CHAPTER 6.0

AFFECTED BIOLOGICAL ENVIRONMENT AND IMPACTS

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6.1 INTRODUCTION

Chapter 6 of this Environmental Impact Statement (EIS) presents the environmental setting and potential impacts of each alternative on biological resources. This chapter addresses a range of biological resources in the vicinity of the Northstar Unit, including: plankton, marine invertebrates, fishes, marine mammals, coastal vegetation, freshwater and terrestrial invertebrates, birds, and terrestrial mammals. Threatened and endangered species are specifically addressed. Information in this chapter supports National Environmental Policy Act (NEPA) decision-making for water discharge (National Pollutant Discharge Elimination System [NPDES]) and ocean dumping (Section 103) permits. Information will also be used to assist in fulfilling NEPA requirements for Section 7 consultation under the Endangered Species Act of 1973 (ESA) and consultation for Incidental Harassment Authorization under the Marine Mammals Protection Act.

The information presented in Chapter 6 provides an understanding of the biological resources in the vicinity of the Northstar Unit. Potential impacts on biological resources associated with the construction, operation, maintenance, and abandonment of each project alternative are described. The criteria used to determine if an impact on the biological environment is potentially significant was based on the NEPA definition of significance, which requires consideration of context (as it affects populations, the affected region, and the locality) and intensity or severity of the impact. The range of intensity included none (no impact), negligible, minor, and significant as defined in Section 1.8. The analysis of intensity considered the magnitude of the impact, the geographic extent, duration and frequency, and the probability of an impact occurring.

The impact criteria for many biological resources are qualitative in this EIS, because of the lack of data on specific effects. Professional expertise and judgment, along with consideration of available scientific literature, were relied upon to derive thresholds at which impacts were considered significant and, therefore, avoidance or minimization would be required to reduce these impacts or demonstrate that the impacts are unavoidable. For evaluating the intensity of an impact to biological resources, consideration is given to whether the action affects the species populations of the geographic area (e.g., barrier islands, North Slope oil fields, Colville River drainage), as well as much larger regional populations (e.g., Arctic Coastal Plain, southern Beaufort Sea).

Chapter 6 addresses the following issues related to the project's potential impacts on biological resources:

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6.2 TRADITIONAL KNOWLEDGE

Traditional Knowledge is included in this EIS in acknowledgment of the vast, valuable body of information about the Arctic that the Inupiat people have accumulated over many generations. This knowledge contributes, along with western science, to a more complete understanding of the Arctic ecosystem. Although Traditional Knowledge has been accumulating for much longer than western science, it has been maintained orally and been recorded sporadically. While such transcriptions have occurred coincident to various research efforts, they rarely have been focused directly on the topics of this EIS. Therefore, in this effort to collect references to Traditional Knowledge on specific topics such as plankton, invertebrates, vegetation, fish, mammals, and birds, the results are fragmentary and in no way represent the complete body of Traditional Knowledge on these topics.

Traditional Knowledge on the biological environment was obtained from testimony by village elders, whaling captains, and other citizens from the villages of Barrow, Nuiqsut, and Kaktovik at the majority of hearings on North Slope oil and gas development held since 1979. Information also was obtained through personal interviews with concerned citizens in and around the project area. Reviews of engineering studies and environmental reports associated with previous and ongoing oil and gas exploration and development activities provided a source of additional Traditional Knowledge. Published and unpublished scientific reports and data; and environmental reports and studies conducted by universities, the oil industry, federal and state agencies, and the North Slope Borough (NSB) also were used as sources for Traditional Knowledge.

Due to historic concerns that Inupiat people have had with offshore oil and gas development, extensive Traditional Knowledge of bowhead whales and their associated issues has been compiled from Inupiat testimony, as compared to some of the other animals. As noted by Sarah Kunaknana of Nuiqsut, who was raised near Prudhoe Bay, *"There are other animals, sea mammals, involved ... but what really concerns us is the migrating whale because [petroleum exploration is in] the path that they take during their migration."* (USDOI, MMS, Alaska, 1990:15).

Inupiat names are spelled according to the transcripts of the hearings, and some statements have been paraphrased to clarify the information.

6.2.1 Plankton and Marine Invertebrates

Inupiat Traditional Knowledge of plankton and marine invertebrates has been obtained primarily through observations of events in nature. For example, Isaac Akootchook of Kaktovik stated that, in 1964, he watched the *"Wave action of [an] earthquake hit ... the microorganisms and the planktons ... were pushed out [of the water] onto the ice."* (USACE, 1984:17). Observations have enabled Inupiat hunters to gain detailed knowledge of ecosystem relationships, as demonstrated by a statement made by Fenton Rexford of Kaktovik, who testified that crustaceans, shellfish, and shrimp are all tied into the bearded seal and the bowhead whale and added, *"If there is an oil spill out there, it will kill off all those shrimp, the crab, [and the] phytoplankton, they will all be affected."* (USACE, Alaska, 1996:43).

6.2.2 Fish

Regarding migration routes of least and Arctic cisco, Archie Brower, former Mayor of Kaktovik, stated, *"I've been catching fish that [were] tagged all the way from Prudhoe Bay over at Griffin Point ... that's about 18 miles east of here."* (USDOI, MMS, Alaska, 1982:5). Johnny Ahtuangaruak of Nuiqsut noted the Colville River is an important spawning area (USDOI, MMS, Alaska, 1982:6).

Inupiat hunters believe that high sound levels associated with seismic exploration will affect fish adversely. To demonstrate the impacts of strong sound waves on fish, Emmett Morrey of Anaktuvuk Pass stated that, when he was a young man netting fish with his father, fish would *"just roll belly up"* if his father hit a piece of willow against the ice (USDOI, MMS, 1983:32).

6.2.3 Marine Mammals

Inupiat hunters have noted that there are more polar bears than there used to be. Archie Ahkiviana, a whaling captain from Nuiqsut, noted that polar bears, *"Are getting [to be] too many,"* and added, *"One time they counted over 100 polar bears right down below Endicott."* (Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:25-26). Hunters have observed that polar bears may be attracted to oil and gas exploration sites. Thomas Napageak, a whaling captain and President of the Native Village of Nuiqsut, stated that polar bears, *"Go toward the noise or anything that moves."* (Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:27). Inupiat hunters also know that polar bears are sensitive to noise during the denning season. Billy Adams, representing the NSB, stated, *"Polar bears that den ... will not tolerate noise disturbance."* (USDOI, MMS, 1986:8). Nuiqsut elder Samuel Kunaknana observed that polar bears have built dens along rivers because of high snow drifts and lack of ice movement, as compared to sea ice (USDOI, MMS, 1979:5).

Inupiat residents had observations on the presence of other marine mammals in the project area. According to Samuel Kunaknana of Nuiqsut, seals occur in high numbers in April on the sea ice near Nuiqsut (USDOI, MMS, Alaska, 1982:6). Thomas Napageak noted that they migrate through the area around Nuiqsut in August and sometimes come close to West Dock (Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:21). He also noted that killer whales and walrus have been observed near Narwhal Island, 20 miles (32 kilometers [km]) northeast of the project area, and a single gray whale was observed there in 1993 (Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:24).

6.2.4 Birds

According to Thomas Napageak, Thetis Island, north of the Colville River delta, and Pole Island, 30 miles (48 km) east of the project area, are important nesting areas for waterfowl, including eider ducks (Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:26). Isaac Nukapigak of Nuiqsut stated that the Peri Islands also are important to migrating birds (USDOI, MMS, Alaska, 1990:17). Inupiat are concerned about the birds' vulnerability to oil. Fenton Rexford, President of the Kaktovik Inupiat Corporation, stated, *"We know that there are a lot of waterfowl that come from all over the world that go through this area ... and if there is an oil spill that would have a drastic [effect] on the population."*

(USACE, Alaska, 1996:22).

6.2.5 Terrestrial Mammals

Hunters in Kaktovik have testified frequently that more caribou roamed the region in the past than do today. In 1979, Nolan Solomon of Kaktovik stated: *"There used to be lots of caribou. There used to be hundreds out there. ... Today, you can hardly see any. I think strongly because of air traffic. Small planes and helicopters fly fifty feet above the coast ... driving our caribou away from their calving areas and migrating patterns and also cause caribou to leave their young."* (USDOI, MMS, 1979:22). In 1982, Jonas Ningeok also of Kaktovik stated: *"There used to be lot of caribou here before they put up the pipeline. Ever since they put that pipeline around this area, the caribou have not been seen up here very much."* (USDOI, MMS, Alaska, 1982:25). Isaac Akootchook, a resident of Kaktovik for 68 years, stated: *"Since this development of the oil companies started, there has been a very noticeable decline [in] the caribou. You have to travel way up ... to the mountains to catch any caribou nowadays."* (USDOI, MMS, 1990:10).

According to Thomas Napageak, caribou belonging to the Porcupine Caribou Herd come as far west as Nuiqsut only if a southwesterly wind has been blowing steadily for a week and it has been warm. Otherwise, they will stop near the Sagavanirktok River. He also stated that some mixing occurs between the Western Arctic, the Central, and the Porcupine Caribou Herds prior to their moving inland (Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:29).

Rossman Peetook of Barrow and Fenton Rexford of Kaktovik noted that caribou derive their salt from the ocean waters and, therefore, effects from an oil spill would also be felt by caribou. (USDOI, MMS, 1983:25). *"We .. get migrating caribou that come into the ocean for a salt lick. They have come from a long migration route and they are deficient in minerals. They go down to the ocean in little lagoons and lick the .. salty ice."* (F. Rexford in USACE, 1996:30).

6.2.6 Threatened and Endangered Species

The Inupiat Eskimo of northern Alaska have pursued the bowhead whale for generations during annual subsistence hunts. Inupiat Traditional Knowledge reflects the strong dependence of the Inupiat people on the ocean for survival. In 1996, this concern was summarized by Edward S. Itta, a whaling captain and President of the Barrow Whaling Captains Association, who testified that, *"The ocean is what holds our culture together ... [and that means] ... the [bowhead] whale."* (USACE, 1996:28). Knowledge of marine ecosystems forms the basis for Inupiat concerns regarding oil and gas development in the Arctic.

During the past 10 years, biologists have worked with indigenous peoples to integrate Traditional Knowledge into their research (Freeman and Carbyn, 1988:22; Freeman, 1992:11; Hobson, 1992:2; Albert, 1992:25; MBC, 1996:127). This interest in Traditional Knowledge is in recognition of the fact that biological studies in the Arctic are usually conducted as intensive, short-term efforts during the brief Arctic summer. In contrast, Traditional Knowledge represents the cumulative observations of people who have lived in the Arctic for many generations. This knowledge is expressed frequently because of the strong interest Inupiat have in science and resource management (Albert, 1988:18; Albert, 1990:345). Craig George, representing the NSB noted: *"There's nothing mysterious about Traditional Knowledge. Wildlife biology is largely an observational science ... the person who has the most number of observational hours has the best data .... and the cumulative hours of observation of the whaling community just dwarfs anything that's been done by the scientific community."* (USDOI, MMS, 1995:49).

6.2.6.1 Bowhead Migration Route and Timing

A number of Inupiat whaling captains have provided detailed testimony regarding the characteristics of bowhead whale migrations. Arnold Brower, then Chairman of the Alaska Eskimo Whaling Commission (AEWC) with 30 years' experience hunting bowheads, noted that spring migration occurs in three pulses, whereas fall migration occurs in two pulses (USDOI, MMS, 1986:24). However, Burton Rexford, Chairman of AEWC in 1995, with 55 years of whaling experience, stated, *"The migration routes are unpredictable due to nature's conditions."* (MBC, 1996:80). Whaling crews have observed that migrating whales appear to have 'scouts,' whales that check ice conditions in advance of the main group (C. Nageak in NSB, 1981:296; W. Bodfish in NSB, 1981:297; L. Kingik in NSB, 1981:297).

Bowheads follow open areas in the ice of the Alaskan Beaufort Sea during spring migration according to Waldo Bodfish of Wainwright (NSB, 1981:295), and generally do not stop anywhere along the migration route (V. Nageak in NSB, 1981:295). Andrew Oenga, who hunted bowhead whales as a crew member out of Barrow from 1943 to 1960, stated, *"I believe from my experience that bowhead whales would reach the leads far offshore from Prudhoe Bay by early May."* (NSB, 1980:182). The spring migration ends at Herschel Island according to Vincent Nageak (NSB, 1981:295). However, whaling crews also have noticed that not all bowhead whales follow the same migration patterns in the Chukchi or Beaufort Seas. According to Harry Brower, Jr., of Barrow, *"they're ... here [Barrow] during the summer, too."* (USDOI, MMS, 1995:85).

Bowhead whales start their fall migration back from the Herschel Island area in August (I. Akootchook in USDOI, MMS, 1995:12). The first pulse consists of bowheads migrating by the hundreds, in schools like fish (T. Napageak - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:23). These whales are not accompanied by calves (J. Tukle in USDOI, MMS, 1986:21). The second pulse consists of females with calves (J. Tukle in USDOI, MMS, 1986:20; T. Napageak - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:22). Bowhead whales apparently take their time returning westward during fall migration, sometimes barely moving at all, with some localities being used as staging areas due to abundant food resources (W. Bodfish in NSB, 1981:296). For example, Susie Akootchook, who was born and raised in Kaktovik, recounted one feeding area located offshore of Kaktovik: *".. We have feeding areas for the bowhead whale in our area. Just last September [1995] we [saw] them just playing around out here."* (USDOI, MMS, 1995:18). Michael Pederson, representing the Arctic Slope Native Association, testified that: *"Areas all along the Beaufort Sea, such as Camden Bay and Harrison Bay are considered bowhead whale feeding areas. We know that they feed [there] ..... The barrier islands all along the coast are considered an important resource to the bowhead whale and are used as staging and feeding areas."* (USACE, 1996:51).

Inupiat whaler Patsy Tukle of Nuiqsut noted that the migration appears to: "*...stop when the winds are very slow ... when the weather is nice, they don't migrate. But when the winds start, [that] is when they actually start going through [Camden Bay] towards Cross Island."* (USDOI, MMS, 1986:24). It takes about 2 days for bowheads to travel from Kaktovik to Cross Island (T. Napageak - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:23). Andrew Oenga stated, *"I know that the whales are migrating back along the barrier islands off Prudhoe Bay by late September."* (NSB, 1980:182). It takes the whales another 5 days to reach Point Barrow from Cross Island (T. Napageak - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:23).

Inupiat have observed that ocean currents carry food consumed by bowheads and that whales follow the currents. For example, if the currents are close to Cross Island, whales migrate near there (T. Napageak - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:13). In the region immediately east of the project area, bowheads sometimes travel on the inshore side of Cross Island (V. Nageak, in Shapiro et al., 1979:A-II-23). Whales are seen inside the barrier islands near Cross Island almost every year and are sometimes also seen between Seal Island and West Dock (F. Long - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:14-15).

Bowhead whales may swim very close to shore on some occasions. Archie Brower, a whaling captain and Mayor of Kaktovik, stated, *"I have seen [bowhead] whales that feed not more than 1,500 feet offshore ... and that's only about somewhere around 15 to 20 feet of water."* (USDOI, MMS, 1979:6). At the Minerals Management Service (MMS) Arctic Synthesis Meeting in Anchorage in 1995, Burton Rexford of Barrow stated that, when he was a boy, *"Often we would observe fall migration of belukha and bowhead whales about 25 yards from the beach shoreline."* (MBC, 1996:80). Isaac Akootchook of Kaktovik reported, *"We saw whales right by the shore .. how deep it is, I don't know, but we [saw] the water [was] colored .. they hit the bottom so that [mud was suspended into the water column]."* (USDOI, MMS, 1979:15). Herman Rexford of Kaktovik noted: *" ... bowheads do travel in the shallow water, especially when feeding. They can come close to the shore ... this was when they [Inupiat] first started whaling."* (USDOI, MMS, 1979:16). Thomas Brower of Barrow noted that smaller whales may swim in water depths of 14 to 18 feet (ft) (4.3 to 5.5 meters [m]) (NSB, 1980:107).

