressed concrete deck panels will be installed on the refurbished bridge supports. This work will not entail driving new piles, icebreaking piers, or bridge revetments. Instead, gravel fill inside the existing piers will be removed to the mud line. A reinforcing steel cage will be lowered into the hollow steel pier. The pier will then be filled with concrete, this will strengthen the bridge piers against ice loads.

The state-of-the-art of uERD wells for this project will be outside current reach of industry technology performance. As a result, BPXA first plans to drill a single well to assure that such drilling is feasible. If that well is successful and the technology is proven, then BPXA will proceed with drilling additional wells and installing new facilities to complete the project as described in the 2007 Liberty DPP.

3.2.1 Air Quality

The ambient air pollutant impacts due to onshore construction of the permanent Liberty facilities are expected to be within the limits of the National and Alaska AAQS. Pollutants will be emitted from temporary operations and/or mobile equipment such as diesel-fired construction equipment, and temporary electrical generators. Pollutant emissions from marine vessels are expected to be negligible because, with the exception of a single sealift, marine vessels will not be used to support construction of the SDI expansion. Pollutant emissions from aircraft are expected to be negligible for the same reason. Fugitive particulate-matter emissions may result from local traffic, but will be minimized through fugitive-dust abatement techniques such as road

watering. As part of the air permitting process, ADEC will review the construction equipment inventory and the construction plans to ensure compliance with the National and Alaska AAQS. A dispersion modeling analysis of project emissions will be included in the air permit application and will demonstrate National and Alaska AAQS compliance. An ambient-air-quality monitoring station has been in operation on the SDI since February 2007 to provide data to support air quality permitting.

3.2.2 Hydrology

The SDI is accessed by the existing Endicott Road. Increased use of this road for the Liberty (SDI) Project would require upgrading of the bridge at the Sagavanirktok West Channel to provide higher capacity. Environmental consequences of this action on the local hydrology would be negligible, because the new superstructure will be identical in length to the existing bridge. Flow patterns through the bridge will not change. Construction-related consequences will be minimized by installation of the new superstructure during the winter, when the river and ground are frozen.

3.2.3 Fish and Essential Fish Habitat

3.2.3.1 Pipeline Construction

The only pipeline construction associated with the project will be from the two Liberty (SDI) Project pipelines that will run approximately 3 mi from the SDI to Endicott MPI. The new pipelines will be located entirely on the existing gravel causeway and will not physically affect fish habitat. Construction noise is not likely to affect fish, and if it does the impact will be localized and avoidable. These are the only pipelines planned for construction. If construction noises do disturb fish, the effect would be localized and avoidable.

3.2.3.2 Small Spills or Leaks

It is unlikely that minor spills (<200 bbl of crude oil) or leaks of oil, chemicals, or wastewater arising from the Liberty (SDI) Project pipeline construction will impact fish or EFH. Such minor discharges likely would be contained and cleaned up immediately, and it is unlikely that any would enter the marine environment.

3.2.3.3 West Sagavanirktok River Bridge and Causeway Culverts

BPXA proposes to upgrade the existing Sagavanirktok River Bridge superstructure. Permitting for the bridge superstructure upgrade will be overseen by the U.S. Army Corps of Engineers and the ADNR OHMP. All work related to the bridge project will occur in the winter.

The current Sagavanirktok River vehicle bridge and the associated causeway and culverts across the floodplain have a history of adversely affecting anadromous fish habitat. The Sagavanirktok River has been specified as being important for the migration, spawning, or rearing of anadromous fishes in accordance with Alaska Statute 41.14.870(a). At least two deep-water overwintering holes are located near the existing bridge and pipeline crossing (Morris, 2000). One is located directly adjacent to the roadway bridge (Bjerklie, 1991a, 1991b, 1993). The hole has maximum depth of about 3 m, with an average depth of about 2.5 m and a cross-river width of 70 m (Bjerklie, 1991a, 1991b, 1993). The upstream and downstream extent of the hole is unknown, but the site provides major overwintering habitat for several species of

freshwater and anadromous fish. In the Sagavanirktok watershed, freshwater species such as grayling, round whitefish, and burbot often overwinter collectively in the few deep-water sanctuaries that are available (Bendock, 1981). The sites near the bridge also appear to be a major overwintering and possibly a spawning area for broad whitefish (Morris, 2000).

The risk to fish during winter operations would be possible disturbance of overwintering areas near the bridge. Streambed disturbance in areas where there is under-ice free water could increase turbidity, and if oxygen-demanding materials are discharged, decreased oxygen levels could be stressful or even lethal to fish. Morris (2000) found that under natural conditions, water quality at overwintering sites in the Sagavanirktok River degrades considerably over the course of the winter. Space becomes more cramped as ice cover thickens and oxygen levels decline. All of the sites that he surveyed were considered either marginal or failed. Such conditions indicate that any fluctuation in environmental conditions potentially can have major effects on fish overwintering survival.

Construction noise generated from the superstructure upgrade could stress or injure overwintering fish. Disturbance during construction or permanent loss of habitat in the vicinity of the construction site is unlikely to result in irreparable damage to fish populations. Stock estimates for broad whitefish 120 to 250 mm in length indicate that the Sagavanirktok population expands and collapses on a regular basis (Gallaway et al., 1997). Population estimates for the period 1982-1984 and 1988-1992 ranged from a low of 25,800 in 1984 to 432,341 in 1990. It is doubtful that a population of this size would rely on a single overwintering site to sustain stock integrity. Craig (1989) postulated that North Slope fish populations reduce their chances of extinction by spreading their members over many overwintering sites, and a significant impact at any one site would not eliminate all members of the population.

The ADF&G's Fish Distribution Database indicates that adult pink and chum salmon have been infrequently documented in the Sagavanirktok River. However, spawning activity or juvenile life stages have not been documented. Essential Fish Habitat will not be adversely affected by bridge construction activity.

3.2.4 Marine Mammals

3.2.4.1 Ice Road Construction (Winter Only)

The Liberty (SDI) Project will involve construction of an ice road approximately 11 km long from a mine site adjacent to the Endicott Road to the SDI. The proposed route will be located adjacent to the Endicott Road and will transit approximately 6.4 km of tundra habitat and 4.8 km of marine environment. Noise and activities from ice road construction could impact marine mammals in the area.

Beluga whales and Pacific walruses are absent from the Liberty (SDI) Project area in winter. Ice road construction and use will occur in winter and will have no effect on beluga whales or walruses.

Adult seals and their pups could be displaced during ice road construction, but seal density near the coast along the ice road route is low (Moulton et al., 2002). Moulton et al. (2002, 2003, and 2005) reported that limited winter industrial activity at Northstar Island, including ice roads, did not appear to significantly affect ringed-seal density in the spring. Williams et al. (2006b) reported no relationship between ringed-seal use of subnivean structures and the distance of those structures from ice roads associated with Northstar Island. Additionally, water along much of the proposed ice road route could be shallow enough to freeze to the bottom during winter and be

unsuitable for use by seals. Ice-road construction for the SDI expansion would have little effect on seal abundance or distribution.

3.2.4.2 Pipeline Construction (SDI to MPI)

The Liberty (SDI) Project will involve construction of two new pipelines between the MPI and SDI along the Endicott Causeway during the winter. No marine mammals are expected to be close enough to be impacted by this activity.

3.2.4.3 Small Spills or Leaks

It is unlikely that minor spills (<200 bbl of crude oil) or leaks of oil, chemicals, or wastewater arising from the Liberty (SDI) Project pipeline construction will impact marine mammals. Such minor discharges would likely be contained and cleaned up immediately, and it is unlikely that any would enter the marine environment. Spill-prevention measures are required to be implemented during pipeline construction to keep small releases of pollutants from entering the marine environment.

3.2.5 Marine and Coastal Birds

3.2.5.1 Noise/Activity Disturbance

Noise and activities associated with upgrading the bridge would primarily occur during the winter and would not affect migratory birds. Similarly, the pipelines between the SDI and MPI are scheduled to be constructed in winter when most birds are absent from the project area and noise/activity impacts from pipeline construction are expected to be minimal.

Increased summer traffic would disturb birds along the Endicott Road, especially if traffic volumes are constant throughout the 24-hour day and occur during the months of July and August. Disturbance to birds from vehicle traffic on the North Slope has been noted for brant and for Canada and white-fronted geese, and the extent of disturbance was shown to be directly correlated with the birds' distance from the road (Murphy et al., 1988; Murphy and Anderson, 1993). Disturbance to birds (e.g., "heads up" behavior) was most apparent within 50 m of roads, but some disturbance was reported as far as 150 to 210 m from the road (Murphy and Anderson, 1993). These disturbances occurred most often prior to nesting and during brood-rearing and fall staging when geese gathered to feed in open areas near roads. Susceptibility to this potential disturbance on eiders could depend on the stage of reproduction. Birds responding unfavorably to this noise and activity may be displaced to other, less suitable areas.