During years when a fall storm pushes ice up against the barrier islands in the Alaskan Beaufort Sea, bowheads may, *"Migrate on the shoreward (lagoon) side of the barrier islands, where the swimming is easier."* (T. Brower in NSB, 1980:107). Crews looked for whales inside the barrier islands during the years of commercial whaling.

In the past, Inupiat whalers questioned the results of aerial censuses of bowhead whales carried out by the U.S. Minerals Management Service (MMS) in the Alaskan Beaufort Sea, based on Traditional Knowledge. Weather and mechanical problems can limit coverage of a survey area and keep planes on the ground altogether. This can affect flight surveys. Inupiat whalers on the water, however, can sometimes see whales when survey planes cannot. Whaling crews sighted 23 bowheads in the Kaktovik region during the fall of 1983 while aerial observers sighted five whales. Survey planes were: *"Going far offshore...because ice conditions were such that whales were migrating about 70 miles offshore. And they were not aware of the shore pulse."* (J. George in USDOI, MMS, 1983:23,58-59). Although the fall 1983

MMS aerial surveys were conducted for inshore, mid-offshore, and far-offshore survey blocks (Ljungblad et al., 1984:68), inherent limitations in a sampling survey mean some animals will be missed. Some limitations of aerial surveys include the fact that planes do not fly in all weather and that submerged bowheads may not be observed due to the speed of the aircraft.

Traditional Knowledge of noise effects on bowhead whales is presented in Section 9.2. Short-term and long-term displacement of bowheads due to noise disturbance from industry is also presented in Section 9.2.

6.2.6.2 Oil Spills

Inupiat concerns regarding the scale of impacts from a large oil spill in the Alaskan Beaufort Sea is a product of their understanding of ecosystem processes. For example, Fenton Rexford of Kaktovik testified: *"If there is an oil spill out there, it will kill off ... shrimp, crab[s], ... [and] phytoplankton, they will all be affected ... [they] are all tied into the whale and the ugruk [bearded seal]."* (USACE, Alaska, 1996:29-30). Archie Brower, a whaling captain from Kaktovik, testified: *"The whole place from the mountains to the ocean is just like our garden. We feed on it. If there's a major blowout on the ocean, [under the ice] if that happens, [and] the ice goes out, it's going to take that oil all along the coast ... and it would destroy our fish, seals, and whales."* (USDOI, MMS, 1979:25). Arnold Brower Jr., of Barrow, stated that, *"Any accidents of oil spill[s] would have a devastating impact to the bowhead population if [a spill were] encountered by a large migrating school that happens to want to pass through their natural migratory pattern."* (USDOI, MMS, 1990:17). Thomas Napageak, then Mayor of Nuiqsut, explained the ultimate Inupiat concern: that a reduction in the bowhead stock from mortality due to an oil spill, *" ... may result in reduction or elimination of bowhead quotas for subsistence hunters in the Inupiat community."* (USDOI, MMS, Alaska, 1990:23).

The Inupiat view that an oil spill could have serious consequences to bowhead whales derives from Traditional Knowledge that most of the bowhead whale population travels to and from the Canadian Beaufort Sea in a fairly narrow migration corridor during a fairly short time. Barrow residents have recorded seeing 300 bowhead whales migrating in a day during spring and, in 1980, 95 percent (%) of the population came through in 6 days (G. Carroll in USDOI, MMS, 1986:38). There is expectation among Inupiat men and women who testified at various hearings since 1979 that a large oil spill would have severe consequences to the bowhead whale population, as well as other wildlife, because effective cleanup measures in ice-covered waters have not yet been developed. Joann Loncar, testifying at the hearing for the Draft EIS for Diapir Field Lease Offering in June 1984 stated: *"The majority of all ... bowhead whales, migrating through the Canadian Beaufort pass [the Diapir field]. And it's not going to be one or two whales [that will be affected], it's going to be the entire herd."* (USDOI, MMS, 1983:49). The large number of bowheads that could potentially be affected by an oil spill is illustrated by a statement by Joash Tukle, a whaling captain from Barrow. During a bowhead whale hunt off Barrow in 1976, he saw: *"About 150 to 200 whales in one spot. I am not telling you now .. what somebody told me, but I was there. I saw it with my own eyes, and it is a fact."* (USDOI, MMS, 1987:47).

Dr. Mike Philo, representing Inupiat in the NSB, pointed out, *"The potential effect on bowhead whales* *[of an oil spill] is not minor, but major, because if there is an oil spill, whether it be into a lead or from the ice as it melts and goes into a lead, not just a few bowhead whales but potentially the majority, if not the whole population, could be exposed to that oil spill."* (USDOI, MMS, 1986:30). Craig George, also representing the NSB, noted, *"... an oil spill that gets into a spring lead ... can't be anything but catastrophic ... [because one year most] ... of the whales passed within two miles of the lead edge."* (USDOI, MMS, 1995:51-52).

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6.3 PLANKTON AND MARINE INVERTEBRATES

6.3.1 Affected Environment

Plankton and marine invertebrates are the basis of the food web in the Alaskan Beaufort Sea and are an important food source for fish, birds, and marine mammals. Plankton and marine invertebrates occur throughout the project area as they or their early life stages drift in the ocean currents. Abundance and distribution of plankton depend on factors of the physical (e.g., wind, currents, turbidity, nutrient availability, and light) and the biological (e.g., competition and predation) environments.

6.3.1.1 Phytoplankton

Phytoplankton are microscopic, unicellular algae which drift suspended in the water and are the primary source of fixed carbon in the sea. Additional primary production is done by epontic algae (microscopic forms living on the underside of sea ice) and benthic algae. Abundance and distribution of phytoplankton are influenced by seasonal patterns in light intensity, nutrients, and oceanographic conditions (USDOI, MMS, 1996:III-B-I). Phytoplankton abundance is greatest in water depths of less than 16 ft (4.8 m). Populations peak in late July and early August due to an increase in light intensity during the open water period. However, annual primary productivity is about the same in both offshore and nearshore waters (Horner et al., 1974:57). Estimates of annual primary productivity range from 10 to 15 grams carbon/square meter/year in the nearshore lagoon areas compared with approximately 10 grams carbon/square meter/year for offshore areas (Horner et al., 1974:61).

6.3.1.2 Zooplankton

Zooplankton include macroscopic crustaceans such as copepods, as well as larval forms of other marine invertebrates and fish (ichthyoplankton) drifting in the water column. Larger zooplankton that may have weak swimming ability include: medusae (jellyfish); ctenophores (combjellies); chaetognaths (arrow worms); and crustaceans such as mysids, euphausiids (krill), and several species of amphipods. These organisms are food for birds and marine mammals.

Abundance and distribution of zooplankton in the Alaskan Beaufort Sea are affected by oceanographic conditions resulting from the clockwise circulation of the currents in the Polar Basin gyre, wind-driven upwelling, and intrusion of warmer, more saline Bering Sea water during the summer (Carey, 1978:181). During both winter and summer, calanoid copepods generally dominate the zooplankton in terms of biomass and densities in the project area. Barnacle, crab, and polychaete larvae are also abundant during summer (Busdosh et al., 1979:11; Horner et al., 1974:45). Copepods are also abundant in shoreline waters of Simpson Lagoon (Johnson and Richardson, 1981:115) and are important prey for seabirds, shorebirds, whales, and several fish species (Craig et al., 1984:359; Lowry 1993:210). Amphipods, mysids, and euphausiids are abundant in the Alaskan Beaufort Sea (Richardson et al., 1987:138). Euphausiids, primarily *Thysanoessa raschii*, are important food items for bowhead whales (Lowry, 1993:210) and ringed seals (Frost and Lowry, 1984:389). Gammarid amphipods and mysids, often considered to be epibenthic (bottom living) species, may swim above the seafloor and be included in the zooplankton.

6.3.1.3 Epontic Communities

Epontic communities are composed of plants and animals living on or in the undersurface of sea ice (USDOI, MMS, 1996:IIIB-2). Pennate diatoms and micro-flagellates are the most abundant algae in the bottom of the ice and in the water just below the ice during spring in the Alaskan Beaufort Sea (Horner et al., 1974:40). As a response to increased light in April, epontic populations develop, peaking in May, and declining in June as the ice layer melts (Alexander et al., 1974b:49). The timing of this peak is important, because epontic organisms provide food for zooplankton prior to the phytoplankton bloom.

6.3.1.4 Benthic Invertebrates

Benthic invertebrates living within bottom sediments (infauna) or on its surface (epifauna) are affected by sea ice, which physically disturbs sediments and limits the abundance and distribution of infaunal and epifaunal organisms. In nearshore waters, bottomfast ice prohibits overwintering of most benthic species at depths of less than 6.6 ft (2 m). Invertebrate communities in these areas are formed annually by re-colonization during ice-free periods (USDOI, MMS, 1990a:III-B-3). Nearshore areas are characterized by epifaunal crustaceans (amphipods, isopods, and mysids) that are motile and opportunistic, as well as infaunal polychaetes and bivalves. Isopods often dominate the invertebrate biomass in these areas (USDOI, MMS, 1996:III B-3).

Other physical factors influencing benthic communities include sediment composition, water temperature and salinity, wave action, and input of organic material (e.g., peat). Sediment grain size influences species composition; deposit-feeders predominate in fine sediments, and suspension-feeders are more common in coarse sediments. Large fluctuations in salinity and temperature occur in the nearshore habitats of benthic organisms. In some coastal lagoons, the exclusion of salt during ice formation and reduced water movement in winter can lead to salinities up to 180 parts per thousand (ppt), which can persist until either breakup or the penetration of freshwater runoff during spring (Houghton et al., 1984:21). During spring breakup, melting ice and flooding rivers may cause hyposaline conditions (nearly freshwater), and water temperatures may reach 54 degrees Fahrenheit (°F) (12 degrees Celsius [°C]) (Feder et al., 1982:B-13). In summer, salinity in Simpson Lagoon normally ranges between 1 and 32 ppt, and water temperature fluctuates from 32° to 57°F (0 to 14°C) (Craig et al., 1984:348). Many organisms survive these fluctuations by either temporarily burrowing into the sediment or moving out of the area.

Water currents in and out of the lagoons help move invertebrates and their larvae into nearshore areas from offshore to recolonize shallow areas after bottomfast ice moves out and exposes the inshore sediments (Griffiths and Dillinger, 1980:155). Currents and wave action also aid dispersion of organic material from terrestrial sources (river deltas and coastal erosion areas) into the marine environment. Organic material, such as peat, is considered a secondary food source for benthic invertebrates (Broad et al., 1979:363). Studies in Simpson Lagoon indicate that mysids and amphipods tended to collect on detrital mats (Griffiths and Dillinger, 1980:155).

Infauna: Diversity and density of infauna in the project area is low due to physical and chemical stresses (Houghton et al., 1984:21; Craig et al., 1984:348). Annelid worms (primarily polychaetes) and bivalve molluscs dominate the infauna to water depths of approximately 33 ft (10 m) in coastal areas (Broad et al., 1979:362; KLI, 1990:20). At depths of approximately 16 to 26 ft (5 to 8 m) in Prudhoe Bay and Stefansson Sound, polychaetes were the dominant infaunal organism, while molluscs and crustaceans were less abundant (Griffiths et al., 1983:11). A 1995 study in the project area confirmed these earlier findings. Benthic samples were collected in water depths ranging from 7 to 45 ft (2 to 13.7 m) between Northstar Island and West Dock (WCC, 1996:ES-1 and 4-40). Polychaete species were predominant, representing 43% of the total fauna, while crustaceans and molluscs composed 21% and 26%, respectively (WCC, 1996:4-12).

In the shear zone, at approximately 49 to 66 ft (15 to 20 m) water depths, ice gouging disturbs bottom sediments, limiting infaunal abundance (USDOI, MMS, Alaska, 1990b:III-B-3). In water depths greater than 66 ft (20 m), biomass and diversity of infaunal organisms increase with depth and distance from shore (Carey, 1978:201). Infaunal biomass is highest at approximately the 460-ft (140.2 m) depth (Carey et al., 1974:671).

Epifauna: Epifauna are generally more abundant and diverse than associated infauna in the nearshore Alaskan Beaufort Sea and the project area. Epifauna are distributed in zones of species groups; for example, three distinct communities are found between the nearshore and offshore areas of Prudhoe Bay (Feder et al., 1982:C-127 to C-130). Epifauna species groups are segregated in the Alaskan Beaufort Sea according to water depths and tend to increase in density and diversity with increasing water depths (Carey et al., 1974:678).

Epifaunal species groups of the nearshore waters in Harrison and Prudhoe Bays and Simpson Lagoon during the summer are dominated by mysids (Alexander et al., 1974a:411-462; Griffiths et al., 1983:10-11). They apparently overwinter in offshore areas and move nearshore when the ice leaves (Griffiths et al., 1983:17). Amphipods, another major component of the nearshore epifauna, appear to occupy a wider range of salinity than mysids (USACE and ERT, 1984:3-54). The isopod *Mesidotea entomon* is a common epifaunal organism in the Alaskan Beaufort Sea (USDOC, NOAA and USDOI, BLM, 1977:116; Broad et al., 1979:362; Griffiths et al., 1983:10-11). Although it is nearly ubiquitous in its distribution and has been reported at extreme depths in other environments, it appears to select water depths of less than 16 ft (4.8 m) in the Alaskan Beaufort Sea (MacGinitie, 1955:153-154; Robilliard and Busdosh, 1979:6).

6.3.1.5 Hard-Bottom Communities

Benthic hard-bottom communities contain macrophytic algae (large kelps), benthic microalgae, and benthic invertebrates associated with rocks or other hard substrate (USDOI, MMS, 1996:IIIB-2). The Boulder Patch in Stefansson Sound near the Endicott Development (Figure 6.3-1) provides a substrate for invertebrates and the brown alga (kelp) *Laminaria solidungula* which is an important carbon producer (Dunton, 1984:312). Such kelp beds support sponges, soft corals, hydroids, sea anemones, bryozoans, chitons, nudibranchs, and sea squirts, plus mobile benthic species, such as sea stars, fish, and crabs which are attracted to these algae (Dunton and Schonberg, 1980:366-387; LGL and Dunton, 1992:Table 1-1). This type of epifauna is often associated with small isolated patches of kelp and red algae which are attached to cobble-sized rock or shell debris in mud bottoms (Toimil and England, 1980:25). These hard-bottom communities are not found in the soft bottom sediments of the remainder of the Alaskan Beaufort Sea and have not been reported in the area surrounding Seal Island. They could, however, occur on concrete pieces left when the island was abandoned or on new structures placed in the area (such as the newly developed island slopes). Provided their local habitat is not adversely altered, large epilithic species can live in the same place for many years. Conversely, colonization of suitable new habitat following a major disruption is slow, possibly taking many years (Toimil and England, 1980:25).

6.3.2 Environmental Consequences

Potential impacts of project alternatives on plankton and marine invertebrates are described in this section. Impacts to plankton and marine invertebrates are considered the same for Alternatives 2, 3, 4, and 5. Therefore, these alternatives are discussed together and summarized in Table 6.3-1.

6.3.2.1 Alternative 1 - No Action Alternative

No construction is required for a No Action Alternative, consequently, there would be no impacts to plankton and marine invertebrates. The natural variability in population levels and habitat of plankton and marine invertebrates in the Alaskan Beaufort Sea would continue undisturbed. As a result of the No Action Alternative, the existing hard-bottom community habitat that has surrounded Seal Island since it was first constructed would not be effected.

6.3.2.2 Alternatives 2, 3, 4, and 5

Construction Impacts: Most construction activities for all alternatives would occur during the winter. Island slope protection and installation of offshore production facilities, however, would take place during the open water season. Gravel mining activities at the Kuparuk River Delta would not affect marine organisms because these activities would be conducted on land. Sediment disturbed by excavation at the mine site is expected to settle out in the abandoned deep pit prior to breakup, resulting in no secondary impacts from increased turbidity.

Placement of gravel to reconstruct Seal Island would build upon the existing underwater gravel structure and any remaining undisturbed soft substrate surrounding the island within the approximate 18.1-acre (7.3-hectare) Distribution of Spectacled Eider Breeding Pairs, 1991-1996 to be minor.

Figure 6.3-1 (Page 1 of 2)

Figure 6.3-1 (Page 2 of 2)

Table 6.3-1 (Page 1 of 2)

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Any widening of the West Dock causeway for Alternative 5 would result in a similar type impact. Moreover, natural sediment transport processes, such as storm events and strudel scour, routinely cause high turbidity and redeposition of fine sediments. As a consequence, infaunal and epifaunal species living on muddy bottoms are adapted to high turbidity and can naturally recolonize areas of seafloor that are disturbed (USACE and ERT, 1984, Volume 2:4-139). Even if recolonization of the disturbed seafloor area did not occur, the area that would be covered by new substrate represents a small portion of the total available habitat and would be a minor impact.

Phytoplankton biomass is low in the Alaskan Beaufort Sea in winter (Horner, 1979:92) due to the combination of low numbers of individuals and very low light levels. Increases in turbidity from gravel placement would lower light levels available for primary productivity. Since primary productivity is already low this time of year, impacts would be negligible. Turbidity would return to the normal range prior to the summer plankton bloom.

Zooplankton living in the water column immediately adjacent to Seal Island may be disturbed during gravel placement and construction dewatering discharge as a result of an increase in turbidity. Some organisms would be able to swim away from the disturbance. Normal currents would carry these organisms out of the affected area. Currents also would be expected to carry new organisms into the affected area. The affected population represents only a small fraction of the zooplankton population in the Alaskan Beaufort Sea and the effects would be minor.

Infaunal and sessile epifaunal organisms on the soft bottom within the enlarged footprint for Seal Island would be buried during gravel placement. The area of burial eventually could increase by approximately 4 acres (1.6 hectares) of soft bottom as a consequence of erosion from storm action and ice gouging on the island slopes. The loss of these individuals would be a minor impact considering that they are a small portion of the total population.

Inspection of the linked concrete mats at Seal Island during August of 1995 showed hard-bottom communities are present on the mats (CFC, 1996:5). These organisms and others living on the gravel comprising the existing Seal Island slopes would be buried completely during gravel placement. Effects to this assemblage from burial and the island slope protection system concrete mats would be considered a minor impact, but this habitat would be recolonized once construction is complete.

The lower portions of the mat and new gravel substrate could provide habitat for development of hard-bottom kelp communities. These communities can have a high species diversity and provide valuable habitat for fish and invertebrates such as crabs, shrimp, starfish, soft corals, hydroids, and sea anemones (Toimil and England, 1980:25). Because the island slope would be constructed of the same materials used previously at Seal Island, it is likely that the new biological community that develops at Seal Island would be similar to that which exists now. It would provide biological diversity for the duration of operation and the island's existence. Overall, impacts to the hard-bottom communities from island construction would be minor.

The construction dewatering discharge would be subject to a NPDES permit as discussed in Appendices

F, G, and O. This dewatering operation is required for installation of a seawater intake system port and an outfall port. An average of approximately 1 million gallons per day (gpd) (3.785 million liters/day), would be discharged with a maximum rate of up to 2 million gpd (7.571 million liters/day). This discharge would occur discontinuously for 2 to 4 weeks during late winter and would be composed of untreated seawater. The discharge would be through the slot cut into the ice for pipeline placement or directly into adjacent waters. This discharge is expected to be high in settleable and suspended solids, but is not expected to transport any other pollutant. Although its sediment load may affect local biota (e.g., smother some benthic organisms), this discharge is short in duration and occurs during a period of quiescent currents. Environmental impacts are expected to be negligible.

Removal of ice from the slot cut to facilitate trenching would eliminate epontic algae and invertebrates where the slot is cut in the ice. However, the area of ice removed would be small, less than 10 acres (4 hectares) in total. Storage of excavated sediments on the ice would leave a residue on the surface of the ice. This residue would substantially reduce light transmission through the ice in the spring, causing a reduction in primary production by phytoplankton and epontic algae food available to zooplankton. The area of soiled ice could exceed 150 acres (61 hectares) in the offshore zone. However, this area is small compared to the total area supporting primary production under the ice in the Alaskan Beaufort Sea, and therefore, the impact is considered minor.

Pipeline trenching activities could produce a variety of effects on soft-bottom benthic organisms. However, in less than 6 ft (1.8 m) of water, the biota in and on sediments under the bottomfast ice would already have moved, been frozen, or likely destroyed by natural processes of ice movement prior to the commencement of construction. Therefore, adverse effects of trenching would be limited to that portion of the pipeline corridor deeper than 6 ft (1.8 m). Trenching and backfilling would affect approximately 30 acres (12 hectares) of seafloor habitat in 6 to 39 ft (1.8 to 11.9 m) deep water. Organisms contained in excavated sediments stored on the ice would die from freezing or mechanical damage. Potential effects of trenching and backfilling on organisms living in or on sediments adjacent to the trench include suffocation from burial, crushing from ice removal, and physiological stress due to increased turbidity during trenching or backfill activities. Stationary organisms such as clams and worms would be most at risk, although mobile species such as isopods and amphipods also could be affected. However, the benthic community is tolerant of similar naturally-occurring perturbations from ice gouging, strudel scour, and severe storms. Natural repopulation of the trench area by infaunal invertebrates is expected within a few years. Density of invertebrates in the offshore zone is typically much higher than in water depths less than 6 ft (1.8 m), providing good stocks to support recolonization (WCC, 1996:4-47). Impacts of trenching would be short-term and minor.

As discussed above, it is not expected that the silt plume would cause a measurable reduction in abundance of common species beyond the range of natural variability or have adverse effects on the benthic biota. Bottom disturbances such as ice gouging and strudel scour, common in the offshore zone, may mask some construction effects on benthic invertebrates as a result of mounding, deposition, and alteration of sediments during the pipe-laying process. Naturally occurring hyposaline and highly turbid conditions occurring during spring breakup could also mask construction impacts. The overall impact from pipeline trenching and backfilling on plankton and marine invertebrates would be minor and disturbed areas are expected to be recolonized after installation of the pipeline.

In view of the anticipated vessel traffic and the depth of water at the dock face (approximately 38 ft [11.6 m]), a propwash would not normally extend to the seafloor. However, propwash from large tugs bringing barges to the island could cause disturbance of bottom sediments. Effects on marine organisms from such sediment disturbance is expected to be negligible, short-term, and similar to normal storm activity and ice grounding.

Operations Impacts: Operations would require a continuous seawater supply and produce a continuous combined effluent. Any phytoplankton or zooplankton entrained in the seawater intake system and entrapped in a filtration system would be backflushed through the discharge system. A portion of the intake seawater is eventually discharged back to the Alaskan Beaufort Sea as products of several different processes: brine from a desalination plant, treated domestic/sanitary wastewater, and effluent from a continuous flush system.
These three streams are commingled and discharged through a submerged port on the south seawall of the facility. This discharge may impinge on a small area of the island's toe and could come into contact with organisms that become established on this toe. However, this discharge is not expected to contain toxic materials and would be diluted rapidly as it enters the receiving seawater.

A second discharge is an annual test of the facility's fire suppression system. The fire suppression test lasts 30 minutes and discharges back into the Alaskan Beaufort Sea up to 88,200 gallons (333,873 liters) of seawater drawn in for the test. This annual test is expected to have no impacts on local plankton and marine invertebrates because the discharge consists of untreated seawater at near ambient temperature.

Effects of an oil spill to phytoplankton would likely include reductions in primary production due to changes in the light spectrum from the effect of water soluble aromatic hydrocarbons. This could cause changes in species composition (Hsiao, 1978:104-105; Hsiao et al., 1978:220), reduce growth, or cause mortality; however, effects vary depending on which species are present, type of oil, and life-cycle (Wells, 1982:67). These changes are typically temporary as the oil will eventually disperse and repopulation of the affected area by phytoplankton from adjacent non-contaminated areas would occur within 9 to 12 hours (USDOI, MMS, 1996:IV-M-2). Impacts of oil to plankton and marine invertebrates are discussed in Chapter 8.

Maintenance Impacts: Repair and maintenance of the offshore pipelines during normal operations would cause limited disturbances, the extent and nature of which would be similar to or less than those created during construction. The impact would depend on the nature of the problem, season of occurrence, and approach used to uncover/rebury (if required) the pipe and perform repairs. During winter, effects would not be anticipated in areas less than 6.6 ft (2 m) deep because benthic organisms would have been eliminated by bottomfast ice. In pipeline segments below floating ice where free water is found, or for summer excavation, disruption to benthic species would occur as a result of pipeline excavation. Impacts would depend on actual maintenance activities. These are, however, expected to be similar to natural bottom disturbances such as ice gouging and strudel scour and are considered a short-term, negligible impact due to rapid re-colonization of these areas in summer.

Island surface grading after breakup and before freezeup is not expected to cause an impact. Maintenance and repairs of the island slope protection system would include removal and replacement of blocks. Disturbance to biological communities living on or near the repaired areas may include increased turbidity, crushing, or destruction of organisms on the removed block. This activity would have an adverse effect on a small portion of the hard- or soft-bottom benthic communities established around the reconstructed Seal Island; therefore, impacts would be considered minor.

Abandonment Impacts: Abandonment impacts would depend upon the abandonment plan that is adopted and will be fully addressed in the assessment of the environmental effects of the abandonment alternatives. For an abandonment scenario involving complete removal of all facilities and infrastructure, impacts to plankton and marine invertebrates would be expected to be similar to those generated during construction and would have a similar, minor impact. Abandonment impacts that involved removal of all facilities and infrastructure would result in the loss of the hard-bottom communities that are expected to form around Seal Island which would also be a minor impact.

6.3.3 Summary of Environmental Consequences

No significant adverse impacts were identified for phytoplankton, zooplankton, and benthic marine invertebrates, or the epontic community which lives under the sea ice, from the development of the proposed project. Winter construction minimizes adverse impacts to marine biota because fewer organisms are present and primary productivity is already low. The impacts identified as a result of construction of Seal Island trenching and burial of the pipeline include mortality from direct burial, smothering, and displacement.

Alternative 1 will result in no impact to the seasonal bloom of phytoplankton and zooplankton or the development of the epontic community growing on the under side of the stable ice during the spring. With this alternative, existing population numbers and productivity will continue to fluctuate seasonally with a range of natural variation.

The development of Alternatives 2, 3, 4, or 5 will result in minor impacts to marine invertebrates from construction of Seal Island through smothering of organisms under the footprint of the island and burial existing hard-bottom communities presently growing in the surrounding area. The trenching for the pipeline will impact both infauna and epifauna through direct physical disturbance, burial with sediment, or from increased turbidity in the surrounding waters. Trenching the shallow waters of the lagoon would have a negligible effect on benthic invertebrates. Impact to marine invertebrates in deeper waters would be considered minor because of the rapid recolonization and geographic range of these species. Impacts of water discharges at Seal Island on plankton and marine invertebrates are considered negligible.

Development of the Seal Island and trenching and burial of the offshore pipeline could result in short-term impacts to plankton and marine invertebrates. Plankton would be rapidly replaced by reproduction or from adjacent areas. Recolonization of the disturbed bottom substrates would occur after construction and long-term productivity of the impacted area would not be adversely affected. The operation of the pipeline and facilities would have no long-term impacts on plankton or marine invertebrates. Maintenance activities that require offshore pipeline repair would have negligible impacts to plankton and marine invertebrates.

The development of any of these alternative would result in no irretrievable or irreversible commitment of marine invertebrate resources. Recolonization of the areas affected would replace lost biomass.

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6.4 MARINE AND FRESHWATER FISH

6.4.1 Affected Environment

Fishes inhabiting the project area fall into three groups: 1) freshwater species limited primarily to freshwater habitats; 2) "anadromous" species that migrate from marine waters to freshwater to spawn, and "amphidromous" species that migrate between freshwater and marine water for purposes other than spawning; and 3) marine species. Fish resources are an important part of the subsistence lifestyle of the Inupiat residents of the Arctic Coastal Plain which is discussed in Section 7.3. The term "anadromous" will be used in this document to refer to fish that spend time in both freshwater and marine environments (Craig and Skvorc, 1989:29). The common name "char" will be utilized in this document to refer to the anadromous chars of arctic drainages which have been called both Arctic char (*Salvelinus alpinus*) and Dolly Varden (*Salvelinus malma*) (Morrow, 1980:58-61). Recent taxonomic studies support the theory that they are a northern form of Dolly Varden (Reist et al., 1997; Craig and Skvorc, 1989:30).

This discussion incorporates information from the following reviews and emphasizes information obtained within the project area or that may be directly applicable to impact analysis. Alaskan Beaufort Sea fish resources have been reviewed in a number of previous documents including: study reports (USDOC, NOAA, 1978:220-231), Environmental Assessments (Dames & Moore, 1988:3-39 to 3-57), EISs (USDOI, MMS, 1990:III-B-5 to III-B-10; 1996:III-B-3 to III-B-6), and publications (Craig and Skvorc, 1989:27-54). Fechhelm et al. (1995:1-29) reviewed fish resources specifically associated with the Northstar Unit.

Nearshore Habitat: Nearshore areas are especially important to most fish species of the Alaskan Beaufort Sea (Table 6.4-1). For purposes of this discussion, nearshore is defined as that portion of the marine environment between the Alaskan Beaufort Sea coast and the outer side of the barrier islands. These waters are shallow, generally less than 10 ft (3 m) deep. Shorefast ice freezes to the bottom within most of the nearshore zone, limiting fish use to the short, but important, open water period from late June to October. The nearshore zone between the Colville River and the eastern edge of the Sagavanirktok River Delta, including Simpson Lagoon/Gwydyr Bay, has been studied extensively, with emphasis on anadromous fish species. This area is of particular interest because it overlaps the Northstar Unit area and offshore pipeline transportation corridors.

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It is generally accepted that shallow, brackish, nearshore marine areas in the Alaskan Beaufort Sea are important habitats during the open water season for anadromous and marine species (USDOC, NOAA, 1978:220-222; Morack and Rogers, 1984:270-273; USDOI, MMS Alaska, 1990:III-B-5 and B-7). In particular, Simpson Lagoon/Gwydyr Bay provides a migratory corridor between the Colville River and Prudhoe Bay (Fechhelm et al., 1995:21). The lagoon system also provides important feeding habitat containing abundant invertebrate prey during the summer (Craig and Haldorson, 1981:522). Preferred invertebrate food items tend to be associated with low to intermediate salinity (0 to 20 ppt) and relatively warm water conditions of 30.7 to 42.8°F (-0.7 to 6°C) that are typical of the lagoon area with temperatures as high as 60°F (15.4°C) in late June (Houghton and Whitmus, 1988:4; Cannon et al., 1991:171-172; Fechhelm et al., 1993:471). Little is known about distribution of biologically important marine species in this region; however, Arctic cod distribution tends to be associated with the transition zone between cold, saline marine waters and warmer, less saline water that results from coastal drainage (Moulton and Tarbox, 1987:48).

Offshore Habitat: Offshore habitats are defined as marine areas between the seaward side of the barrier islands and the pack ice zone in water depths from 10 to 165 ft (3 to 50.3 m). Most of the project area and proposed production and transportation facilities are located in the offshore habitat zone. This zone thaws during the short summer open water season and becomes covered with landfast ice in the winter (Section 5.6). The ice cover in the offshore zone does not reach the sea bottom at most locations, thus fish have access to the area year-round. In contrast to the nearshore zone, relatively few biological investigations have targeted the offshore area.

6.4.1.1 Freshwater Fish Species

Except for the Kuparuk River, watersheds of streams between Prudhoe Bay and Milne Point (East Milne Creek and Sakonowyak, and Putuligayuk Rivers) (Figure 6.4-1) are tundra drainages that freeze to the bottom by late winter. The Kuparuk River, a larger stream with some year-round flow, contains Arctic grayling *(Thymallus arcticus)*, round whitefish *(Prosopium cylindraceum)*, ninespine stickleback *(Pungitius pungitius)*, and slimy sculpin *(Cottus cognatus)* (Bendock, 1979:687).

Arctic grayling is the most important freshwater species in the project area. It is valuable to sport and subsistence fisheries and spawns in shallow stream areas in early spring, immediately after breakup. Eggs hatch in a few weeks and the young fish rear in shallow stream areas until declining stream flow in the fall forces them downstream to wintering areas. Adult and juvenile grayling disperse widely during the open water season to stream or pond feeding areas and move to wintering areas prior to freezeup.