Noise and activity associated with facility construction at SDI and MPI could disturb and displace small flocks of molting long-tailed ducks and individual red-throated and Pacific loons. Disturbance could decrease foraging efficiency of long-tailed duck, common eider, and loons, negatively affecting their energetics. Disturbance due to these construction activities would be limited to less than 2 summers and these birds are anticipated to move short distances away from the disturbance to other habitats. These alternative habitats may be less suitable.

Nesting common eiders (~16 nests) and glaucous gulls (~4 nests) on nearby Duck Island 1 & 2 could also be disturbed by facility construction-related activities at SDI. Disturbance could interrupt nesting behaviors. Disturbance during nesting could lead to nest abandonment with subsequent death of eggs or young (Johnson, 2000b). Disturbance due to facility construction activities would be limited to <2 summers. Due to specialized nesting requirements of common eiders, it is unknown if these birds could locate alternative, suitable nesting sites.

3.2.5.2 Small spills or leaks

Minor spills (<200 bbl of crude oil) and leaks of oil or chemicals could affect the quality and abundance of prey species for diving seabirds around the SDI. Chronic discharges of small amounts of petroleum compounds could reduce water repellency of bird feathers, compromising their insulative capacity, resulting in hypothermia and death/drowning. The most abundant species (long-tailed ducks, common eiders, red-throated loons and Pacific loons) would experience the largest collective mortality, but smaller populations would be impacted to a disproportionately greater degree. Preventive measures will be implemented during onshore construction to minimize small releases of pollutants from entering the marine environment where they could impact a large number of coastal and marine birds prior to an active spill response.

3.2.5.3 Increased Road Traffic to Site

Increased vehicle traffic on the Endicott Road during facility construction could limit the ability of some tundra-nesting birds and their broods to access coastal habitats. Birds responding unfavorably to high levels of vehicular traffic could avoid crossing the road remain in areas where they could experience increased predation or be may be displaced to other, less suitable areas. These potential effects could be experienced for up to two years, until facility construction is completed. BPXA informed FWS that speed limits on the Endicott road system are reduced from 45 mph to 35 mph between July 1 and August 15 to protect snow geese. The reduced speed limit for vehicles during the nesting and/or broodrearing period could help reduce the negative effects of increased construction traffic. Per the FWS Final BO, BPXA must report all avian mortalities and collisions (including vehicle collisions) and their circumstances.

3.2.5.4 Marine Access

The sealift could temporarily displaced eiders, murrelets, and loons from preferred marine feeding habitats, but impacts would likely be minimal and displaced birds could use adjacent habitats or return to preferred habitats after sealift passage. Per the FWS Final BO, BPXA has committed to ensuring that vessels do not enter the Ledyard Bay Critical Habitat Unit located in the Chukchi Sea, where large numbers of flightless spectacled eiders molt.

3.2.5.5 Bird Strikes

Additional facilities constructed on both the MPI and SDI would lead to an incremental increase in bird strike mortality especially for migrating sea ducks, many of which fly low and fast along coastal areas during spring and fall migrations. The drilling rig, which will be approximately 250 ft tall, will be on the SDI for at least 3 years and could contribute to an increase in bird strikes when present. The present level of bird strike mortality associated with MPI facilities is unknown. The other buildings/facilities could contribute to additional collision mortality for the life of the project.

BPXA design engineers have committed to consult with the FWS on identifying and implementing ways to reduce how facility lighting attracts/disorients birds in the project vicinity. Effectively reducing escaped lighting is believed to reduce the potential for birds to strike facilities on the MPI and SDI. Per the FWS Final BO, BPXA has committed to the placement of warning strobes outside the eastern sheet-pile wall in an effort to help migrating eiders avoid the Endicott SDI. Also per the FWS Final BO, BPXA must report all avian mortalities and collisions

and their circumstances. The transmission of these data will help determine if these design features are effective.

Increased vehicle traffic on the access road during facility construction could limit the ability of some tundra-nesting birds and their broods to access coastal habitats. Some of these broods (particularly snow geese and brant) could be struck by vehicles when attempting to cross the roadway or could avoid crossing the road and experience increased predation. The present level of mortality from roadkill is unknown. A reduced speed limit for vehicles during the nesting and/or broodrearing period could help reduce the negative effects of increased construction traffic. These negative effects are difficult to estimate, but the reporting of roadkill birds could help evaluate whether this is a substantial form of mortality to some species.

Increases to existing bird strike mortality is assumed to be low (<20 birds/year), however mortality could be larger due to episodic events such as a flock of birds colliding with structures (especially during periods of darkness or inclement weather) or entire broods could be struck by one vehicle. The removal of a hen would likely result in the loss of an entire brood. Overall, onshore construction activities will increase the potential for bird mortality, but this increase is not anticipated to be major. The aforementioned reporting of all avian mortalities and collisions and their circumstances will help verify the assumption that collision mortality is low and any adverse effects are small.

3.2.5.6 Increased Bird-Predator Populations

Creation of artificial nesting habitats for ravens and other predatory birds have influenced their distribution across the North Slope. Newly constructed facilities for the Liberty (SDI) Project may create nesting habitats for ravens and other predatory birds which could lead to increased predation on tundra-nesting birds in the project vicinity (USDOI, FWS, 2003). Bridge spans and new pipelines may create nesting habitats for ravens and other predatory birds.

Per the FWS Final BO, BPXA has committed search Liberty (SDI) Project structures for raven-nesting activities from March 1 through June 30 each year. Monitoring would take place every 4 days and, if nesting materials are found, they will be removed and disposed of to prevent their reuse by ravens. An annual report summarizing monitoring efforts will be provided to the FWS by BPXA through MMS before December 31 each year. If effective measures are implemented, increased predation from increased nesting of bird-predators on project structures should avoid impacts to coastal and marine birds.

Other components of the Liberty (SDI) Project may afford foxes new denning sites. For example, the currently proposed mine rehabilitation plan includes retention of portions of an elevated earthen berm and the stockpiles of organic overburden, which could become a site of future new fox dens. Per the FWS Final BO, BPXA intends to monitor the berm and stockpiles weekly from April 15 through June 15. If denning activities are observed, the ADF&G and FWS will be contacted to develop a plan to prevent further activity. An annul report summarizing monitoring efforts will be provided to the FWS by BPXA through MMS before December 31 each year.

3.2.5.7 Habitat Effects

BPXA has indicated that ice roads, north of the Endicott Road, may be used during winter construction of onshore facilities, similar to that used for expansion of the SDI. If ice roads were used, some tundra-nesting and foraging habitats (~39 acres) would be unavailable during the

spring following ice road construction. The ice road and associated snowdrifts will not likely melt before shorebirds and other migrants establish breeding territories and nesting sites.

Snow geese use wet meadows along the north side of the Endicott Road to grub for rhizomes during early spring, prior to nesting on Howe Island. The proposed ice roads cross through early-spring foraging habitats and summer brood-rearing habitats used by snow geese, tundra swans, and brant. Late melting of the ice road will delay the development of sedges and other forage species. The delay in forage maturation decreases the fiber content and increases the nutritional value as forage for brood-rearing geese in July and August (Gadallah and Jefferies, 1995; Piedboeuf and Gauthier, 1999). Ice road construction could alter local nesting distributions and habitat usage during spring and summer. These changes would be short-term (3-4 years), are localized, and minimal habitat impacts are anticipated.

3.2.6 Terrestrial Mammals

3.2.6.1 Ice Road Construction

Ice road construction and use would cause disturbance to caribou that may remain on the Arctic Coastal Plain during winter. Ice roads provide a hard surface, which as compared to deep snowdrifts, caribou may prefer for travel. Visibility for drivers may be limited due to darkness and snowstorms during winter months; these factors increase the likelihood of vehicle-collision mortalities for caribou and muskoxen. However, there are strict rules in the oil fields about vehicle travel during periods of poor visibility to ensure personnel safety. Because most caribou and muskoxen move south into the foothills and mountains of the Brooks Range during winter, very few collision mortalities have occurred during these months. If the growth of the Central Arctic Herd results in more caribou remaining on the Arctic Coastal Plain during winter, the likelihood of collisions with vehicles and equipment will increase.