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6.4.1.2 Anadromous Fish Species

Arctic cisco (*Coregonus autumnalis*), least cisco (*Coregonus sardinella*), char (*Salvelinus* species [sp]), and broad whitefish *(Coregonus nasus*) are the most abundant anadromous fish species in the project area. Table 6.4-1 summarizes directional fish trap net (a long, bag-shaped trap held open by hoops) catch data for 10 years of Endicott Project fish monitoring studies from Simpson Lagoon to the east side of the Sagavanirktok Delta. These data provide a good indication of species presence and proportional abundance in the nearshore zone during open water. Four anadromous species (Arctic cisco, least cisco, char, and broad whitefish), combined with Arctic cod *(Boreogadus saida)* and fourhorn sculpin *(Myxocephalus quadricornis)* (among marine species) make up 94% of the total catch (USDOC, NOAA, 1978:220).

A comparison of the relative abundance of the six most common species collected within Gwydyr Bay with the overall Endicott Project catch (Table 6.4-2) shows that nearshore fish species composition within the project area is similar across the Colville to Sagavanirktok River region. This comparison shows that least cisco, char, and fourhorn sculpin are more abundant in Gwydyr Bay than in other shoreline areas; whereas Arctic cod and Arctic cisco are less abundant.

Arctic Cisco: Arctic cisco *(Coregonus autumnalis)* have a complex and unusual life history which has only recently been understood. Figure 6.4-1 shows the distribution and movements of young-of-the-year (recently hatched fish), juvenile and sub-adult fish, and prespawning adults. Alaskan Beaufort Sea Arctic cisco are believed to originate from spawning stocks in the MacKenzie River of Canada (Gallaway and Britch, 1983:15-20). Young-of-the-year Arctic cisco leave the MacKenzie River and spread out along the Alaskan and Canadian Beaufort Sea coast in summer. The extent of summer movement is determined largely by coastal, wind-driven currents, which transport the small fish. Prevailing currents move these young fish westward and, in some years, they reach Simpson Lagoon by late August (Gallaway, 1990:141). Prior to freezeup, the fish move to wintering areas in the lower Colville and Sagavanirktok Rivers. In subsequent years, juvenile and sub-adult Arctic cisco spend their summers in Alaskan Beaufort Sea nearshore areas and their winters in the Colville and Sagavanirktok Rivers. They reach sexual maturity at 7 to 8 years, then move back to the MacKenzie River to spawn and do not return to the Alaskan Beaufort Sea.

Least Cisco: Least cisco *(Coregonus sardinella)* present between the Colville and Sagavanirktok Rivers originate from spawning stocks in the Colville River (Craig and Haldorson, 1981:468). Following breakup each summer, Colville River fish disperse both east and west along the coast, with some fish passing through Simpson Lagoon/Gwydyr Bay and traveling as far east as the Sagavanirktok River Delta (Figure 6.4-2). In the fall (late August to early September) the fish return to overwintering areas in the Colville River, again passing through Simpson Lagoon/Gwydyr Bay. This movement pattern occurs in all years for larger cisco; however, the movements of smaller least cisco are determined in part by wind and current. Smaller fish reach the eastern end of Gwydyr Bay in only about 1 out of every 2 years (Fechhelm et al., 1994:897-898).

Table 6.4-2 (page 1 of 1)

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Distribution of least cisco in Simpson Lagoon/Gwydyr Bay is similar to Arctic cisco, with highest concentrations of fish occurring near mainland and island shorelines. Least cisco prefer warm, low salinity water and generally are less tolerant of high salinity water than Arctic cisco. While older least cisco tolerate salinities up to 20 ppt (Reub et al., 1991:58), abundance of young fish decreases at water temperatures below 39°F (4°C) and salinities greater than 15 ppt.

Broad Whitefish: Spawning populations of broad whitefish *(Coregonus nasus)* are present in both the Colville and Sagavanirktok Rivers. The Colville River is an important spawning area for broad whitefish (J. Ahtuangaruak in USDOI, MMS, 1982:6). All age groups enter nearshore coastal areas to feed during the open water season and return to river overwintering areas in the fall (Figure 6.4-2). Small broad whitefish are not expected in the project area. Adult broad whitefish have a greater salinity tolerance than younger fish, up to 15 ppt (Reub et al., 1991:57); therefore, they disperse farther along the coast, including Gwydyr Bay. Recent evidence suggests that most of the broad whitefish found on the Kuparuk Delta originate from the Colville River (Cronin et al., 1995). Therefore, adult broad whitefish, like least cisco, utilize Simpson Lagoon as feeding habitat and a brackish water travel corridor between the Colville River and areas to the east. Most travel occurs within the lagoon system, although a few fish have been caught along the outer shore of the barrier islands.

Char: Char (*Salvelinus* sp.) are generally distributed across the entire nearshore Alaskan Beaufort Sea during the open water season (Figure 6.4-3). Spawning populations are present in the Sagavanirktok and Canning Rivers, and tributaries of the Colville River. Most char in the project area originate from Sagavanirktok River stocks (Craig and Haldorson, 1981:566). Char usually spend 2 years in freshwater prior to migrating to the Alaskan Beaufort Sea for the summer, but are able to tolerate a wide range of salinity and temperature. They return to rivers to overwinter and/or spawn in the fall. Sampling shows that char abundance in nearshore areas near the Northstar Unit is highest in early and late summer, while mid-summer abundance is low (Cannon et al., 1987:119-121). This pattern suggests that char move from the rivers to offshore feeding areas where they spend much of the summer, passing through nearshore areas on the outward and inward legs of their migratory journey. It should be noted, however, that Craig and Haldorson (1981:470) found char in Simpson Lagoon/Gwydyr Bay throughout the open water period. Stomach contents of char collected in September 1985 and 1986 included epontic crustaceans that inhabit the undersides of ice floes, providing indirect evidence that some char are feeding amid offshore ice floes, at least during September (Cannon et al., 1987:39).

6.4.1.3 Marine Fish Species

Numerous marine fish species have been caught in the nearshore Alaskan Beaufort Sea (Table 6.4-3). Arctic cod, Canadian eelpout, and various sculpins made up 70% of the catch during trawl surveys in the eastern Chukchi and Alaskan Beaufort Seas (Frost and Lowry, 1983:2). Limited surveys with small mesh trawls at 33 to 46 ft (10 to 14 m) depths from Pingok Island to West Dock were dominated by Arctic cod, with fourhorn sculpin and snailfish commonly encountered (Craig and Haldorson, 1981:437; Tarbox and Spight, 1979:2-11; Moulton and Tarbox, 1987:45). Fine mesh surface tow nets have provided information on small pelagic fish and planktonic fish larvae in the area north of West Dock (Dames & Moore, 1989:6; Thorsteinson et al., 1991:35). These studies demonstrated the abundance of Arctic cod, and found that planktonic cod larvae were common in surface waters in late summer, along with larvae of snailfish, capelin, and sculpins.

Offshore fish sampling has not occurred frequently during the winter in the Alaskan Beaufort Sea. A variety of under-ice nets were used at two sites east of the project area (Craig and Haldorson, 1981:455) (Table 6.4-3). Only two species were caught, Arctic cod and snailfish, with Arctic cod dominating the catch. Very little is known about the distribution of marine species under the ice during the long Arctic winter.

Arctic Cod: Arctic cod is considered an important food source for marine mammals and larger fish and is the most abundant fish in nearshore habitats (USDOI, MMS, 1996:III-B-5). Distribution ranges from shoreline habitats to the edge of the pack ice. This wide-ranging, circumpolar marine species spawns in mid-winter (January and February) at unknown locations near the coast. Arctic cod larvae appear in the sea in May to July, with the larval stage lasting about 2 months (WCC, 1979:A-2). Transition to juveniles usually occurs in August.

In general, Arctic cod are more abundant in nearshore habitats during the latter half of the open water season, probably in response to favorable salinity (10 to 20 ppt) and warmer temperature conditions (Reub et al., 1991:58). The inshore intrusion of marine waters that accompanies reduced freshwater input and westerly winds late in the open water season may cause cod to move shoreward into lagoon areas. While in Simpson Lagoon, the distribution and feeding habits of Arctic cod are similar to those of anadromous species.

Some evidence suggests that Arctic cod are attracted to structures in the water, such as ice floes, docks, and drilling islands, in both summer and winter (Tarbox and Spight, 1979:2-40). Average density of Arctic cod in August 1978, offshore from Prudhoe Bay, West Dock, and Stump Island, was found to be 9 fish/35,314 cubic ft (9 fish/1,000 cubic m) in water at depths ranging from 6 to 19 ft (2 to 6 m) and 0.2 fish/35,314 cubic ft (0.2 fish/1,000 cubic m) at depths greater than 19.6 ft (6 m) (Tarbox and Spight, 1979:2-17).

6.4.1.4 Sport and Commercial Use of Fish Resources

Limited sport fishing occurs in the Alaskan Beaufort Sea and in the project area, or within freshwater in the project area. Oil field workers fish for Arctic grayling in old gravel pits in the Kuparuk oil field that have been rehabilitated as deepwater fish habitat to support fish. Occasional fishing for char occurs at the mouth of the Putuligayuk and Sagavanirktok River drainages.

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Commercial use of fish resources of the Alaskan Beaufort Sea is limited to one small, family-owned gill net fishery in the Colville River Delta that has operated since 1967 (Griffiths et al., 1983:8). Arctic cisco, least cisco, and broad whitefish are the primary species caught. The commercial catch is sold for human consumption and dog food in Fairbanks and Barrow (USDOI, MMS, 1996:III-B-5). Average annual catch, for the subsistence (Section 7.3) and commercial fisheries combined, for the 1985 to 1995 period on the Colville River Delta was 44,503 Arctic cisco and 19,533 least cisco (Moulton, 1996:27). In 1993, the exploitation rates by subsistence and commercial fisheries combined were 13% and 4.5% of estimated populations of catchable-size fish for Arctic and least cisco, respectively (Moulton, 1996:27, 40, 44). Studies indicate that catch levels were well within acceptable ranges (Griffiths et al., 1983:14; Moulton et al., 1990:34-37). Catches of Arctic cisco are linked to the recruitment of young-of-the-year from the MacKenzie River, because recruitment determines the number of catchable fish 5 to 7 years later (Moulton et al., 1991:154). Catches of least cisco appear to be related in part to environmental conditions on the Colville River Delta.

6.4.2 Environmental Consequences

The following section describes the potential impacts of each project alternative on marine and freshwater fish resources. Impacts to freshwater and marine fish are expected to be the same for Alternatives 2, 3, 4, and 5. Therefore, potential impacts of these alternatives to freshwater and marine fish are discussed together and summarized in Table 6.4-4.

6.4.2.1 Alternative 1 - No Action Alternative

No construction is required for a No Action Alternative, consequently, there would be no adverse impacts to fish. The natural variability in population levels and habitat of fish in the Alaskan Beaufort Sea would be undisturbed by a No Action Alternative. As a result of the No Action Alternative, no new deepwater fish overwintering habitat would be created at the Kuparuk River Delta mine site or at Seal Island in the Alaskan Beaufort Sea.

6.4.2.2 Alternatives 2, 3, 4, and 5

Construction Impacts: Gravel removal would be conducted in the winter and would occur in a high water channel of the lower Kuparuk River isolated from the river water; therefore, no direct impacts to freshwater fish would occur. Upon completion, the pit would be connected by a channel to the Kuparuk River and allowed to flood during breakup. The completed pit would result in the creation of a 30-acre (12 hectare) lake up to 40 ft (12.1 m) deep and would include at least 4 acres (1.6 hectares) of shallow water, 6 ft (1.8 m) deep along the south side of the mine site. Because of the elevation and proximity to Gwydyr Bay, the rehabilitated mine site would become brackish. Similar restoration of gravel mines has been conducted at several locations within the project area, such as Sag C and Put 27 gravel mines (Hemming, 1995:32). The flooded pit is

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expected to provide overwintering and summering habitat for anadromous fish; therefore, the long-term impact to fish from gravel mining for the project would be beneficial. Species likely to benefit from such habitat include least cisco, broad whitefish, and juvenile Arctic cisco.

Only marine fish would be present during placement of gravel to reconstruct Seal Island. Marine fish could be impacted by an increase in turbidity at the island site, noise from pile driving, and smothering of prey organisms within the approximate 18.1-acre (7.3 hectare) footprint of Seal Island. Direct mortality to some slow-swimming fish species, such as snailfish and sculpin, also could occur from gravel placement. Low fish densities, combined with the likelihood of escape by most fish, indicate that such an impact to the food web would be negligible. The increased turbidity surrounding the island as a result of gravel placement would reduce available habitat to marine fish during the construction period. As noted in Section 6.3, less than 160 acres (64.8 hectares) of seafloor would be impacted by a silt plume when reconstructing the gravel island (if a predominate current exists at the time of gravel placement, this acreage may decrease by a factor of two or more). To avoid the more turbid portions (e.g., 100 mg/L or greater suspended solids concentrations) of this silt plume, fish transiting near Seal Island may have to swim somewhere between 1,000 to 2,000 ft (304.8 to 609.6 m) around the silt plume. This silt plume would dissipate upon completion of gravel placement. Given the large area of other available habitat, impacts to fish would be minor.

The Kuparuk Deadarm mine site, located approximately 5 to 6 miles (8 to 9.7 km) up the Kuparuk River (Figure 4-8), would be the most likely source of freshwater for ice road construction. The site is within 3 miles (4.8 km) of BP Exploration (Alaska) Inc.'s (BPXA's) proposed Northstar gravel mine location in the Kuparuk River delta and could be accessed by an ice road on the Kuparuk River. Although fish are present in the Kuparuk Deadarm mine site, it is sufficiently deep for removal of up to 100 million gallons (378 million liters) of water per year (as allowed by the State of Alaska under Permit No. ADL 75979). Water extraction for the project is estimated to range from approximately 13.1 million gallons (49.6 million liters) per year (Alternative 2) to 15.3 million gallons (57.9 million liters) per year (Alternative 4), or approximately 13% to 15% of the permitted amount. Based on the small amount of drawdown and screened intakes to prevent entrainment of fish, no impacts to freshwater fish are expected.

Installation of the seawater intake system and a discharge port requires trench dewatering on the island. This dewatering discharge is a one-time event lasting roughly 2 to 4 weeks in late winter, with an average flowrate of 1 million gpd (3.8 million liters/day) and maximum flowrate as high as 2 million gpd (7.6 million liters/day). The water will be discharged directly into the Alaskan Beaufort Sea via either a slot in the ice or into waters adjacent to the island. The discharge water would contain no contaminants, although initially it would have a high turbidity due to the presence of the suspended sediments. The slot described above is also used for trenching and subsea pipeline placement. The fish most likely to be near this activity is Arctic cod. This species is unlikely to suffer any physiological stress from the presence of suspended solids in the discharge because they can avoid high turbidity areas. There would, nevertheless, be some reduction in available habitat around the island. However, the loss of this habitat beyond the island's footprint from construction activities is temporary. The primary impact would be a decrease in available habitat covered by the island's expanded footprint; however, in view of the large area of the Alaskan Beaufort Sea relative to the area of impact, impacts to marine fish would be negligible.

Other marine species, such as snailfish and sculpin, that are oriented to the seafloor are more likely to be affected. Because these species should repopulate the seafloor affected by the silt plume, its impact is short term in the context of fish populations as a whole; therefore, impacts within the silt plume area would be negligible.

Installation of the subsea pipeline would be limited to the period of full ice cover. Anadromous fish would not be expected to be present in marine waters during this time period, and all species would be excluded from nearshore areas by bottom-fast ice. A short-term modification of the nearshore habitat would occur from trenching and burial of the pipeline. Therefore, impacts to anadromous fish from trenching are likely similar to those stresses resulting from natural ice gouging events.

Marine fish could be affected by trenching activities associated with offshore pipeline construction, possibly causing direct mortality due to mechanical action, noise, smothering due to displaced sediments, increased turbidity, altered bottom composition, and altered bottom topography. Local residents have noticed that fish are sensitive to noise pressure (E. Morrey in USDOI, MMS, 1983:32).