Areas of suitable grizzly-bear denning habitat occur throughout the Sagavanirktok River delta along river channel and flood terrace banks, and on stabilized-sand-dune ridges. Construction of the ice road over or very close to a grizzly bear den would cause death, injury, or disturbance for individual bears or female bears with newborn cubs. About 60 to 70 grizzly bears frequent the oil field area (Shideler and Hechtel, 2000). BPXA will work with the ADF&G to identify known bear dens in the vicinity of the planned ice roads. The ice road would avoid known dens. Identification of arctic-fox den structures would also prevent injury and destruction of fox den sites. Fox den structures may be used repeatedly for centuries. Older dens are large, easily recognizable structures located on mounds, low hills, or ridges with thin snow accumulations, many entrances, and altered vegetation types (Burgess, 2000). Some resident arctic foxes that remain at den sites throughout the winter (Burgess, 2000) would be displaced by den site destruction or disturbance, and would likely to seek shelter under modules and open crawl spaces beneath buildings at nearby oil field facilities.

Ice roads built on top of lemming burrows and runways may lead to onsite death and habitat abandonment by lemmings; arctic ground squirrel burrows that exist under the snow would lead to death of hibernating ground squirrels and destruction of these sites. Ground squirrel burrows are located on mounds, river bluffs, stabilized sand dune ridges, and other well-drained locations throughout the project area. Ice road construction and disturbance would affect a few individuals, and no population-level effects on grizzly bears, arctic foxes, arctic ground squirrels, or lemmings are anticipated.

Minor fuel or antifreeze spills may leach into nearby underground burrows causing death of arctic ground squirrels, foxes, and lemmings. Antifreeze spills on the ice road may attract arctic foxes, squirrels, and lemmings, and would cause injury or death if ingested in sufficient quantity. A few individuals would be affected, and no population-level effects are anticipated from these spills and leaks.

3.2.6.2 Mine Site Development

A few individuals or small groups of caribou may remain in the project area during winter, but most will move south into the foothills and the Brooks Range and would not be exposed to disturbance from mine site excavation. Some tundra habitats used by caribou and muskoxen for foraging would be lost or altered due to mine site excavation, but the areas would be minimal compared to available habitats, and no population-level effects are anticipated.

Grizzly denning and foraging habitats would be potentially lost or altered in the excavation area. Excavation of the mine site in areas containing arctic ground squirrel burrows or arctic fox dens would cause death of a few hibernating ground squirrels and destruction of burrows and fox dens. As with ice road construction, identification and avoidance of active grizzly bear dens and arctic fox den structures would prevent injury to these animals and destruction of their dens.

As described for ice road construction, minor spills or leaks of such materials as fuel or antifreeze from vehicles and equipment used during mine site construction may occur and contaminate den sites. Antifreeze spills may attract arctic foxes and would cause injury or death of a few individuals if ingested in sufficient quantity. Population effects are not anticipated from these spills and leaks.

3.2.6.3 West Sagavanirktok River Bridge

A few individuals or small groups of caribou may remain in the project area during winter, but most will move south into the foothills and the Brooks Range and would not be exposed to noise and activities associated with the bridge upgrade. Bridge design would presumably allow passage of caribou, muskoxen, and grizzly bears beneath the bridge and would not block movements of these animals along riparian corridors. Small areas of river-bluff habitats used by bears for denning and foraging would be lost. Grizzly bears that den at or very near the bridge site would be killed, injured, or disturbed by winter construction. At bridge approaches, alteration of tundra habitats supporting arctic ground squirrel burrows or arctic fox dens would cause death of a few hibernating ground squirrels and destruction of the burrows and fox dens. Identification and avoidance of active grizzly bear dens and arctic fox den structures would prevent injury to grizzly bears and destruction of fox den sites.

The bridge project and pipelines crossing the river downstream from the bridge, may make this area less attractive to caribou and muskoxen for movement along the riparian corridor. The additional shade created by these multiple overpasses, however, would provide shade habitats that caribou may use to avoid parasitic bot and warble flies which are negatively phototaxic.

Minor spills or leaks of such materials as fuel or antifreeze at the construction site may attract arctic foxes, and ingestion of the antifreeze in sufficient quantities would cause injury or death. Overall, population-level impacts from bridge project activities are not expected.

3.2.7 Wetlands and Vegetation

The most noteworthy disturbance to wetlands and vegetation will potentially occur during the onshore construction phase of the Liberty (SDI) Project. Development of the gravel mine site, transporting materials during construction activities, and improvements to transportation corridors will have varying levels of impact to wetlands and vegetation.

3.2.7.1 Ice Road Construction

Onshore ice-road construction will primarily be used during the SDI expansion to transport gravel fill from the mine site to the SDI. Additional ice roads may be used to bypass the West Sagavanirktok River Bridge or during upgrade of the bridge superstructure. The impact from ice roads varies with topography and soil moisture conditions. Moist or wet meadow communities typically show little to no sign of disturbance after the ice road has melted (Payne, Guyer, and Keating, 2003; Yokel et al., 2003). Drier sites, elevated microsites, and tussock-type tundra are at a relatively greater risk for disturbance (Jorgenson, 1999; Pullman et al., 2003). Ice-road construction has the potential to compact the subnivean layer, damage or kill off some plants, and remove standing dead material from the aerial canopy (Walker et al., 1987).

It is unlikely that minor spills or leaks of oil or chemicals arising from ice road activities will impact wetlands and vegetation. Such minor discharges would likely be contained and cleaned up immediately.

3.2.7.2 Mine Site Development

The primary mine cell will cover an area of approximately 21 acres. Vegetation, mineral surface soils, and unusable gravels removed from the mine will be stockpiled adjacent to the excavated areas. Including the stockpiled material, a total area of approximately 50 acres will be used for the mining operation. Excavation, mining, and stockpiling of materials will destroy vegetation in that area. Development will follow an approved mining and rehabilitation plan.

3.2.7.3 Small Spills or Leaks

It is unlikely that minor spills (<200 bbl of crude oil) or leaks of oil or chemicals arising from mine site activities will impact wetlands and vegetation. Such minor discharges would likely be contained and cleaned up immediately.

3.2.7.4 West Sagavanirktok River Bridge

Upgrade of the West Sagavanirktok River Bridge will rely on ice roads to support construction activities. The impact associated with ice roads is discussed in Section 3.2.7.1 above.

Bridge upgrade activities would result in increased traffic to and from the construction site. A portion of the construction would be conducted during winter months which would reduce the level of dust fallout to some degree. Fallout from dust plumes associated with vehicle traffic has the potential to alter wetland characteristics and vegetation communities. Xeric, prostrate shrub-dominated communities and non-vascular species of moss and lichen are the most susceptible to impacts. Potential thinning of the vegetative canopy and altering of species composition would be the most common result of increased traffic and associated dust fallout (Auerbach, Walker, and Walker, 1997; Everett, 1980; Walker and Everett, 1987).

3.2.7.5 Rig and Facilities Installation

Traffic along the Endicott Road would increase to accommodate drill rig construction and fabrication and installation of module and infrastructure components. Fallout from dust plumes associated with vehicle traffic has the potential to alter wetland characteristics and vegetation communities, as discussed in Section 3.2.7.4 above.

3.2.7.6 Pipeline Construction (SDI to MPI)

It is unlikely that minor spills or leaks of oil or chemicals arising from new pipeline construction will impact wetlands and vegetation. The causeway along which the pipelines will be constructed is gravel fill placed during the Endicott development and largely barren of vegetation. Such minor discharges would likely be contained and cleaned up immediately.

Construction activities along the SDI to MPI road are not adjacent to any tundra that would be affected by dust fallout. However, in support of construction activities it would be expected that traffic along the main Endicott Road would increase. Fallout from dust plumes associated with vehicle traffic has the potential to alter wetland characteristics and vegetation communities, as discussed in Section 3.2.7.4 above.

3.2.8 Threatened and Endangered Species

3.2.8.1 Noise/Activity Disturbance

Bowhead Whale

Noise and activity disturbances as a result of construction of Liberty (SDI) Project pipelines between the MPI and SDI would be unlikely to impact bowhead whales. Pipeline construction would take place during the winter and would not influence bowhead whales wintering in the Bering Sea. Bowhead whales will not be in the project area during bridge upgrading. There will be no impacts on bowhead whales from noise and activity originating from the bridge upgrade. Per the informal consultation dated October 19, 2007 (refer to Appendix D of this EA), NMFS stated "…while the Liberty project may affect these whales, our assessment…finds any such effects are insignificant (such effects could not be meaningfully measured or detected) or discountable (such effects would not reasonably be expected to occur)."