Remaining sediment after the completion of the offshore pipeline construction will be stored temporarily in areas away from the construction site. The sediment will be placed on the ice surface to a depth of approximately 1 ft (0.3 m). Residual sediment will be left along the corridor paralleling the pipeline route and should be no more than 1 inch (2.54 centimeters [cm]) thick. The area of soiled ice could extend to more than 150 acres (61 hectares) which includes the area along the trench and the disposal area outside the lagoon. The residue left on the ice will probably have an insulating effect on the underlying sea ice, reduce light transmission through the ice in spring, and increase turbidity in the water as it melts. Sediment suspension and deposition in the area from trenching backfilling and temporary storage of sediment would likely produce a plume after melting. Due to the low rate of under-ice current flow in the region, it is expected that most sediment would be deposited on the bottom within 0.6 miles (1 km) of the storage site; trench tests in 1996 suggest within 1,000 feet (304.8 m)(Montgomery Watson, 1996:Tables 1 and 2). The primary impact would be a temporary decrease in available habitat; however, in view of the large area of the Alaskan Beaufort Sea relative to the impact zone, the impact to marine and anadromous fish is considered negligible.

Within the floating ice zone, marine fish density is low and impacts from turbidity and mechanical disturbance of the seafloor would be limited to a narrow area. Most fish would move away from the disturbance, as a result of the temporary reduction in available habitat. Fish in the immediate vicinity could be subjected to abnormal stress, causing increased utilization of fat reserves and reduced winter survival. Effects of pipeline installation on marine fish under the ice would be expected to be localized and temporary. The silt plume associated with any particular section of pipe will be dispersed within no more than a few days after the pipe is buried. Given the large surrounding area and low density of fish, impact to local fish populations from offshore pipeline construction would be considered minor.

In the lagoon area, redistribution of seafloor sediment from wave action and ice movement would tend to cause the pipe trench backfill to blend with the existing bottom surface in a few years. Seafloor irregularity would not cause major alteration to ocean currents or affect the configuration of coastal water masses that are important to anadromous fish. Impact to fish from seafloor alterations and changes in shoreline configuration after pipe installation would be negligible.

The proposed onshore pipeline route does not cross any fish streams except the Putuligayuk River. Two additional vertical support members (VSMs) would be installed at the river crossing to support the new pipeline. Pipeline routing avoids all large ponds that might contain fish, and lakes and ponds adjacent to the route would not contain fish during winter. VSM installation would occur during winter when sediments are frozen and fish are not present. Therefore, no impact to freshwater fish from onshore pipeline construction would occur.

Operation Impacts: The completed gravel island would slightly reduce the amount of open water habitat available to marine fish, but would also increase the diversity in an area of relatively uniform soft-bottom, 39 ft (11.9 m) deep marine habitat. As described in Section 6.3, the diversity and abundance of marine invertebrates would likely be higher on the slopes of the island than on the seafloor surrounding it. It is likely that some marine fish would be attracted to the island to feed on these organisms and because of the seabed topography near the island compared to the surrounding Alaskan Beaufort Sea ecosystem. Arctic cod are thought to be attracted to structures such as gravel islands in both summer and winter (Tarbox and Spight, 1979:2-40). Other species, such as snailfish, might be attracted to the hard-bottom substrate on the armored slopes of the island. The presence of an enlarged gravel island with armored slopes would likely enhance habitat for most marine fish. Due to the increased presence of fish and benthic organisms, seals may become attracted to Seal Island, particularly after the project is decommissioned and if the island slope protection is left in place during abandonment. On balance, the long-term impact of a reconstructed Seal Island would likely be beneficial to marine fish species, lasting through the projected operating period of 15 years and continuing after abandonment as long as the island remains in place.

Operations on the gravel island are not expected to contribute to increased periods of open water. Therefore, no impacts to marine fish species from additional open water are expected.

Operational discharges from the production facilities into the marine environment would include: system flushwater, desalination brine, and treated domestic/ sanitary wastewater, all mixed together prior to discharge, plus water from an annual test of the island's fire suppression system. The discharge(s) from the fire suppression system tests are made using fire monitors (large movable water cannon-like devices) where the test water is seawater. These effluents require NPDES permitting (Appendices F, G, and O). The discharge related to the system flushwater, desalination brine, and treated domestic/sanitary wastewater requires a mixing zone to ensure adequate dilution. This mixing zone is small (16.4 ft [5 m] across) and is designed to ensure water quality standards are met at its boundary. The principal pollutant requiring dilution in this mixing zone is temperature and, occasionally, fecal coliform. The fire suppression system test discharges are not expected to contain pollutants. Because of the small size of the mixing zone and the nature of the pollutants, no detectable effects to fish from the discharges are anticipated, and impacts are considered negligible.

Potential effects of an oil spill on fish would include direct mortality from oil toxicity, chronic physiological or behavioral changes, destruction of food organisms, and habitat destruction. Actual effects would depend on many variables, including the amount of oil spilled, species and age composition of fish present, success of cleanup, time of the year, and weather factors. Impacts of a large oil spill to freshwater, anadromous, and marine fish are discussed in Chapter 8.

There are no data documenting noise effects on fish in the project area. Noise studies in other locations have been limited to the analysis of fish communication, only one study that was relevant to noise impacts on fish was found during a comprehensive literature search. In that study, a 4-month pilot project in Bodega Bay, California (Klimley and Beavers, 1997:1), 13 rockfish (*Sebastes* sp.) were tested individually in an enclosure for their responses to playback of the sound used for the acoustic thermometry of ocean climate project. The sound pressure level was 145.1 decibels (dB) at 3.2 ft (1 m) and 109.5 dB at 39.4 ft (12 m) from the speaker. The researchers did not observe much movement by the fish and there was little difference in fish behavior during experimental playback compared to control periods. Had the sound pressure levels used in the experiments been higher, they may have elicited an alarm response among the rockfish. The general threshold of response for rockfish to impulsive sounds made by an air gun used in geophysical surveys was 180 dB, but responses were detected in some fishes at levels as low as 161 dB (Pearson et al., 1992:1343-1356). At this level, blue rockfish milled in tighter circles and black rockfish moved to the bottom. Olive rockfish either moved up in the water column or descended to the bottom where they became immobilized. Based on the rockfish pilot study, only very loud noises (over 160 dB) are expected to affect fish. Different fish species probably respond differently to noise; therefore, effects on Alaskan Beaufort Sea fish may not be the same as for rockfish. Since all noise from the project (except seismic) would be less than 138 dB at 0.6 miles (1 km) from the facilities (Chapter 9), impacts of noise on fish are expected to be minor.

Maintenance Impacts: Repair and maintenance of the offshore pipelines during normal operations would cause limited disturbances, the extent and nature of which would be similar to or less than those created during construction. The impact would depend on the nature of the problem, season of occurrence, and approach used to uncover/rebury (if required) the pipe and perform repairs. During winter, effects would not be anticipated in areas less than 6.6 ft (2 m) deep because fish would not be present due to bottomfast ice. In pipeline segments below floating ice where free water is found, or for summer excavation, disruption to marine and anadromous fish would occur as a result of pipeline excavation. Impacts would be dependent on actual maintenance activities. These disruptions and temporary displacement from habitat are, however, expected to be similar to pipeline construction and would be a minor impact.

Maintenance and repairs of the island slope protection system likely would include installation of replacement blocks and maintenance of the gravel berm. The scope of these activities would depend upon the severity of damage from wave and ice actions. Island surface management and maintenance and repairs also would be carried out on an ongoing basis. Fish could be directly affected by disturbance and noise and indirectly affected by reduction in invertebrate prey species disturbed by maintenance activities. Impacts, therefore, would be localized around the island and temporary (duration of the activity), and impacts to fish resources would be negligible.

Abandonment Impacts: Abandonment impacts would depend upon the abandonment plan that is adopted and will be fully addressed in the assessment of the environmental effects of the abandonment alternatives. For an abandonment scenario involving complete removal of all facilities and infrastructure, impacts to freshwater and marine fish would be expected to be similar to those generated during construction and would be considered minor impacts.

6.4.3 Summary of Environmental Consequences

No significant unavoidable adverse impacts to fish resources from project development would occur. Implementation of Alternative 1 (No Action) would result in no impact to existing fishery resources. The Colville River fishery would continue to experience fluctuations in population levels within the range of natural variation. Reconstruction of Seal Island and trenching of the buried pipeline (associated with Alternatives 2, 3, 4, and 5) would result in a temporary increase in turbidity and subsequent short-term displacement of local fish populations in water deeper than 6.6 ft (2 m).

Overall, construction of the project is expected to result in minor, short-term impacts to local fish populations due to displacement and loss of habitat. No adverse effects from construction or operation are anticipated which would affect the long-term productivity of this fishery.

Reclamation of the mine pit on the Kuparuk River delta and the side slopes of Seal Island would be beneficial to fish. Creation of additional deep water and overwintering habitat would result in a positive increase in long-term productivity due to a potential improvement to fish habitat.

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6.5 MARINE MAMMALS

6.5.1 Affected Environment

Marine mammals of the offshore ecosystem in the Alaskan Beaufort Sea include: bowhead whales; beluga whales; ringed, bearded, and spotted seals; and polar bears (Table 6.5-1). The bowhead whale is listed on the endangered species list and is discussed in detail in Section 6.9 and the Biological Assessment found in Appendix B of this EIS. Walrus and gray whale seldom occur in the project area (Moore and Clarke, 1992: 3; Fay, 1982:7). These species are generally geographically limited to the westernmost part of the Alaskan Beaufort Sea, and are therefore not discussed further in this EIS.

6.5.1.1 Beluga Whale

The white or beluga whale *(Delphinapterus leucas)* (Qilalugaq) is the smallest cetacean regularly found in the Chukchi and Alaskan Beaufort Seas. Although commonly associated with ice and seasonally migratory in response to the advance and retreat of seasonal sea ice, they are not ice-dependent.

Belugas occur seasonally in the Alaskan Beaufort Sea, migrating through in spring and fall to and from their summer range in the Canadian Beaufort Sea (Figure 6.5-1). The western Alaska (Bering, Chukchi, Beaufort Seas) population of belugas winters at the edge of the pack ice in the central and southern Bering Sea and in

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open polynyas (permanent openings) of the northern Bering and southern Chukchi Seas (Hazard, 1988:200). Some whales from this stock remain in bays, lagoons, and estuaries of the eastern Bering and Chukchi Seas into the summer, while others continue north in the spring, traveling north of the project area, following nearshore lead systems in the eastern Chukchi Sea to Point Barrow and then eastward through offshore leads in the central Alaskan Beaufort Sea to the MacKenzie River Delta area of the Canadian Beaufort Sea (Hazard, 1988:201).

Belugas often migrate in groups of 100 to 600 animals (Braham and Krogman, 1977:3). The spring beluga migration usually coincides with the bowhead whale migration, with both arriving in the Canadian Beaufort Sea in May and June (Hazard, 1988:205). Research suggests that the summer distribution of belugas is influenced by prey availability, ice conditions, and water temperatures (Frost and Lowry, 1990:54-55). Belugas generally are common off shorefast ice near the Colville River Delta until late June or mid-July, but are sparse or uncommon in ice-free waters of the Alaskan Beaufort Sea in late July and early August (Hazard, 1988:205). The fall migration across the Alaskan Beaufort Sea extends from August or early September through October (Seaman et al., 1986:207-208). Most of this westward fall migration takes place along the pack ice edge, seaward of the continental shelf and well offshore (Seaman et al., 1986:207; Treacy, 1994:47), although belugas have been observed frequently throughout the open water zone (Treacy, 1991:43; 1992:41; 1993:47; 1994:51; 1995:47-49). Belugas are absent from the Alaskan Beaufort Sea from November through about March (Seaman et al., 1986:27).

The total western Alaskan population of belugas is estimated to be at least 50,000 (Small and DeMaster, 1995:35). Of this total, approximately 38,000 are thought to summer in the Canadian Beaufort Sea and Amundsen Gulf. This western Alaska population appears stable and may be increasing (Small and DeMaster, 1995:35).

Beluga whales have been observed near West Dock and the Colville River delta (T. Napageak - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996). Results from aerial surveys conducted in late summer/autumn from 1979 to 1994, in late August 1995, and in September/October 1995, recorded belugas from just north of the barrier islands to about 80 miles (129 km) offshore, with most sighted between 37 to 75 miles (60 to 121 km) offshore in water depths over 328 ft (100 m) (Miller et al., 1996:50). During aerial surveys in 1996 conducted by the MMS, a total of 88 beluga sightings and 436 individuals were recorded within the central Alaskan Beaufort Sea (146° to 151° west) (Miller et al., 1997:5-5 to 5-96). Forty-three (49%) of the sightings and 152 (35%) of the individuals observed were sightings within the project area (147° to 150°30' west).

Belugas prey on a wide variety of fish and invertebrates, with diet varying by season and locale (Hazard, 1988:216). In the winter, when most of the population is located offshore along the ice front and within polynyas of the pack ice, fish such as pollock and Arctic cod may be important prey (Lowry, 1985a:8). During the summer, they appear to feed primarily on fish, including salmon, smelt, capelin, eulachon, herring, and Arctic and saffron cod, and on invertebrates such as shrimp, squid, and octopus (Hazard, 1988:211).

6.5.1.2 Ringed Seal

The ringed seal *(Phoca hispida)* (Natchiq) is the smallest and most ice-adapted of the northern seals, and the only species that regularly maintains breathing holes and lairs in and on unbroken shorefast ice during winter (Figure 6.5-1) (Lowry et al., 1985:8). Ringed seals are able to maintain holes, using claws on their front flippers, in shorefast sea ice up to 6.6 ft (2 m) thick (Smith and Stirling, 1975:1300-1302; Kelly, 1988b:61).

Ringed seals are the most numerous and widely distributed of the northern seals and occur in all arctic and subarctic seas where seasonal or permanent ice is present (Kelly, 1988b:60). A large portion of the Alaska population of ringed seals is migratory, wintering on the seasonal ice of the Chukchi Sea and northern and central Bering Sea, and moving north with the retreat of sea ice in spring to the northern Chukchi and Beaufort Seas. In past years, population shifts of ringed seals from the Eastern Beaufort Sea into the Alaskan Beaufort and Chukchi Seas have been observed during winter, however, unusual ice conditions during that year may have contributed to the observed movement and it is unclear if this is a regular occurrence (Kelly, 1988b:60-62). Some juveniles and subadults summer in ice-free nearshore waters of the Chukchi and Beaufort Seas (Frost et al., 1988:5), although most remain with the retreating pack ice (Figure 6.5-1). Conversely, large numbers of adults and subadults overwinter in shorefast and pack ice of the northern Chukchi and Beaufort Seas rather than migrating southward (Kelly, 1988b:80).

Winter density and distribution of ringed seals is determined by ice characteristics, snow cover, water depth, and availability of food resources (Lowry et al., 1985:81-82; Kelly, 1988b:61-62; Green and Johnson, 1983a:11). With the onset of ice formation around November, ringed seals reoccupy the shorefast ice, where they maintain multiple breathing holes and haulout dens through the winter, and establish birth dens in the spring (Smith and Stirling, 1975:1300-1302; Kelly, 1988b:660-62). Breathing holes maintained by ringed seals near Seal Island have been recorded at densities of up to 2.77 holes/square mile (1.07 holes/square km [km^2]) (Green and Johnson, 1983b:12). The availability of suitable sites for birth dens in the pack ice is primarily determined by the presence of pressure ridges. As winter progresses, pressure ridges form at the leads, and snow drifts develop on the lee side of these ice structures. Ringed seals hollow out the drifts to form birthing dens, which may be found in every sizeable drift in some areas (Smith and Stirling, 1975). Although sea ice conditions in the Northstar Unit are variable from year to year, the ice is generally characterized by smooth, shorefast ice (Green and Johnson, 1983b:7). This type of ice is preferred denning habitat in the inshore areas when covered by sufficient snow to accommodate the formation of birth dens (Burns et al., 1982:49; Frost et al., 1988:406).