Polar Bear

Polar bear denning habitat occurs in the project area (Durner, Amstrup, and Ambrosius, 2001), and noise and activity during ice road construction could disturb polar bears at maternal den sites (Blix and Lentfer, 1991). Although polar bears may tolerate and habituate to industrial activity, maternal females with newborn young are more sensitive to disturbance and can be displaced from their den sites due to human activities. It is recommended that BPXA consult with FWS polar bear specialists before building ice roads to obtain the current information regarding polar bears in the project area. Should a polar bear den be discovered, appropriate mitigation measures will be employed, as specified in FWS Letters of Authorization (LOAs) for BPXA-operated North Slope oil fields. The current FWS LOA was issued January 1, 2007, and expires December 31, 2007. BPXA, in an email to MMS on October 18, 2007, acknowledged the expiration date of the current LOA and anticipates the annual renewal.

Impacts of industrial noise and activity from construction at the SDI on polar bears are described in detail in Section 3.1.11.1 and would be similar to the effects of winter ice road construction.

ESA-protected Birds

Some facility construction (especially pipelines and bridge work) would be completed during the winter, when ESA-listed birds are not in the project area. Noise and activity disturbances continuing into the spring nesting season at the SDI site likely will have minimal effects on eiders nesting on inland tundra habitats, but could displace murrelets and nonbreeding eiders and loons from marine areas around the SDI. Similarly, post-breeding eiders and yellow-billed loons could experience the same impacts later in the summer and fall. These temporary impacts should be minimal due to the large amount of assumed similar habitat in the surrounding area and the low density of ESA-listed birds in the project area.

3.2.8.2 Small Spills or Leaks

Bowhead Whale

Bowhead whales are unlikely to be impacted by minor spills (<200 bbl of crude oil) or leaks of oil or chemicals originating from construction of pipeline between the MPI and SDI. Such minor discharges would be held with in containment or would be cleaned up immediately. Bowhead whales migrate 15 km or more offshore from the coastline, and any discharge from the Endicott Causeway would be unlikely to enter their offshore environment.

Polar Bear

Polar bears are unlikely to be impacted by minor spills (<200 bbl of crude oil) or leaks of oil or chemicals originating from construction of pipeline between the MPI and SDI. Such minor discharges would be held with in containment or would be cleaned up immediately.

ESA-protected Birds

Minor spills and leaks of oil could affect the quality and abundance of prey species for ESA-listed birds. Chronic discharges of small amounts of petroleum compounds during SDI expansion ultimately could reduce water repellency of bird feathers, compromising their insulative capacity, resulting in hypothermia and death/drowning when these materials melt out of ice and snow. The greatest potential for impacts is to migrating flocks of spectacled eiders (during the spring and fall), however, the loss of fewer numbers of yellow-billed loons could result in a relatively greater impact. Spill-prevention measures are required to be implemented during facility construction to keep small releases of pollutants from entering the marine environment, where they could impact a large number of birds prior to an active spill response.

3.2.8.3 Increased Road Traffic to Site

There is also the possibility for increased road traffic to obstruct the movement of spectacled eiders, especially during brood-rearing and molting periods when birds are flightless. TERA (1996) reported that spectacled eider broods traveled an average of 0.53 km each day during the first week following hatching, and broods were known to cross roads repeatedly. Reduced speed

limits have been implemented on the Endicott Road in past years as a mitigation tool for minimizing impacts on snow geese broods. Continuing reduced speed limits will also help minimize the impacts on spectacled eiders from increased road traffic resulting from development of the Liberty (SDI) Project. Additionally, the nesting density of spectacled eiders in the Liberty (SDI) Project area is low, and it is likely that few birds would be disturbed by increased road traffic.

3.2.8.4 Marine Access

Any sealifts could temporarily displaced eiders, murrelets, and loons from preferred marine feeding habitats, but impacts would likely be minimal and displaced birds could use adjacent habitats or return to preferred habitats after sealift passage. The sealift could disturb tens of thousands of spectacled eiders molting in the Ledyard Bay Critical Habitat Area (Chukchi Sea). BPXA has committed to completely avoid sealift transit through the Ledyard Bay Critical Habitat Area.

3.2.8.5 Bird Strikes

Migrating eiders tend to fly low and fast along coastal areas during spring and fall migrations and they sometimes are killed when they collide with structures in their path, especially during periods of darkness or inclement weather. Day, Prichard, and Rose (2005) reported the mortality of 36 common and king eiders as a result of collisions with facilities at Northstar Island and Endicott over a 4-year period. The present level of bird strike mortality associated with MPI facilities is unknown.

New facilities constructed on both the MPI and SDI are expected to result in an incremental increase in ESA-listed bird strike mortality, especially for spectacled and Steller's eiders. The drilling rig, which will be approximately 250 ft tall, will be on the SDI for at least 3 years and could contribute to an increase in bird strikes when present. The other buildings/facilities could contribute to additional collision mortality for the life of the project.

Spectacled eider density typically is greater in the Liberty (SDI) Project area than at Northstar Island (at the eastern extent of its range), and Steller's eiders are rare in the area. The low numbers of these two listed eider species in the area should result in a low potential for collisions with Liberty (SDI) Project facilities. Conservation measures are required per the FWS Final BO to decrease the potential for spectacled eiders being killed from collisions with Liberty (SDI) Project facilities and the MPI.

BPXA design engineers have committed to consult with the FWS on identifying and implementing ways to reduce how facility lighting attracts/disorients birds in the project vicinity. Effectively reducing escaped lighting is believed to reduce the potential for birds to strike facilities on the MPI and SDI. Increased vehicle traffic on the access road during facility construction could limit the ability of some spectacled eiders and their broods to access coastal habitats. Some of these eider broods could be struck by vehicles when attempting to cross the roadway or could avoid crossing the road and experience increased predation. The present level of mortality from roadkill is unknown. A reduced speed limit for vehicles during the nesting and/or broodrearing period could help reduce the negative effects of increased construction traffic. These negative effects are difficult to estimate, but the reporting of roadkill birds will help evaluate whether this is a substantial form of mortality to some species.

Increases to existing bird strike mortality is assumed to be low (<1 bird/year), however mortality could be larger due to episodic events such as a flock of eiders colliding with structures or entire broods being struck by one vehicle. The removal of an eider hen would likely result in the loss of an entire brood. Overall, onshore construction activities will increase the potential for ESA-listed bird mortality, but this increase is not anticipated to be major. Per the FWS Final BO, BPXA must report all avian mortalities and collisions (including vehicle collisions) and their circumstances. The transmission of these data will help verify the assumption that collision mortality is low, and negative effects are small.

3.2.8.6 Increased Bird-Predator Populations

Wildlife access to human-use foods during construction of new facilities could increase the abundance and distribution of bears or arctic foxes in the area. Per the FWS Final BO, BPXA intends to implement techniques to prevent wildlife accessing anthropogenic food and waste. These techniques include installation of predator-proof dumpsters, new refuse-handling techniques, and educating their workforce on problems associated with feeding wildlife.

Creation of artificial nesting habitats for ravens and other predatory birds have influenced their distribution across the North Slope. Newly constructed facilities for the Liberty (SDI) Project may create nesting habitats for ravens and other predatory birds which could lead to increased predation on threatened eiders and yellow-billed loons in the project vicinity (USDOI, FWS, 2003). Bridge spans and new pipelines would potentially increase the amount of artificial nesting habitat for ravens and other predatory birds.

Per the FWS Final BO, BPXA has committed to search Liberty (SDI) Project structures for raven-nesting activities from March 1 through June 30 each year. Monitoring would take place every 4 days and if nesting materials are found, they will be removed and disposed of to prevent their reuse by ravens. An annual report summarizing monitoring efforts will be provided to the FWS by BPXA through MMS before December 31 each year. If effective measures are implemented, increased predation from increased nesting of bird-predators on project structures should avoid impacts to coastal and marine birds.

Other components of the Liberty (SDI) Project may afford foxes new denning sites. For example, the currently proposed mine rehabilitation plan includes retention of portions of an elevated earthen berm and the stockpiles of organic overburden, which could become a site of future new fox dens. Per the FWS Final BO, BPXA intends to monitor the berm and stockpiles weekly from April 15 through June 15. If denning activities are observed, the ADF&G and FWS will be contacted to develop a plan to prevent further activity. An annul report summarizing monitoring efforts will be provided to the FWS by BPXA through MMS before December 31 each year.

The Final BO measures are expected to be implemented; therefore, increased predation from enhanced bird-predator populations should not affect ESA-listed birds.

3.2.8.7 Habitat Effects

There would be no loss of habitat for bowhead whales from the bridge upgrade, and there will be no major habitat loss for spectacled and Steller's eiders. There is currently a bridge at this location, and the bridge upgrade would not result in loss of eider habitat.

There would be no loss of habitat for polar bears due to the bridge upgrade.