The number of ringed seals in Alaskan waters is not well documented (Small and DeMaster, 1995:30); however, estimates range from one to six million (Lowry et al., 1985:84). It is probable, based on extrapolation from aerial surveys and on predation estimates for polar bears (Amstrup, 1995:199), that the Alaskan Beaufort Sea portion of the population averages at least 326,500, consisting of an estimated 208,000 in the pack ice and 118,500 in the shorefast ice in winter and spring.

Aerial counts from May and June 1997 indicated an estimate of 2.6 seals/square nautical mile ($0.77/km^2$) for the area from Barrow to the Canadian border (State of Alaska, 1997:4). Based on aerial counts from 1970 to 1987, during May and June when seals most commonly haul out on the ice, overall observed seal density on the shorefast ice was approximately one seal per every 1.0 to 1.2 square miles (2.5 to 3.1 km^2), with local densities in the shorefast and nearshore pack ice of one seal per every 0.1 to 3.3 square miles (0.3 to 8.5 km^2) (Burns and Harbo, 1972:279; Lowry and Frost, 1981:44). Recent survey data from the central Beaufort Sea, which included the offshore project area, have shown densities of 0.85 to 1.71 seals/square mile (0.33 to 0.66 seals/square kilometer [km^2]) (Frost et al. 1997:3). Inupiat hunters confirm that seals (ringed and bearded) are numerous in the Alaskan Beaufort Sea, including high numbers on the sea ice near Nuiqsut (S. Kanaknana in USDOI, MMS, 1982:6). In general, the observed abundance and density of ringed seals is variable from year to year and location to location, depending to a large degree on snow, ice, and weather conditions during and preceding the survey period (Stirling et al., 1982:4). Observed densities usually have been highest in and near the stamukhi zone between shorefast and pack ice, diminishing both seaward of this zone into the pack ice and shoreward on the landfast ice.

Ringed seals are opportunistic feeders on a wide variety of pelagic as well as epibenthic organisms. They rely heavily on Arctic cod through the winter months (November to April), with a shift toward marine crustaceans (gammarid and hyperiid amphipods, shrimp, euphausiids, mysids, and isopods) in late spring and summer (Lowry et al., 1980:2254; Frost and Lowry, 1984:388-390).

6.5.1.3 Bearded Seal

The bearded seal *(Erignathus barbatus)* (Oogruk) is the largest of the northern seals (Kelly, 1988a:79) and, like the ringed seal, is largely ice-associated. Unlike the ringed seal, however, they rarely maintain breathing holes or birthing dens in shorefast ice. Bearded seals stay mostly within the mobile pack ice, concentrating around its edge (Smith and Stirling, 1975:36).

The bearded seal is circumpolar in distribution, ranging as far north as 85°N over continental shelf water less than 656 ft (200 m) deep (Kelly, 1988a:80). They are also migratory, with most of the Alaskan population following the retreat and advance of the seasonal pack ice north and south across the Chukchi and northern Bering Seas (Nelson et al., 1985:57-58).

The Alaskan Beaufort Sea offers limited habitat for bearded seals in both summer and winter, due primarily to water depths. Because of their epibenthic feeding habits, bearded seals are limited to feeding in water depths of 426 ft (130 m) or less (Nelson et al., 1985:58). In summer, much of the edge of the broken pack ice, a favored habitat for bearded seals (Figure 6.5-1), is over water too deep to permit energy-efficient feeding. As a result, few bearded seals are present in the project area. In general, the summer population density decreases from west to east (Lowry and Frost, 1981:43). Most of the Alaskan Beaufort Sea population stays at or near the edge of the pack ice where it overlaps the continental shelf (USDOC, MMS, 1996:III-B-7), while a smaller number remain in open water or with nearshore ice remnants (Burns et al., 1980:153). The Alaskan Beaufort Sea offers limited feeding habitat during the winter because it freezes. Much of this population is thought to vacate the Alaskan Beaufort Sea with the onset of winter (Lowry and Frost, 1981:43), shifting west into the Chukchi Sea and then south to the northern Bering Sea with the advance of seasonal ice. Small numbers of bearded seals do winter in the Alaskan Beaufort Sea, but generally within the narrow area (stamukhi zone) between the shore-fast and pack ice (Burns and Frost, 1979:22).

Estimates of the total bearded seal population in Alaska waters range from approximately 300,000 to 450,000 (USDOI, MMS, 1996:III-B-7). The winter density of bearded seals in the nearshore Alaskan Beaufort Sea was estimated at about 1 seal per 9.6 square miles (25 km^2) (USDOC, NOAA, 1977:76).

Bearded seals are primarily epibenthic feeders, preying on a wide variety of fish and invertebrate species (Kelly, 1988a:83). Preferred feeding depths in the Alaskan Beaufort Sea are reported to be 82 to 164 ft (25 to 50 m) (Kingsley et al., 1985:1207). Diet varies with age, season, and locale. Major prey items in the Alaskan Beaufort Sea include clams, crabs, shrimp, sculpins, and Arctic cod, augmented by amphipods, isopods, and octopus (Burns and Frost, 1979:60-65; Nelson et al., 1985:59).

6.5.1.4 Spotted Seal

The spotted seal *(Phoca largha)* (Qasigiaq) is a northern form of its close cousin, the harbor seal *(Phoca vitulina)*. Although ice-adapted, they are not nearly as ice-dependent as ringed and bearded seals. In the Alaskan Beaufort Sea, they spend most of their time in nearshore ice-free waters, commonly hauling out on island or mainland shores (Figure 6.5-1).

Spotted seals are seasonal visitors to the southern Alaskan Beaufort Sea from July through about September, where they tend to concentrate in inlets and river mouths. They are found during summer as far east as Herschel Island in the Canadian Beaufort Sea (Quakenbush, 1988:110), although most are found in the Alaskan Beaufort Sea. Concentrations occur on Oarlock Island, near the Colville River Delta, and at the mouth of the Piasuk River in Smith Bay (USDOI, MMS, 1996:Fig. III-B-4). When the ice pack is absent, habitat requirements of spotted seals are similar to harbor seals, and they occupy river mouths and coastal haulout sites such as the Colville River Delta (Quakenbush, 1988:111).

Spotted seals abandon the Alaskan Beaufort Sea in September or early October, moving west into the northern Chukchi Sea and then south through the Chukchi and into the Bering Sea ahead of the winter ice front (Lowry et al., 1994:i). Most of the population winters along the ice front in the Bering Sea (Lowry et al., 1994:5), then follows the retreating ice front north in the spring into the northern Chukchi and Alaskan Beaufort Seas. Some animals, however, remain for the summer in ice-free waters of the Bering and eastern Chukchi Seas (Lowry, 1985:91).

The total number of spotted seals summering in the Alaskan Beaufort Sea is roughly estimated at about 1,000 (USDOI, MMS, 1996:III-B-8). The total Bering Sea population is estimated at between 200,000 and 250,000 (Quakenbush, 1988:111).

Spotted seals prey on a wide array of fish and pelagic crustaceans, with diet varying by season and locale. During winter, they are heavily dependent on fish such as capelin and pollock at the ice front. During spring and summer, young animals rely more on small fish and crustaceans (shrimp, euphausiids, crabs, amphipods), with adults consuming larger fish species, crustaceans, squid, and octopus (Lowry, 1985b:93).

6.5.1.5 Polar Bear

Polar bears *(Ursus maritimus)* (Nanuq) are wide-ranging predators present year-round over most of the Alaskan Beaufort Sea region. They are highly ice-adapted and strongly ice-dependent. The polar bear is circumpolar in distribution, ranging seasonally in Alaska waters, from the central Bering Sea to 88°N latitude (Amstrup, 1995:45).

The Southern Beaufort Sea population ranges from Cape Bathurst in Canada into the northern Chukchi Sea and appears to be relatively discrete (Amstrup, 1995:283). The population in the Alaskan Beaufort Sea shifts from north to south and back following the advance and retreat of sea ice (Amstrup, 1995:284). In winter, most of the population is concentrated along the shear zone between the multi-year pack ice and the shorefast ice. In summer, most of the population shifts north to remain at or near the edge of the pack ice (Taylor, 1982:117), although some individuals may remain on shore through the summer (Lentfer, 1985:28).

Polar bears range from at least 37.2 miles (60 km) inland to over 186.4 miles (300 km) offshore in the Alaskan Beaufort Sea, with individual bears known to range up to 466 miles (750 km) from east to west and 233 miles (375 km) from north to south (Amstrup et al., 1986:91; 1995:124-126). These bears are most active from October through December and during May and June. They do little wandering from January through March and during September (Amstrup, 1995:82).

Polar bears have been observed congregating on the barrier islands in the fall and winter because of available food and favorable environmental conditions. Polar bears will occasionally feed on bowhead whale carcasses nearby Cross Island and on Barter Island to the east. In a November 1996 survey conducted by the U.S. Geological Survey, 28 polar bears were observed near a bowhead whale carcass on Cross Island, and approximately 11 polar bears were within a 2-mile (3.2 km) radius of a bowhead whale carcass near the Village of Kaktovik on Barter Island (Kalxdorff, 1998:5). In October 1998, 47 polar bears were observed on barrier islands and the mainland from Prudhoe Bay to the Canadian border (G. Durner - Pers. Comm., 1998:3).

Satellite tracking of radio tagged polar bears between 1985 and 1997 within a 5- to 20-mile (8 to 32 km) radius of Seal Island resulted in two polar bear observations within 5 miles (8 km), 24 within 10 miles (16 km), 66 within 15 miles (24 km), and 187 within 20 miles (32 km) of the island (G. Durner - Pers. Comm., 1998:2). Since 1967, personnel involved with polar bear research using conventional methods, have sighted 5 bears within 5 miles (8 km), 36 within 10 miles (16 km), 60 within 15 miles (24 km), and 109 within 20 miles (32 km) of Seal Island (G. Durner - Pers. Comm., 1998:3).

The world population for this species probably exceeds 20,000, with estimates of the Alaska population ranging from 3,000 to 5,000 (USDOI, FWS, 1995:xii). The Southern Beaufort Sea population is estimated at about 1,500 to 1,800 (Amstrup, 1995:160, 215), with an average density of about one bear per 38.6 to 77.2 square miles (100 to 200 km^2) (Amstrup et al., 1986:244; Armstrup and DeMaster, 1988:43). Somewhat higher densities of one bear per 30 to 50 square miles (78 to 130 km^2) are estimated within the nearshore Alaskan Beaufort Sea (USDOI, MMS, 1996:III-9).

Polar bear numbers declined toward the end of the trophy hunting era (1958 to 1972), but have recovered since passage of the U.S. Marine Mammal Protection Act in 1972. Inupiat hunters have noticed that there are more polar bears than there once were (A. Ahkiviana - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:25-26). Based on long-term population data from 1982 to 1992, the southern Beaufort Sea polar bear population growth rate was 2.4% annually (Amstrup, 1995:230). Because the U.S. Fish and Wildlife Service (USFWS) believes this population is near the carrying capacity of the environment, the growth rate is expected to slow or stabilize.

Polar bears breed from late March through May (USDOI, FWS, 1995:xii), with cubs born in late December or early January (Amstrup, 1995:23). Male polar bears, as well as non-pregnant females and females with young, remain active throughout the winter. Pregnant females excavate dens in drifted snow, usually by late November. Of 90 polar bear dens categorized by Amstrup and Gardner (1994:1), 48 (53%) occurred on drifting ice, 38 (42%) on land, and 4 (4%) on land-fast ice (Figure 6.5-1). The recent trend towards an increase of onshore denning in the Canadian Beaufort Sea (Stirling et al. 1988:ii; Stirling and Andriashek, 1992:363) and in the Alaskan Beaufort Sea (Amstrup, 1995:292) may be the result of denning bears being relatively faithful to denning substrate and limited hunting in the early to mid-1900s, which may have prevented re-establishment of land denning until recently (Amstrup and Gardner, 1994:1). This suggests that denning polar bears are sensitive to disturbance and there should be concern for potential disruptions (Amstrup, 1995:292). The highest occurrence of dens on land is found east of the project area, within the Arctic National Wildlife Refuge (ANWR) and into Canada. Other known denning areas along the Alaskan Beaufort Sea coast are on barrier islands (Pingok, Cottle, Thetis, Flaxman), the Colville River Delta, and other stream mouths and lagoons (USDOI, FWS, 1995:25, 27-28). Polar bears are known to den near the project area. Polar bears have denned near the Kuparuk River Delta area (Amstrup - Pers. Comm., 1998:1). Polar bear maternity den records within a 5- to 20-mile (8 to 32 km) radius of Seal Island show no den sites within 10 miles (16 km), three within 15 miles (24 km), and seven within 20 miles (32 km) (G. Durner - Pers. Comm., 1998:2). Pregnant females tend to return to the same general area on either land or pack ice for denning, although not to the same particular location (Amstrup, 1995:92).

Females normally give birth to two cubs (Ramsay and Stirling, 1988:615) in late December or early January (Amstrup, 1995:23). Cubs remain with the mother in the den until late March or early April. After emergence from the den, cubs normally nurse and remain with the mother for about 3 years. About 140 females of the Alaskan Beaufort Sea polar bear population reproduce each year (USDOI, FWS, 1995:22), resulting in a reproduction rate of 0.23 to 0.32 cubs per female per year overall (Amstrup and DeMaster, 1988:47).

Polar bears prey primarily on ringed seals, although they will take bearded seals, spotted seals, young walrus, beluga whales confined in ice, and will also feed on the carcasses of any of these animals (Amstrup and DeMaster, 1988:44; USDOI, FWS, 1995:XIII-XIV; Kalxdorff, 1998:18). Ringed seals are taken by stalking on the open ice, at breathing holes and haulout dens, and in birth dens (Stirling et al., 1975:6).

6.5.2 Environmental Consequences

The following section describes the potential impacts of the project alternatives on marine mammals. Discussion of impacts is organized based on project alternatives described in Chapter 4. A discussion of the relevant issues to marine mammals is presented in the alternatives sections as they are related to project phases (construction, operation, maintenance, abandonment) and project components (gravel mining, island reconstruction, onshore pipeline construction, offshore pipeline construction, offshore facilities construction). Impacts to marine mammals are the same for Alternatives 2, 3, 4, and 5. Therefore, these alternatives are discussed together and summarized in Table 6.5-2.

6.5.2.1 Alternative 1 - No Action Alternative

No construction is required for a No Action Alternative, consequently, there would be no impacts to marine mammals. The natural variability in population levels and habitat of marine mammals in the Alaskan Beaufort Sea would be undisturbed by a No Action Alternative.

6.5.2.2 Alternatives 2, 3, 4, and 5

Construction Impacts: Gravel mining activities from development of the Kuparuk River Delta mine, such as blasting and movement of heavy equipment for loading and transporting gravel, would create noise and disturbance. Much of the noise and activity associated with mining and gravel hauling would be similar to other industrial activities, such as snow removal, truck traffic, and road maintenance, that already occur periodically in the project area. Beluga whales would not be affected by gravel mining activities as they are not in this area during winter (Hazard, 1988:200). Ringed and bearded seals would not be affected by gravel mining on the Kuparuk River Delta because this area is not winter seal habitat due to the presence of bottom-fast ice (Frost and Lowry, 1984:387). Spotted seals would not be present in the Alaskan Beaufort Sea during gravel mining activities, therefore they would not be impacted (Lowry et al., 1994:i). No impacts to whales and seals are expected.

Disturbance to female polar bears at maternity dens could result in either abandonment of cubs or premature exposure of cubs (Amstrup, 1993). Polar bears that den onshore require a greater topographic relief than that found in this area of the Alaska Coastal Plain, since they need deep, compacted snow drifts from which they can excavate snow dens (Amstrup and DeMaster:

Table 6.5-2 (page 1 of 2)

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1988:45). Polar bears have denned near the Kuparuk River Delta area (S. Amstrup - Pers. Comm., 1998:1). Polar bear denning habitat on the Arctic Coastal Plain includes banks which are greater than or equal to 5 ft (1.5 m) high. Consequently, denning polar bears are possible and could occur near the mine site. Should denning polar bears be disrupted near the mine site, the impact would be considered minor.

Offshore ice road construction, pipeline construction and island reconstruction are not expected to affect spotted seals and beluga whales because they are not present within the project area during winter, when construction is planned (Hazard, 1988:200). A large portion of the Alaska population of ringed seals is migratory, wintering on the seasonal ice of the Chukchi Sea and northern and central Bering Sea, and moving north with the retreat of sea ice in spring to the northern Chukchi and Beaufort Seas (Frost and Lowry, 1984:387). Impacts to the ringed seal from ice road construction, offshore pipeline construction, and island reconstruction, are considered minor and primarily related to temporary displacement due to noise and are discussed in detail in Chapter 9. Based on data from aerial counts between Point Barrow and the Canadian border (State of Alaska, 1997:4) it was estimated that less than 35 ringed seals would be present in the offshore pipeline corridor. Based on these densities, up to 12 ringed seals may be displaced by noise and activity during construction and installation of facilities on Seal Island. Due to the low numbers of bearded seals in the nearshore Alaskan Beaufort Sea during winter (Lowry and Frost, 1981), the impact of disturbance from noise of pipeline and ice road construction on this species is likely to be localized, temporary, and negligible. Since offshore pipeline construction activities and island reconstruction will occur during the winter at a time when beluga whales and seals are not in the project area, no impact to these species are anticipated.

Polar bears may either avoid or be attracted to construction activities on the island, offshore pipeline construction, and ice road construction, depending upon the circumstances and temperament of individual bears (Amstrup et al., 1986:242). Attraction of polar bears would likely result in increased risk of confrontations with humans and some bears could be killed. Due to the relatively small southern Beaufort Sea polar bear population of (approximately 1,800), their low reproductive potential, and low density (Amstrup et al., 1986:224; Amstrup and DeMaster, 1988:43), the harvest quota set by the NSB/Inuvailuit Game Council management agreement for the Southern Beaufort Sea population aims for strict conservation. The agreement establishes sustainable harvest quotas based upon an estimate of population size, modeling of sustainable yield rates for female polar bears, and information regarding the sex ratio of the harvest (Treseder and Carpenter, 1989:4; Nageak et al., 1991:341). Although construction activities could result in attraction and some mortality of bears, this is expected to occur infrequently and would not affect polar bear populations. This impact is considered to be minor.

Construction activities, such as ice road construction, pile installation and drilling, would create noise and vibration that could impact beluga whales, ringed, spotted, and bearded seals and polar bears. Potential impacts from noise on these species, such as avoidance, are considered minor and discussed in Chapter 9.

Operation Impacts: Operations on Seal Island would take place year-round over the expected 15-year life of the project. These operations are not expected to create additional open water leads due to the design parameters of the island that would allow normal ice patterns to form in the vicinity of the island. However, should an open water area form around Seal Island, seals near the area can be expected to utilize the open water as a breathing hole, which may subsequently attract polar bears. Entrapment of seals in the open water lead could occur, although this would be considered a minor impact to the ringed seals.

Long-term marine mammal habitat is not expected to be created as a result of construction of Seal Island. Increased numbers of fish at Seal Island (Section 6.4.2.2) may attract seals to the island. Spotted seals may use the island as a haulout site when they are present in the Alaskan Beaufort Sea from July through September (Quakenbush, 1988:11). However, given that spotted seals normally congregate at river mouths, it is unlikely that they would use Seal Island (Quakenbush, 1988:110). Ringed and bearded seals are ice-adapted and are not expected to be attracted to Seal Island as either a feeding or haulout site (Lowry et al., 1985:81-82; Kelly, 1988b:61-62; Green and Johnson, 1983a:11; Smith and Stirling, 1975:36). The attraction of seals to Seal Island as a result of the creation of a long-term habitat is considered to be minor.

Marine mammals primarily would be affected through increased levels of noise from gas-fired turbines and generators, and by ship and helicopter traffic to and from the island for routine operations. Transportation of personnel and supplies during routine island operations would include the use of trucks on ice roads during winter (November to April), helicopters during broken ice seasons (May/June and October/November), and barges during open water (May/June to September/October). Noise effects from offshore sources on marine mammals such as ringed and bearded seals and beluga whales would be limited to behavioral reactions and possible avoidance of Seal Island. Polar bears may either avoid or be attracted to operational activities depending on the circumstances and temperament of the individual bears (the same would be true for pipeline and ice road operation activities). Potential noise-related impacts to marine mammals during the operations phase are minor and are discussed further in Chapter 9.

Potential effects of oil to marine mammals could include direct mortality from oil contact and loss of thermoregulation (ability to maintain a constant internal body temperature independent from environmental temperature), oil toxicity, chronic physiological or behavioral changes, destruction of food organisms, and habitat destruction. Effects of oil on beluga whales have not been well documented and are subject to speculation (Geraci, 1990:197-168). Observations of other cetacean species during an oil spill have not demonstrated a tendency to avoid oil on the water (Harvey and Dahlheim, 1994:260-263); therefore, if oil were present, belugas would be affected. The effects of oil on ringed seal populations are unknown; however, a number of studies have investigated the effects of oil on individual ringed seals. Controlled experiments on three ringed seals in a laboratory holding pen showed that exposure to oil-contaminated water immediately caused the animals to shake vigorously, and all seals died within 71 minutes (Geraci and Smith, 1977:402). Subsequent necropsy (after death examination) did not link the cause of death directly to oil exposure but was probably related to stress. Six ringed seals in natural seawater holding pens in the Arctic showed swollen nictitating (eye) membranes and, in one case, corneal (eye) erosions, but all seals had recovered by the fourth day after exposure to oil (Geraci and Smith, 1977:403).

Investigations of the effects of oil on other seal species have demonstrated conclusively the toxic effects of contact with crude oil. Studies of the effects of oil on harbor seals during and after the *Exxon Valdez* oil spill have shown that harbor seals apparently exhibited no avoidance of oil, either in the water or at haulout sites (Frost and Lowry, 1994:i; Frost et al., 1994:109). Seals exposed to fresh oil or vapors suffered eye damage, skin irritation, disorientation, hemorrhage of internal organs, conjunctivitis, and brain lesions, and it was estimated that hundreds of seals died after contacting oil (Frost and Lowry, 1994:xi, 46; Spraker et al. 1994:304-305). Mortality of pups was estimated at 23% to 26%, and adult mortality was 36%. Data from aerial surveys conducted during the molt in 1983, 1984, and 1989 through 1992 indicate that counts of harbor seals decreased more in oiled areas of Prince William Sound following the *Exxon Valdez* oil spill than in unoiled areas (Frost and Lowry, 1994:40). However, declines in several of the geographic populations throughout Alaska, in particular near the Kodiak Archipelago and in Prince William Sound, have been noted over the past several years (prior to the *Exxon Valdez* oil spill). A major decline of 85% of the harbor seal population at Tugidak Island, located in the Gulf of Alaska to the South of Kodiak, was recorded between 1976 and 1988 (Pitcher, 1990:121)

The effects of oil on bearded and spotted seals have not been well documented, but they are likely to be similar to those for ringed and harbor seals. An oil spill could also affect bearded seals through impacts on their food web. Bearded seals might be more prone to consumption of prey contaminated from oil spills due to their reliance on benthic and epibenthic prey, which are generally limited in terms of mobility. These seals also might suffer population declines or dislocation if local prey availability is reduced.

Polar bears may suffer hair loss due to oiling of the fur (Derocher and Stirling, 1991:56) resulting in severe cold stress (Oritsland et al., 1981:3). A doubling of the metabolic rate has been observed in polar bears after exposure to oil, as well as an increase in core body temperature reminiscent of fever in humans (Oritsland et al., 1981:3). The increased body temperature may be compensation for a reduction in fur insulation (Hurst et al., 1982:263).

Controlled experiments on three polar bears exposed to oil resulted in observed tremors and weight loss, followed by kidney failure and eventual death (Engelhardt, 1981:170; Oritsland et al., 1981:6). Other serious effects included changes in the liver and brain, bone marrow depletion, ulcers of the gastrointestinal tract, and inflammation of lungs and nasal passages (Oritsland et al., 1981:4). During these experiments, polar bears showed no avoidance of oil in water, and it was concluded that polar bears contacting oil would be contaminated to a large extent (Oritsland et al., 1981:55). Oil contamination could have severe consequences to polar bears based on these experiments. Lentfer (1990:15) concluded that a bear that has encountered contamination if not rehabilitated will suffer lethal effects. He noted that the effects of a large spill or multiple small spills on polar bear habitat are not well understood. The lingering effects of spilled oil in or near denning areas may cause the loss of litters, aborted fetuses, or selection of denning areas in less favorable (i.e., more vulnerable) habitats (Bright, 1998:2). Potential impacts of oil to marine mammals are discussed in Chapter 8.

Maintenance Impacts: Both planned and unplanned maintenance activities associated with operations would take place year round over the expected 15-year life of the project. Planned maintenance of offshore pipelines would not entail excavation and, therefore, impacts to marine mammals are considered negligible. Unplanned maintenance of offshore pipelines during normal operations that requires excavation would cause limited disturbances similar to those created during construction. The degree of impact would vary depending on the nature of the problem, season, and approach used to uncover/rebury the pipe and to perform repairs. During the open water season, the magnitude of effects on nearshore species such as the spotted seal would vary depending on the extent of required repairs and the method used to excavate the pipeline and conduct repairs. These impacts are expected to be short-term and limited and, thus, have a minor impact on marine mammals.

Abandonment Impacts: Abandonment impacts would depend upon the abandonment plan that is adopted and will be fully addressed in the assessment of the environmental effects of the abandonment alternatives. For an abandonment scenario involving complete removal of all facilities and infrastructure, impacts to marine mammals would be expected to be similar or possibly greater to those generated during construction and would be considered negligible to minor.

6.5.3 Summary of Environmental Consequences

No significant adverse impacts were identified for marine mammals from development of the project (bowhead whales, which are an endangered species, are discussed in Section 6.9 - Threatened and Endangered Species) with the possible exception of potential impacts to polar bears from a large oil spill (discussed in Section 8.7.2.3).

Alternative 1 results in no impact to marine mammal resources in the Alaskan Beaufort Sea. Under Alternative 1 - No Action Alternative, the existing population would continue to experience fluctuations in populations levels with a range of natural variation as are occurring at the present time.

The development of Alternatives 2, 3, 4, or 5 would result in some minor impacts to ringed seals and polar bears during the stable ice period (e.g., noise and construction disturbance on ringed seals). Polar bears may be either attracted or displaced by activity on the ice, but impacts are considered minor. In addition, impacts to denning polar bears are not expected. Beluga whales are only present during the open water period in fall, and no impacts are anticipated.

Under Alternatives 2, 3, 4, and 5, development of Seal Island and construction of the offshore pipeline could result in direct, short-term impacts from disturbance and displacement of seals from the vicinity of Seal Island or the ice road traffic and disturbance or attraction of polar bears to the island. No impacts to spotted seals are expected, and only negligible impacts to bearded seals are anticipated. No long-term adverse impacts to marine mammals from planned construction, operation, or maintenance activities were identified.

The abandonment of Seal Island would not create any additional habitat for marine mammals or affect the use of the area by marine mammals.

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- Napageak, Thomas

6.6 COASTAL VEGETATION AND INVERTEBRATES

6.6.1 Affected Environment

The coastal vegetation and wetlands of the Arctic Coastal Plain are important components of the ecosystem as they support a large food web of terrestrial and aquatic invertebrates, provide habitat for resident and migratory wildlife species, and regulate the regional hydrologic regime and maintain water quality. The coastal vegetation and variety of invertebrates present on the Arctic Coastal Plain are strongly influenced by land features, climate, soil composition, surface water, and microtopography, which also determines the composition of several tundra communities.

6.6.1.1 Setting

Alaska's Arctic Coastal Plain is covered by low-growing tundra vegetation and innumerable ponds and lakes, but no trees. Saturated soils, severe weather conditions, and a short growing season contribute to low species diversity and slow growth relative to areas south of the Brooks Range. Because of cold soil temperatures and the short growing season, decomposition is slow, and energy and nutrients tend to remain bound up as dead organic matter. Net primary productivity, nutrient release, and energy flow rates increase with site moisture. Thus, for the Arctic Coastal Plain, wetter sites generally will make a greater contribution to overall ecosystem productivity (Lawson et al., 1978:x).

The onshore portion of the alternative pipeline routes are located within the region of the Arctic Coastal Plain referred to as the rolling thaw-lake plain and the flat thaw-lake plain (Walker and Acevedo, 1987:1) (Section 5.3.1). These areas are generally characterized as mostly flat and wet with numerous thaw-lakes, polygon-patterned and non-patterned ground, and underlain by shallow permafrost (Walker et al., 1980:14; Walker, 1985:5). The distribution of vegetation is influenced by climate, soils, surface water, and microtopography. Associated invertebrate communities are correlated with water regime and vegetation and appear in a brief burst of activity during warm summer weather while the vegetation is growing.

Climate is a major factor in distribution of vegetation communities. Summer temperatures along the Beaufort Sea coast are generally cool, with a rather steep temperature gradient going inland. In July, temperatures can increase from a mean of 39°F (4°C) at the coast to 46°F (8°C) at inland areas (Walker, 1985:9). This is believed to be responsible for a coastal band of vegetation that has fewer shrubs, limited tussock-type sedges, and reduced moss and lichen growth (Walker, 1985:91; Walker and Acevedo, 1987:12).

Most of the region has hydric (wet) soils as a result of shallow permafrost and seasonal flooding. Saturated soils above the permafrost layer during the growing season result in anaerobic (no oxygen) conditions which favor the growth of wetland vegetation. Anaerobic conditions and low temperatures also impede decomposition of organic material, resulting in the accumulation of plant material as peat or muck. Soils are mostly acidic across the coastal plain, except in the area around the Sagavanirktok River Delta where alkaline silt (loess) is blown inland from the delta by prevailing northeast winds, creating alkaline soils (Walker, 1985:119).

Most of the onshore project area is wetlands. Lakes, ponds, and streams make up 25% of the onshore project area (Figure 6.6-1). Drained or partially-drained lake basins are also characteristic of the onshore project area and develop into ecologically diverse wetland complexes of shallow water and flooded and wet tundra communities (Bergman et al., 1977:20-23).

Microtopography (small surface features) created by ice-wedge polygons results in a mosaic of micro-habitats, each with distinct vegetation (Walker and Acevedo, 1987:11). Three types of patterned ground cover most of the region: low-centered polygons, high-centered polygons, and disjunct polygon rims. The most common type of polygon in the project area is low-centered polygons, which have wet centers and moist raised rims. High-centered polygons with relatively higher centers and the somewhat well-drained or "moist" tundra are less common in the project area (Walker, 1985:41).

6.6.1.2 Land Cover Mapping

Vegetation of the general Prudhoe Bay region has been mapped in association with soils and land forms in relatively broad categories, based on features interpreted from aerial photographs (Webber and Walker, 1975:81-91; Walker et al., 1980:24-64; BPXA, 1992:Map 2). The original maps were refined and modified to produce a vegetation map of the project area (Figure 6.6-1).

Wetlands within the project area have been mapped by the USFWS, National Wetlands Inventory (NWI) and these maps were used in the southeast portion of the project area, which was not covered by the above mapping efforts (USDOI, FWS, 1991:Maps 1-5). These maps were developed using a slightly different classification system which provides less detail than the project area maps based on Walker et al. (1980:24).

6.6.1.3 Terrestrial Communities

There are four major tundra vegetation communities in the onshore project area, generally defined by moisture regimes: dry, moist, wet, and aquatic (Table 6.6-1). Less common and sparsely vegetated types include sand dunes, barrier islands, mud flats, and beaches. Lakes, ponds, and streams also may have little vegetation, but are important habitat for invertebrate species. Invertebrate species vary with the moisture regime and are associated with specific vegetation types.

Many of the dominant plant species, such as *Carex aquatilis* (water sedge) and *Eriophorum* sp. (cottongrasses), have a wide ecological range and dominate many of the vegetation communities, differing only in the degree of water saturation they prefer (Walker, 1985:104). These two species, plus *Dryas integrifolia* (entire-leaf

Figure 6.6-1a (Page 1 of 2)

Figure 6.6-1a (Page 2 of 2)

Figure 6.6-1b (Page 1 of 2)

Figure 6.6-1b (Page 2 of 2)

Figure 6.6-1c (Page 1 of 2)

Figure 6.6-1c (Page 2 of 2)

Table 6.6-1 (Page 1 of 1)

mountain avens), make up approximately 78% of the vascular plant cover of the project area (Walker, 1985:104).