ESA-listed Birds

Ice from ice roads has the potential to linger over tundra after the surrounding snow has melted in spring. Lingering ice on the ice-road footprint could prevent this strip of tundra habitat from temporarily being used as nesting habitat for spectacled eiders. Tundra compaction beneath ice roads can result in structural changes to the plant community following melting of the ice (Walker, 1996), which could temporarily affect eider use within the ice road footprint. The compacted tundra may not recover for many years, making it unsuitable as eider habitat. This potential impact could be minimized by selecting an ice road route that avoids tundra near known eider-nesting locations and favors habitat not preferred by eiders, but it is unclear if BPXA would complete this work or whether it would prove successful in retaining eider nesting habitat. This is partially due to the likelihood that eiders would not nest near (within 200 m) the roadway due to traffic noise and other activity. Because road activity (including ice roads) likely precludes nesting by eiders near the road, alterations of these habitats (e.g. creation of an ice road) will have minimal effects.

Ice road construction involves withdrawing water from deep lakes in areas adjacent to the Endicott Road. Bergman et al. (1977) reported that spectacled eiders at Point Storkersen used deep *Arctophila* lakes during pre-nesting, nesting, and post-nesting periods. Deep *Arctophila* lakes also have been used by broodrearing spectacled eiders in NPR-A (Derksen, Rothe, and Eldridge, 1981). In addition, spectacled eiders often select nest sites near the edge of lakes, often within 1m of the shore. Withdrawal for ice roads that lowers the water level of lakes could affect spectacled eider nesting habitat. Most lakes would likely return to pre-withdrawal levels during spring flooding (Rovansek, Hinzman, and Kane, 1996), but care should still be taken when selecting lakes for water sources for ice roads. Water taken from deep open and deep *Arctophila* lakes should be minimized or avoided as these lakes may be used by spectacled or Steller's eiders. However, these are the lake types most suitable as water sources for ice-road construction from an industry perspective and BPXA has not committed to avoiding the use of lakes important to spectacled eiders.

Similarly, water drawn from deepwater lakes to create the ice roads could alter nesting habitats used by yellow-billed loons. While BPXA has stated they would survey these lakes for their use by loons prior to ice road construction, it remains unclear if BPXA would actually avoid withdrawing water from lakes used by loons.

3.2.9 Cultural Resources

In accordance with NHPA provisions of the November 24, 2006, Memorandum of Understanding among MMS, the U.S. Corps of Engineers, ADNR, and BPXA:

> The MMS, after consultation with the COE and other cooperating agencies, will notify BPXA if it determines that it is necessary to assess whether the Liberty (SDI) Project may affect archaeological resources within the project area. The MMS will request that BPXA provide archaeological and, if required, traditional cultural properties reports in accordance with the National Historic Preservation Act of 1966 (16 USC § 470 et seq.). The MMS will consult with the State Historic Preservation Officer and applicable Tribal Historic Preservation Officers, if necessary. This consultation will also cover the cooperating agency permit review requiring consultations.

The SHPO, in letters to BPXA on January 26, 2007, and the U.S. Corps of Engineers on June 8, 2007, requested that archaeological surveys be conducted in Liberty (SDI) Project area that previously had not been surveyed. These project areas would include locations where project activities such as ice road construction, gravel extraction, SDI expansion, West Sagavanirktok River Bridge upgrade, pipeline construction, facilities installation, and new drill rig construction could occur. BPXA notified MMS on July 2, 2007, that a cultural resources survey contract has been awarded to Reanier & Associates, with a final report expected in late 2007.

The MMS, after consulting the State of Alaska AHRS database, has identified no cultural and archaeological sites offshore, nearshore, or onshore within the area of potential effect of the Liberty (SDI) Project. The SHPO concurred with the MMS determination of no effect to offshore historic or prehistoric resources. The U.S. Army Corps of Engineers agreed to the responsibility to conduct a separate consultation in accordance with NHPA for onshore resources. Refer to Appendix F for SHPO consultation correspondence.

3.2.10 Socioeconomics and Related Impacts

This section discusses the possible socioeconomic and related impacts (including subsistence-harvest resources, sociocultural, and environmental justice) associated with onshore construction. Possible impacts could arise from various construction activities (e.g., ice road construction, mine site development, pipeline construction, and West Sagavanirktok River Bridge upgrade), small operational spills of refined products, and the temporary presence of construction workers in the area.

3.2.10.1 Economy and Sociocultural Systems

The Liberty FEIS (USDOI, MMS, 2002) estimated that the entire project would generate 870 full-time equivalent (FTE) construction jobs and an additional 1,248 indirect FTE jobs in Alaska during 14 to 18 months of construction. The current proposal is likely to have smaller labor needs, and only some of these would be associated with onshore construction. For example, the maximum annual number of workers required during onshore construction and associated SDI expansion is estimated to be 116. In principle, adverse sociocultural impacts could arise from either major adverse impacts on subsistence-harvest resources or an influx of substantial numbers of workers. However, neither impact is anticipated. Therefore, there would be no major sociocultural impacts associated with onshore construction.

3.2.10.2 Subsistence and Area Use Patterns

Subsistence-harvest data presented in Section 2 indicate that in terms of total subsistence harvest for the potentially affected communities, the major subsistence foods include caribou, bowhead whales, and various types of fish such as cisco and broad whitefish. Conclusions on possible impacts of onshore construction on important subsistence resources are addressed in this EA and summarized as follows:

- **Section 3.2.3 Fish and Essential Fish Habitat:** Pipeline construction noise is not likely to affect fish and, if it does, the impact will be localized and avoidable. Small spills or leaks likely would be contained and cleaned up immediately, and it is unlikely that any would enter the marine environment. West Sagavanirktok River bridge upgrade will not adversely affect Essential Fish Habitat.

- **Section 3.2.6 Terrestrial Mammals:** Ice road construction and disturbance would affect a few individuals, and no population-level effects on grizzly bears, arctic foxes, arctic ground squirrels, or lemmings are anticipated. Minor fuel or antifreeze spills would affect a few individuals, and no population-level effects are anticipated from these spills and leaks. Mine Site Development would affect some habitat, but the areas would be minimal compared to available habitats, and no population-level effects are anticipated. West Sagavanirktok River bridge upgrade is not expected to have overall, population-level impacts.
- **Section 3.2.8 Threatened and Endangered Species (bowhead whale, and polar bear [proposed]):**Noise and construction activity will not impact the bowhead whale. Protecting core maternity denning areas per the existing FWS LOA mitigation measures is important to the long-term conservation of polar bears.

Thus, there are not expected to be any major effects on subsistence-harvest resources resulting from onshore construction activities.

3.2.10.3 Environmental Justice

Major adverse sociocultural or subsistence-resource impacts would raise environmental justice issues because, as noted elsewhere in the EA, the majority of the population is a recognized minority. However, major impacts to subsistence resources and harvests, and sociocultural systems are not anticipated; therefore, disproportionate high adverse environmental justice impacts are not anticipated as a result of onshore construction.

3.2.11 Waste Management

All waste from the Liberty (SDI) Project would be handled in accordance with State, Federal, and local regulations. Use of permitted disposal wells and other approved disposal methods will result in zero surface discharge of drilling wastes and, in conjunction with BPXA's waste minimization policy, will result in little or no impact from waste disposal. See Section 10 of the Liberty DPP for more information on waste handling.

3.3 DRILLING, OIL PRODUCTION, AND ABANDONMENT

During the drilling and oil-production phases, discharges and accidental spills might affect the environment. Later, during the eventual Project Termination of the Liberty field, the owners of the Endicott Causeway would have to make decisions about the fate of the causeway (DPP Section 13). The causeway is located in State water; the State might decided to maintain and use it or to let it be abandoned. The effects of causeway abandonment is likely to be reviewed by the U.S. Army Corps of Engineers, because the causeway is in navigable waters. As required by 30 CFR 250.700(b), MMS also would review the effects of abandonment of the Liberty "facility," which would include the 860,000 yd^3 enlargement of the SDI. An additional, detailed plan about abandonment of the wells and facilities would be required by MMS at the time of abandonment. The specific requirements can be found at 30 CFR 250 Subpart Q - Permanently Plugging Wells (250.1710 through 1717); Removing Platforms and Other Facilities (250.1725 through 1780); and Site Clearance for Wells, Platforms, and Other Facilities (250.1740 through1743).

The U.S. Army Corps of Engineers has the authority to place the following special condition on the Department of Army, Clean Water Act 404 authorization (if issued):

- Upon abandonment, all on or above ground fills shall be removed unless otherwise identified as part of the final abandonment plan.

The rationale for the special condition refers to a General Condition on the permit form that states that upon abandonment, the site must meet the approval of the District Engineer/Commander.

3.3.1 Air Quality

The ambient air pollutant impacts due to drilling and oil production activities at the Liberty (SDI) Project are expected to be within the limits of the National and Alaska AAQS and the applicable PSD Class II increments. Pollutants will be emitted from drilling operations on the SDI and a new gas-fired combustion turbine on the MPI. As part of the air permitting process, ADEC will review the Liberty emission unit inventory to ensure compliance with all applicable New Source Performance Standards (NSPSs) and National Emission Standards for Hazardous Air Pollutants (NESHAPs). The ADEC will also determine best available control technology (BACT) for the PSD-affected pollutants. A dispersion modeling analysis of project emissions will included in the air permit application and will demonstrate National and Alaska AAQS and PSD Class II increment compliance. An ambient-air quality monitoring station has been in operation on the SDI since February 2007 to gather data to support air quality permitting.

3.3.2 Sediment Suspension and Transport

Erosion of the gravel fill material is expected to be minimal following installation. Similarly, the suspension of fine materials also will be minimal. The majority of the fine fractions near the waterline will be winnowed from the fill material by wave action during the first open-water season. While these particles will contribute to TSS concentrations, the impact is anticipated to be very small. The release of fine material from the pad following the initial open-water season is expected to be negligible. Turbidity might increase temporarily if the causeway is removed at abandonment, and the effects of that phase would be similar to the description in Section 3.1.2.

Barging operations are expected to be limited to a sealift for the ***LoSal™*** EOR plant modules. Marine access is a secondary option for rig mobilization and demobilization. Extensive dredging is not anticipated. As a result, increased turbidity associated with marine operations is expected to be minimal, temporary, or nonexistent, partly because barge traffic will be routed around the Boulder Patch (Section 3.1.5.1).

3.3.3 Oceanography

The proposed SDI pad expansion is not expected to have any noteworthy impact on regional oceanography. Minimal localized impacts can be anticipated.

During winter, rapid changes in temperature may produce thermally induced shrinkage cracks propagating from the perimeter of the SDI pad expansion (a source of stress concentration). These cracks may provide strudel drainage pathways at the time of river overflood. These conditions are expected to be similar to those that occur at the existing SDI facility.

If ice roads are used to support drilling operations, the thickened ice may act as a partial barrier to river overflood and divert a portion of the flow. The expanded SDI pad footprint is not anticipated to impede the river overflood or affect the extent of overflood on the sea ice. The aforementioned cracks propagating from the perimeter of the SDI pad expansion are expected to be similar to those that occur at the existing SDI facility. The resulting strudel drainage pathways

will be displaced slightly relative to the current pad configuration, but the propensity for strudel scouring is not expected to be substantially different from the existing condition.

Currents in the immediate vicinity of the pad expansion will be affected during the breakup and open-water periods. However, the current patterns and velocities are not expected to be substantially different from those at the existing SDI facility. Local wave patterns also will be altered but are anticipated to be similar to existing conditions.

3.3.4 Marine Water Quality

The release of fine material from the pad following the initial open-water season is expected to be negligible.

The SDI pad expansion will be integrated with the existing SDI drainage system. A perimeter road will confine surface water drainage onto the work surface. This containment also will reduce the risk of any incidental equipment spills (oil, diesel fuel, and hydraulic fluid) from reaching marine waters.

The Liberty (SDI) Project will have zero surface discharges of drilling wastes. Operational discharges will include reject water from the ***LoSal™*** EOR process plant, reverse-osmosis reject water, seawater treatment filter backwash, and sanitary/domestic wastewater.

Per BPXA letter to the EPA, Alaska Operations Office dated July 24, 2007, regarding domestic/sanitary wastewater streams:

> It should be noted, that although the Liberty Project will generate additional sanitary and domestic wastewater streams, these wastes will be transported to and disposed of in NPDES permitted wastewater treatment facilities designed and permitted to accommodate these waste streams. As such, there are not anticipated changes (e.g. piping, treatment or additives) to the selected wastewater treatment facility. There are no current plans to utilize NPDES General Permit No. AKG-33-0000 for the disposal of sanitary and domestic waste streams generated from this project. The options for disposal of sanitary and domestic wastewater generated from the Liberty Project are as follows:
>
> 1. Utilization of the permanent living quarters (PLQ) at the Endicott production facility to house construction and drilling personnel. This option would utilize the existing Endicott wastewater treatment infrastructure. This is preferred Liberty Project option for wastewater disposal (see DPP Section 10.3 WASTE MANAGEMENT).
> 2. Utilization of a temporary construction/drilling camp at or near the project location. Wastewater would be stored in holding containers and trucked to the existing Endicott production facility for disposal (see DPP Section 10.3 WASTE MANAGEMENT).
> 3. Utilization of a temporary construction/drilling camp at or near the project location. Wastewater would be stored in holding containers and trucked to existing Prudhoe Bay Unit infrastructure for disposal.
>
> At this time, it is not known which sanitary and domestic wastewater disposal option will be used. This will depend on several factors – primarily bed space availability at the Endicott production facility during the time of construction and drilling activities.

An amendment has been submitted to the NPDES permit renewal request to cover the discharge from the ***LoSal™*** EOR process plant. Per the aforementioned BPXA letter to EPA dated July 24, 2007, the ***LoSal™*** pilot project scheduled for fall 2007 will use freshwater sources. Therefore, there will be no wastewater discharge produced, as LoSal™ water will be injected for enhanced oil recovery purposes. Stormwater and firewater test discharges will be permitted under the existing NPDES General Permit for Facilities Related to Oil and Gas Extraction.

Issues associated with a crude oil spill are discussed in Section 3.4.

3.3.5 Benthic and Boulder Patch Communities

Regarding cumulative effects on the benthos and Boulder Patch kelp community, the effects of construction and abandonment of just the proposed addition to the SDI are expected to be short lived (Section 3.1.5.3). The Liberty FEIS concluded similarly that the abandonment of the original Liberty offshore island would be minor (USDOI, MMS, 2002:Sections III.C.e(2)(a) and III.D.6.e (1). However, the abandonment of the SDI addition probably would occur at the same time as abandonment of the whole Endicott causeway. The level of cumulative effect of sediment eroding from the whole causeway for decades if the causeway and SDI are abandoned in place would be much greater and longer lasting than if the causeway and SDI were to be removed. In a sense, the causeway addition and initial construction involve the movement of millions of cubic yards of gravel from an onshore quarry to an offshore location within a few miles of the Boulder Patch. Any fine sediment material extend the berm that is offshore of the causeway (Section 2.7.3.5). Furthermore, the natural erosion rate of the causeway might be increased due to the retreating summer ice cover and increasing fetch for storm waves, and such erosion would be increased greatly if the Arctic becomes ice free, as projected by climate models for the late-summer within the lifetime of this project (by 2040). A definitive conclusion about the level of effects on the kelp cannot be formed at this stage, partly because it is not clear that the whole causeway would be abandoned, and partly because future rates of erosion have not been projected. Regardless, if the SDI addition to the causeway were to be abandoned, MMS and the U.S. Army Corps of Engineers would require a detailed abandonment plan, per 30 CFR Part 250 subpart Q, at the time of abandonment. The U.S. Army Corps of Engineers has the authority to place the following special condition on the Department of Army, Clean Water Act 404 authorization (if issued):

- Upon abandonment, all on or above ground fills shall be removed unless otherwise identified as part of the final abandonment plan.

The rationale for the special condition refers to a General Condition on the permit form that states that upon abandonment, the site must meet the approval of the District Engineer/Commander.

The measurement of kelp growth rates at DS-11 for the past 4 decades have helped to determine the “natural” effects of erosion and suspended sediments around the existing causeway. Continued annual measurement of the rates would help with the eventual distinction during abandonment of sedimentation effects due to: (1) the existing causeway with increased erosion rates due to the retreating summer ice cover, and (2) the causeway with an enlarged SDI.

3.3.5.1 Large Oil Spills

A detailed discussion of the potential effects of large oil spills (equal to or greater than [≥]200 bbl of crude oil) on the Boulder Patch kelp community and other lower trophic organisms can be found in USDOI, MMS (1996a, 2002) and USDOI, BLM and MMS (1998).

Boulder Patch

A detailed discussion of the potential effects of large oil spills on the Boulder Patch community can be found in USDOI, MMS (2002). Studies indicate that Liberty crude would be particularly resistant to natural dispersion in the water column. It probably would disperse very little and very slowly down into the Stefansson Sound water column. Based on mixing models, the amount and toxicity of Liberty crude oil reaching subtidal marine plants are expected to be so low that the oil would have no measurable effect on these plants, regardless of when the spill occurred.

Oil-spill-trajectory analysis (Section 3.4.3) indicates that the dispersal plume under east winds would largely bypass the Boulder Patch and would be confined to nearshore waters west of the SDI. Plume deflection under west winds would carry surface oil eastward into Foggy Island Bay and likewise would bypass most of the Boulder Patch.

Other Coastal and Benthic Invertebrates

As discussed above, the inability of Liberty crude oil to substantially penetrate the water column would shield benthic invertebrates from contamination. Oil reaching the nearshore shallows likely would be toxic and probably would have lethal or sublethal effects on some invertebrates that inhabit these areas during summer, including mollusks, annelid worms, echinoderms, crustaceans, and amphipods. Based on estimates made for the initial offshore alternative of the Liberty project, an assumed large oil spill would be estimated to have lethal or sublethal effects on about one-third of the nearshore benthic invertebrate community (USDOI, MMS, 2002) in the Stefansson Sound area. Recovery for nearshore benthic invertebrates likely would occur in a single season after water quality returns to prespill conditions. Because of ice cover, nearshore shallows are devoid of benthic invertebrates during winter. After breakup, most invertebrates move onshore to repopulate the area for the duration of the open-water season.

Studies have shown that large oil spills commonly have no major effect on planktonic organisms. Even if spills contact large numbers of plankton, the short regeneration time of these organisms and rapid replacement from nearby waters likely keep any effect to a minimum. Because of their wide distribution, large numbers, rapid regeneration rate, and high fecundity, plankton communities exposed to large oil spills appear to recover quickly (NRC, 1985). Any oil spill associated with the Liberty (SDI) Project operations likely would have only a localized and short-lived effect on plankton communities. Further, nearshore invertebrates that reside in the water column (copepods, mysid shrimp, and euphausiids) have the potential for being affected by surface concentrations of saline brine by discharge from the ***LoSal™*** EOR process plant. The discharge would be regulated by the EPA; regardless, the effect on plankton would be almost immeasurable because of their widespread distribution, large numbers, and high reproduction rates.

3.3.6 Fish and Essential Fish Habitat

3.3.6.1 Water Usage

The Liberty (SDI) Project development will also require water for:

- Construction of the ice road: 22 million gallons per year (gal/yr) during the peak construction season
- Drilling rig use: 15 million gal/yr during drilling

- Temporary camp: 2.7 million gal/yr during drilling

Plans currently call for the ice road to be built almost entirely from water in the existing Duck Island Mine site, which is believed to hold on the order of 600 million gallons of water. The Endicott seawater treatment plant (STP) can provide an additional 20,000 barrels per day (bpd). Water also is available from several existing sources in the eastern Prudhoe Bay Unit. Should the existing water sources prove insufficient to support the Liberty (SDI) Project, it may be necessary to remove water from deepwater tundra lakes or rivers. In this event, different sites will be assessed to determine if water withdrawal can proceed within State and Federal agency guidelines.

3.3.6.2 Small Spills or Leaks

It is unlikely that minor spills (<200 bbl of crude oil) or leaks of oil or chemicals arising from drilling and oil production at the Liberty (SDI) Project will impact fish. Such minor discharges would likely be contained and cleaned up immediately. It is unlikely that any discharges would enter the marine environment.

3.3.6.3 Large Oil Spills

The lethal and sublethal effects of oil spills on fish have been discussed extensively in USDOI, MMS (1996a, 2002) and USDOI, BLM and MMS (1998). The greatest potential for a large oil spill (≥200 bbl of crude oil) adversely affecting fish and fish habitat is during the open-water summer season that lasts from May through September. The nearshore shallows in and around the proposed Liberty (SDI) Project area and Endicott Causeway are the obligatory nursery grounds for a genetically distinct stock of broad whitefish that spawn in the Sagavanirktok River. This nearshore area also serves as prime summer feeding grounds for juvenile arctic and least cisco. The Sagavanirktok Delta is a critical migratory pathway for Dolly Varden that annually move between upriver overwintering and spawning sites and offshore feeding grounds. The Liberty (SDI) Project also lies within the nearshore, brackish-water coastal corridor used by most anadromous and amphidromous species to disperse and forage along the coast. Large number of marine fish, including fourhorn sculpin and arctic flounder, also forage in nearshore waters.

Extensive oil contamination in nearshore areas would likely have lethal and sublethal effects on the anadromous, amphidromous, and marine fish that reside there. Large foraging areas could be lost. It is possible that the nearshore corridor used for migration and feeding dispersals by anadromous and amphidromous species could be broken. Contamination and blocking of the nearshore corridor in late summer could prevent these fish from returning to their obligatory freshwater overwintering grounds in the Colville and Sagavanirktok rivers. Recovery would be more rapid for some species than others. Arctic cisco spawn exclusively in the Mackenzie River in Canada and the least cisco in the Colville River. Large segments of their respective populations would be unaffected by an oil spill in the Liberty (SDI) Project area, allowing for a more rapid recovery. Broad whitefish and Dolly Varden stocks that spawn and overwinter exclusively in the Sagavanirktok River could be more seriously impacted, and population recoveries would likely be slower.

Freshwater fish would probably not be affected to any great extent by a large Liberty oil spill emanating from the SDI or Endicott Causeway. River discharge would prevent contaminated water from moving upriver into freshwater habitats. Although limited numbers of freshwater fish

are found in the Sagavanirktok Delta during summer, their numbers are small and likely represent only a tiny fraction of the population.

Fourhorn sculpin, arctic flounder, arctic cod, and saffron cod are the two predominant marine species that occupy nearshore shallow waters during summer. Extensive oil contamination in these areas could have lethal and sublethal effects on any fish that came in contact with the spill, depending on intensity and duration. However, the impact to overall populations would be minimal. Marine fish populations are widespread throughout the Beaufort Sea, and the Liberty (SDI) Project area represents only a small portion of their summer habitat. Because of their wide, vast distribution and high reproductive rates, the impact of a large Liberty oil spill to marine fish species would be minor.

A large oil spill from the proposed Liberty (SDI) Project may adversely affect EFH; however, MMS believes that with the project being based from an existing SDI and not requiring a new subsea pipeline to transport oil to shore, those effects have been reduced to the maximum extent practicable and are consistent with the NOAA document entitled Non-Fishing Impacts to Essential Fish Habitat and Recommended Conservation Measures (USDOC, NOAA, 2003).

3.3.7 Marine Mammals

3.3.7.1 Noise/Activity Disturbance

Noise and other disturbances from the proposed drilling activities for the Liberty (SDI) Project could impact marine mammals in the area. Beluga whales are not likely to be affected because of the distance between drilling activities and their migratory corridor well offshore from the barrier islands. Greene and Moore (1995) reported that underwater noise originating from artificial islands is generally inaudible beyond a few kilometers. It was predicted that drilling noise during periods of normal ambient conditions would attenuate to below-audible ranges approximately 2 km from the source. Underwater drilling noise could be audible up to 10 km from the source during unusually calm periods (Greene and Moore, 1995), but most beluga whales would likely be beyond 10 km from the SDI drilling source, and disturbance to beluga whales from SDI drilling activities would be unlikely.

Pacific walruses are absent during winter and rare visitors during summer in the Liberty (SDI) Project area. It is unlikely that noise from drilling and oil production would impact walruses.

Seals in the area could potentially be disturbed by drilling and oil production activities from the Liberty (SDI) Project. Numerous acoustical studies have reported underwater distances at which drilling sounds reach background levels. Blackwell, Greene, and Richardson (2004) reported that drilling noise during winter at Northstar Island reached background levels at approximately 9.4 km. Blackwell and Greene (2006) reported underwater broadband sounds associated with oil production at Northstar Island during the open-water season reached background levels at distances of 2 to 4 km. Ringed seals may be able to detect underwater industrial sounds out to 1.5 km in the water and approximately 5 km in the air (Blackwell, Greene, and Richardson, 2004). Moulton et al. (2002, 2003, and 2005) reported that limited winter industrial activity at Northstar Island did not appear to significantly affect ringed-seal density or behavior in the spring. Williams et al. (2006b) reported no relationship between ringed seal use of subnivean structures and the distance of those structures from Northstar Island. In addition, seals may become habituated to industrial sounds near artificial islands (Blackwell,

Lawson, and Williams, 2004a). Noise and activity disturbances from drilling and oil production activities at the Liberty (SDI) Project are unlikely to displace or disturb large numbers of seals.

3.3.7.2 Small Spills or Leaks

It is unlikely that minor spills (<200 bbl of crude oil) or leaks of oil or chemicals arising from drilling and oil production at the Liberty (SDI) Project will impact marine mammals. Such minor discharges would likely be contained and cleaned up immediately. It is unlikely that any discharges would enter the marine environment.

3.3.7.3 Large Oil Spills

A large oil spill (≥200 bbl of crude oil) originating from the Liberty (SDI) Project poses the greatest potential to impact marine mammals when measured against all other development-related consequences. The impact on marine mammals from an oil spill would depend on numerous factors, including the species, its age and health status, and the size/behavior of the spill. Seals, beluga whales, and possibly a few Pacific walruses could experience many impacts from direct exposure to oil, including skin and eye irritation, risk of infection, and stress. These effects could contribute to the death of a few individuals (Geraci and Smith, 1976; Geraci and St. Aubin, 1980; St. Aubin, 1990). Furthermore, ingestion through consuming oiled prey or inhalation could lead to an accumulation of hydrocarbons in the bloodstream and cause death through kidney failure (Oritsland et al., 1981).

3.3.8 Marine and Coastal Birds

3.3.8.1 Noise/Activity Disturbance

Drilling noise would be limited, because all drilling rig facilities will be enclosed. Associated noise and activities would continue from 2010 through 2013, potentially disturbing and displacing birds from the vicinity of the SDI. It is possible that some birds could habituate to drilling noise and activity, but our analysis assumes that all birds would be displaced to other nearby areas. Human/industrial activity on the expanded SDI during drilling and production could lead to long-term abandonment of Duck Island 1 & 2, located west of the SDI, by common eiders (~16 nests) and glaucous gulls (~4 nests).

Operational traffic along the Endicott Road would decrease from levels associated with SDI expansion and facility construction phases of this project. The existing operational levels of traffic on the Endicott Road have not led to distributional changes for broodrearing snow geese (Johnson, 1998; Johnson, 2000a) and no substantial changes in marine and coastal bird distribution or abundance is anticipated.

Overall, noise and disturbance associated with drilling and production operations would continue to be localized, and no long-term adverse effects on marine and coastal bird populations are anticipated.

3.3.8.2 Small Spills or Leaks

A small spill is defined as <200 bbl, but BPXA estimates 42 bbl of product would be spilled over the life of the Liberty (SDI) Project. The 95% confidence interval on the total volume of small product spills range from 10 to 125 bbl. An estimated 2 bbl/yr would be spilled. Over a 12-hour period, 15% of a small diesel fuel oil spill into the Beaufort Sea would persist, because 45% would evaporate and 40% would disperse. Over 19 hours, 11% of a 2-bbl spill of light diesel fuel

oil in the Beaufort Sea would remain, with 22% evaporating and 67% dispersing. This spill would cover approximately 0.37 acres of the waters surface after 19 hours.

Minor spills and leaks of oil, chemicals, or wastewater could affect the quality and abundance of prey species for diving seabirds if they were to enter the marine environment. Discharges of small amounts of petroleum compounds also could reduce water repellency of bird feathers, compromising their insulative capacity, resulting in hypothermia and death/drowning. The most abundant species (long-tailed ducks, common eiders, and red-throated and Pacific loons) would experience the largest collective mortality, but smaller populations would be impacted to a disproportionately greater degree. Chronic discharges could collectively affect a large number of birds over time. Preventive measures such as daily visual inspections are required to be ongoing during drilling and production operations to keep small releases of pollutants from entering the marine environment where they could impact a large number of birds prior to an active spill response.

It is unlikely that minor spills (<200 bbl of crude oil) or leaks of oil or chemicals arising from drilling and oil production at the Liberty (SDI) Project will impact marine and coastal birds. Such minor discharges would likely be contained and cleaned up immediately. It is unlikely that any discharges would enter the marine environment.

3.3.8.3 Large Oil Spills

A large spill is defined as ≥200 bbl. BPXA estimates an 8% chance of one or more large spills occurring over the production life of the project. At the 95% confidence interval BPXA estimates a 4 to 15% chance of one or more large spills occurring over the production life of the Liberty (SDI) Project. BPXA estimates a 92% chance of no large spills occurring over the life of the Liberty (SDI) Project.

For purposes of spill-trajectory modeling and analyses, a spill size of 1,000 bbl was used (in the Liberty FEIS [USDOI, MMS 2002]). This modeling did not account for any cleanup or containment but indicated that a spill could happen at any time of the year. In certain situations, containment could be enhanced if the spill were held against the Endicott Causeway, slowing the potential for the spill to spread into marine areas.

A large oil spill from the SDI during drilling and production would have a variety of impacts to marine and coastal birds if they were to enter the marine environment, depending on the size of the spill, time of year, and trajectory of the spill. Spilled oil can cause direct mortality by contact resulting in hypothermia, shock, and drowning, or indirect mortality through ingestion during preening or contamination of prey species. Details for the mechanisms for oil-spill impacts to birds are discussed in Section III of the Liberty FEIS (USDOI, MMS, 2002).

A large spill originating from SDI drilling activities directed offshore of the Endicott Causeway during May to early November would contact flocks of migrating king and common eiders and molting long-tailed ducks, broodrearing common eiders and glaucous gulls in the Stefansson Sound region. A large spill during either spring or fall migration periods, when hundreds to thousands of birds move along the Beaufort Sea coast daily, would substantially increase the number of birds exposed to floating oil. For example, a large spill reaching the nearshore coastal areas between Prudhoe Bay and Tigvariak Island during the summer likely would contact more than 1,000 long-tailed ducks; hundreds of glaucous gulls; and dozens of common eiders, king eiders, scoters, and loons. These individuals represent 1 to 3% of their populations on the Arctic Coastal Plain. Spill losses are expected to be minor for regional

populations of birds with stable or increasing numbers, but losses of birds with declining populations, such as long-tailed ducks, may be more serious.

A large spill reaching the Sagavanirktok River delta during July through September could expose all of the Howe Island nesting snow geese as they leave Howe Island with their goslings and most (62%, 2,367 of 3,816 total geese, 982 adults) of broodrearing snow geese, based on their July 19, 2006, distribution. The Howe Island snow goose colony represents a large proportion of the snow geese nesting in Arctic Alaska. More than 4,000 broodrearing and staging waterfowl (1,494 snow geese, 1,098 white-fronted geese, 1,038 Canada geese, 251 brant, 103 tundra swans, 220 northern pintails) could be exposed to a large spill reaching the Sagavanirktok River delta, representing 1 to 10% of the Arctic Coastal Plain populations for these species. Loss of foraging habitats in the Sagavanirktok River delta for these waterfowl, including coastal salt marshes, mudflats and river channel habitats in the Sagavanirktok River delta, potentially would be more problematic (Noel, Johnson, and Butcher, 2004; Sedinger and Stickney, 2000). Spill losses for these species are expected to be minor for most regional populations, with the exception of snow geese. These waterfowl species have exhibited stable or increasing numbers across the Arctic Coastal Plain.

A large spill contacting the Sagavanirktok River delta during late summer and fall shorebird staging in August and September could directly affect thousands of shorebirds and likely would result in the long-term contamination of coastal tundra and mudflat habitats (Troy, 2000). Degradation of foraging habitats and contaminated prey species would reduce survival of migrant shorebirds, with thousands to tens of thousands of migrant shorebirds potentially affected (Andres, 1994; Powell, Taylor, and Lanctot, 2005). A major spill into the Sagavanirktok River would have regional effects on bird productivity and abundance.

Overall, the risk of a large spill is considered low. The risk of spilled oil entering the marine environment is low; the risk of substantial harm to coastal and marine birds is further reduced, because marine and coastal birds are not present throughout the year. The risk of a spill and potential for contacting birds is affected by spill response and containment, which could be effective in preventing a spill reaching the Sagavanirktok River/delta area. While the effects from a large spill entering the marine environment have the potential to affect a large proportion of regional bird populations, this is not considered a likely event, and no major impacts are anticipated.

3.3.8.4 Discharges

Some hypersaline and process waters would be discharged from the MPI, which is authorized under a National Pollutant Discharge Elimination System (NPDES) permit. These discharges, regulated by the Environmental Protection Agency (USEPA) to avoid adverse environmental effects, may result in minor changes to forage availability for long-tailed ducks, eiders, loons, and glaucous gulls in the vicinity of the MPI. Seawater intake would entrain some forage species, reducing the quantity of available forage by a very small amount.

Warm effluent discharges would create a thaw area in the ice of the receiving water that is attractive to early arriving sea ducks such as king eiders, common eiders, and loons. If the discharge is nutrient enriched, local marine productivity could be enhanced, attracting long-tailed ducks, common eiders, loons, and glaucous gulls to the area throughout the summer. Attraction to these discharge streams could expose birds to contaminants, but compliance with EPA permit stipulations should reduce this potential risk to low levels.