The vegetation communities and associated invertebrate species are closely linked and largely determine which species of birds use which tundra types. Insects are the most abundant invertebrates, followed by mites (Acarina), spiders (Araneae), and springtails (Collembola). Terrestrial invertebrates are integrated into arctic systems and play many biological roles, including decomposition and predation. The occurrence of invertebrates in the Arctic is dependent on the effects of temperature, daylight, insolation, and moisture (Danks, 1992:161). In addition, invertebrates in the Arctic must make physiological adaptations to low winter temperatures, short growth and reproduction seasons, low temperatures during the growing season, low primary production, and weakness of photoperiodic cues (MacLean, 1975:269).

Dry Tundra: Dry tundra communities occur on well-drained mineral soils or gravely soils and cover approximately 2% of the Prudhoe Bay oil fields (Walker et al., 1980:25) and less than 1% of the Arctic Coastal Plain between the Colville and Canning Rivers (Beechy Point Quadrangle) (Walker and Acevedo, 1987:49). As shown on Figure 6.6-1, these percentages appear to be approximately correct for the project area (vegetation types 1, 2 and 6). Vegetation typically consists of prostrate shrubs (*Salix* sp. and *Dryas integrifolia*), herbaceous species such as *Oxytropis nigrescens* (black oxytrope) and *Saxifraga oppositifolia* (purple mountain saxifrage), and *Carex* sp. (sedges) (Walker et al., 1980:25). Dry tundra communities are found on the sides of pingos, elevated and exposed windblown ridges, river bluffs, high-centered polygons, and rims of drained lake basins (Walker, 1985:21).

Dry tundra communities in the project area exposed to saltwater include dry coastal bluffs and beaches dominated by *Cochlearia officinalis* (common scurvy grass) and *Puccinellia phryganodes* (creeping alkali grass). In areas subject to inundation by salt water, *Dryas integrifolia* is killed, while *Braya purpurasens* (purple braya) and *Puccinellia andersonii* (shining alkali grass) remain alive (Walker et al., 1980:30). Dry tundra communities are described under the NWI classification system as palustrine scrub-shrub wetlands due to their saturated soils and the presence of permafrost.

Invertebrates of dry tundra in the project area include larvae of craneflies (Tipuilidae) and midges (Chironomidae) (Truett and Kertell, 1990:15).

Moist Tundra: Moist tundra areas are typically drained of standing surface water soon after snowmelt, but small areas of water remain in depressions. It is found in poorly-drained, patterned ground of high-centered polygons or in strangmoors, areas of discontinuous ridges and low wet areas. Expanses of unpatterned moist tundra also occur in areas of drained-lake basins (Walker, 1985:24). This vegetation type consists of graminoid meadows of either tussock-forming *Eriophorum* sp. or non-tussock *Carex* sp., and dwarf shrubs (Walker, 1985:25). Common species are *Eriphorium angustifolia* (thinleaf cottongrass), *Carex aquatilis*, *Carex bigelowii* (Bigelow's sedge), *Dupontia fisherii* (Fisher's tundra grass), *Alopecurus geniculatus* (alpine foxtail), and dwarf shrubs such as *Dryas integrifolia* and *Salix* sp. (Walker, 1985:24). Moist tundra communities are typically classified as palustrine emergent and scrub-shrub wetlands under the NWI classification system.

Invertebrates in standing water habitats early in the year are dominated by midges, other dipterans, oligochaetes, steroptera, coleoptera and gastropods (OIW, 1979:32). Following snowmelt, moist tundra areas become drier and are similar to dry tundra with regard to invertebrate species composition.

Wet Tundra: Wet tundra is the dominant vegetation community on the Arctic Coastal Plain and is widespread in the onshore portion of the project area. It is found in poorly-drained, patterned ground of low-centered polygons or strangmoor, and unpatterned areas in drained-lake basins (Walker et al., 1980:27). Wet tundra sites typically have standing water in early summer, which drains by mid-summer in most years (Walker, 1985:26). Wet tundra also occurs in the onshore project area at microsites, such as troughs around high-centered polygons, between hummocks in moist areas, and along lake margins (Walker et al., 1980:27).

Acidic wet sedge tundra is composed primarily of *Carex aquatilis* with minor amounts of other sedges, such as *Carex saxitalis* (russet sedge), *Carex rariflora* (loose-flowered sedge), *Carex rotundifolia* (round-fruit sedge), and *Eriophorum angustifolia.* Only a few forbs or shrub species (*Salix* sp.) are found in wet tundra communities (Walker et al., 1980:30; Walker, 1985:26).

These communities are classified as palustrine emergent wetlands or emergent and scrub-shrub wetland under the NWI classification system.

Invertebrate species present in wet tundra areas include: chironomids, calanoid copepods, daphnids, nemourids, and physids, as well as oligochaete worms, snails, mites, and turbellarians.

Aquatic Tundra: Aquatic tundra communities consist of vegetation at sites with a continuous water cover throughout most summers (Walker et al., 1980:28). This vegetation type most often occurs at the margins of lakes and ponds, and in partially-drained lake basins. Plant species in aquatic tundra are controlled by water depth (Walker, 1985:28). In shallow water less than 4 inches (10 cm) deep, *Carex aquatilis* dominates, with lesser amounts of other sedges, such as *Eriophorum angustifolium* and *E. scheuchzeri* (Scheuchzer's cottongrass). Slightly deeper water, up to 12 inches (30 cm) deep, supports stands of *Carex aquatilis* with only a few aquatic forbs species, such as *Caltha palustris* (marsh marigold) and *Utricularia vulgaris* (blatterwort) (Walker, 1985:28). In deeper water up to 3.3 ft (1 m) deep, *Arctophila fulva* (pendant grass) is the dominant species and typically is found along the margins of lakes or large ponds, especially in partially-drained lake basins. In the larger, oriented thaw lakes that do not have protected embayments, *Arctophila fulva* is less common (Walker, 1985:29). These wetlands are classified as palustrine emergent wetlands under the NWI classification system.

Invertebrate species composition in aquatic tundra areas is similar to that found in ponds and lakes (Section 6.6.1.4). Those most associated with emergent plants are caddisflies (*Limnephilus* and *Micrasem*a sp.), the stonefly (*Nemoura* sp.), predaceous dytiscid beetles (*Agabus* and *Hydroporus* sp.), chironomids (*Corynoneura*, *Paraanytarsus*, and *Trichotanypus* sp.), mites (*Libertia* sp.), enchytraeid worms (*Propappus* sp.), snails (*Physa* sp.), and turbellid worms (West and Snyder-Conn, 1987:11; Hobbie and Pendleton, 1984:27).

Wet Saline Tundra: Saline tundra (salt marsh) communities are less common, limited in size, and mainly found in low-lying areas along the coast, such as the mouths of streams or rivers and in shallow protected areas adjacent to estuaries and lagoons (Walker et al., 1980:30). These salt-affected communities are composed of plant species found almost exclusively in these coastal habitats. *Carex subspathacea* (Hoppner's sedge), *Carex ramenskii* (Ramensk's sedge), *Carex urcina* (bear sedge), and *Puccinellia phryganoides*, and salt-tolerant forbs such as *Stellaria humifusa* (low starwort) and *Cochlearia officinalis* are found in saline tundra.

These relatively productive communities are limited in distribution on a regional basis, but are heavily used by some shorebird species during brood-rearing and post-breeding periods, and by brood-rearing, staging, and migrating waterfowl (TERA, 1994:30). Large expanses of saline tundra occur on the deltas and low-lying areas of the Sagavanirktok, Kuparuk, and Putuligayuk Rivers and in drained-lake basins adjacent to the coast, including areas near Point McIntyre and Point Storkersen (USDOI, FWS, 1991:Map 1). Saline tundra communities are classified as estuarine emergent wetlands under the NWI classification. Estuarine systems include all the semi-enclosed nearshore waters within the barrier island/lagoon systems and adjacent saline tundra. Estuarine intertidal wetlands may be either vegetated (with salt-tolerant grasses and forbs) or unvegetated flats (USDOI, FWS, 1991:10).

Species of invertebrates present in wet saline tundra include zooplankton (cladocerans and copepods), pelecypods, priapulids, polychaetes, tunicates, isopods, mysids, and amphipods.

Sand Dunes, Barrier Islands, Mud Flats, and Beaches: Another dry soil community is found in sand dunes. Sand dune communities occur in small areas at the mouths of the Kuparuk and Sagavanirktok Rivers and typically consist of *Elymus arenaria* (sea lyme-grass) and *Dupontia fisherii.* More stable dunes support a diverse flora of grasses and small forbs adapted to very dry conditions, and include *Androsace chamaejasme* (sweet-flowered rock jasmine), *Artemisia borealis* (arctic wormwood), and *Festuca* sp. (fescue grasses) (Walker, 1985:35).

The low-lying barrier islands located offshore are composed primarily of gravel and sand, and are subject to periodic inundation with saltwater. They support a sparse vegetative cover of *Elymus arenaria* and salt-tolerant forbs such as *Mertensia maritima* (oysterleaf) and *Honckenya peploides* (sea-beach sandwort) (Schamel, 1978:55). These areas are classified as estuarine wetlands under the NWI classification system (USDOI, FWS, 1991:14).

Invertebrates which occupy the mudflats and lower beach habitats include several species of clams, worms, and snails. Marine zooplankton that concentrate along the beaches of the barrier islands and along the outer coast are an important food source for some juvenile birds (Johnson and Richardson, 1981:286; Connors, 1984:407).

6.6.1.4 Aquatic Habitats

Approximately 99% of the onshore project area is wetland and aquatic habitat, with the remaining habitat being dry tundra (Bergman et al., 1977:23). Approximately 25% of the onshore project area is lakes, ponds, and streams. Drained or partially-drained lake basins, which make up approximately 17% of the wetland habitats, are also characteristic of the onshore project area and develop into ecologically diverse wetland complexes of shallow water and flooded and wet tundra communities (Bergman et al., 1977:20-23). Aquatic grass tundra, dominated by *Arctophila fulva*, occurs along the shoreline of many lakes classified as lacustrine (USDOI, FWS, 1991:8).

In arctic ponds and lakes, the phytoplankton is comprised of numerous species of nanoplankton (mostly very small chrysophytes and crytophytes) which are heavily grazed by the common zooplankton species (primarily crustaceans) (Hobbie and Pendleton, 1984:19). These aquatic habitats and the wet portions of tundra communities in the project area also support large populations of larger invertebrate species (macroinvertebrates), which provide food for waterfowl and shorebirds (Bergman et al., 1977:27). Bottom-dwelling invertebrates are more abundant than free-swimming forms (Bergman et al., 1977:20-23). Most freshwater aquatic habitats in the project areas do not support fish populations, because they freeze to the bottom during winter. Aquatic invertebrates are the main source of animal protein for diving birds, especially females and young during brood-rearing.

Freshwater rivers/streams within the project area include the Sagavanirktok, Putuligayuk, and Kuparuk Rivers, classified under the NWI classification as riverine systems. The larger rivers are generally unvegetated and do not freeze completely in deep areas. Small, slow-moving tundra streams have emergent vegetation such as *Arctophila fulva* along their edges (Bergman et al., 1977:18-20), but larger rivers are unvegetated. The unvegetated or partially-vegetated river bars and flats are also considered riverine (USDOI, FWS, 1991:1). Vegetation on gravel bars consists of herbs (*Lupinus arcticus, Hedysarum mackenzii, Artemisia tilesii, Crepis nana, Epilobium* sp., *Taraxacum lacerum, Astragalus* sp.), horsetails (*Equisetum arvense*), rushes (*Juncus arcticus*), shrubs (*Salix* sp., *Alnus crispus*), and grasses (*Agropyron macrourum, Deschampsia caespitosa*) (OIW, 1979:55).

Trichoptera, ephemeroptera, plecoptera, and chironomids are the most common invertebrates in rivers and streams (OIW, 1979:32).

6.6.2 Environmental Consequences

The following section describes the potential impacts of each project alternative on coastal vegetation and invertebrates. Discussion of impacts is organized based on project alternatives described in Chapter 4. A discussion of the relevant issues to coastal vegetation and invertebrates is presented in the alternatives section as they are related to project phases (construction, operation, maintenance, abandonment) and project components (gravel mining, island reconstruction, onshore pipeline construction, offshore pipeline construction, offshore facilities construction). Impacts to coastal vegetation and invertebrates are similar for Alternatives 2, 3, 4, and 5: only the amount of the habitat affected differs among alternatives as a result of different landfall locations. Therefore, potential impacts to coastal vegetation and invertebrates from Alternatives 2, 3, 4, and 5 are discussed together, with the amount of affected habitat delineated and summarized in Table 6.6-2.

6.6.2.1 Alternative 1 - No Action Alternative

No construction is required for a No Action Alternative, consequently, there would be no impacts to coastal vegetation and invertebrates. The vegetation communities and wetlands in the project area would continue to experience gradual change from natural processes such as the draining and filling of lake basins, coastal erosion, and the thaw lake cycle.

6.6.2.2 Alternatives 2, 3, 4, and 5

Construction Impacts: Development of the proposed gravel mine site at the mouth of the Kuparuk River would affect approximately 35 acres (14 hectares) of riverine barrens consisting of unconsolidated sand and gravels with some early successional stages of gravel bar plant communities. These communities are regularly disturbed by river flooding. North of the proposed mine on higher ground, vegetation consists predominantly of wet tundra with *Carex aquatilis*, moist tundra, and dry prostrate shrub tundra (BPXA, 1997:2-4). This habitat would not be disturbed in the process of gravel mining. The gravel mine site is primarily unvegetated, but any pioneer vegetation, such as annual forbs, herbs, and shrubs, established on the sand and gravel of the site would be removed with the snow and ice to prepare the area for gravel mining.

This terrestrial habitat at the gravel mine site would be converted to aquatic habitat after gravel extraction activities are complete. The mine would be connected by a channel to the Kuparuk River and allowed to flood during the breakup period. This would result in creation of a 30-acre (12.1-hectare) lake with depth of up to 40 ft (12.2 m) and would include at least 4 acres (1.6 hectares) of a 6-ft (1.8 m) deep shelf along the south side of the mine site (Figure 4-16). The shallow areas of the lake likely would not support emergent vegetation such as *Arctophila fulva* or *Carex* sp. due to the water depth. The habitat created by gravel mining would consist of a deep, open water lake which would not freeze to the bottom during the winter, providing fish overwintering and rearing habitat as invertebrates would be available as a food source.

Loss of the river bar habitat would decrease the amount of this habitat in the local area. The river bar habitat is sparsely vegetated and temporary in nature, due to regular flooding and erosion. Impacts on vegetation and invertebrates from the loss of river bar habitat are considered to be minor, due to the abundance of this habitat in the general area.

Table 6.6-2 (Page 1 of 2)

Table 6.6-2 (Page 2 of 2)

Ice road construction over tundra habitat during gravel mining activities and onshore pipeline construction would consist of 2.8 miles (4.5 km) of ice roads from the mine site to the freshwater lake which would supply water for ice road construction, and along the pipeline route from landfall, as applicable to each alternative (BPXA, 1997:2-4). Thirty-one acres (12.5 hectares) of moist tundra and 6 acres (2.4 hectares) of wet tundra would be affected by the ice road to the water supply source. The access ice road at Point McIntyre would impact approximately 3.7 acres (1.5 hectares) of moist tundra. Ice roads remain in place later in the spring compared to snow on the adjacent tundra and green up later due to the ice cover. Ice roads also tend to compress the vegetation for a couple of years after initial construction and result in less microtopographic variation. Recovery of the microrelief is expected to occur over a couple of years through action of the freeze/thaw cycle (Walker et al., 1987:24). Tundra vegetation is expect to recover within a few years; therefore, impacts are expected to be short-term and would be considered minor.

A small portion of the onshore pipeline corridor for Alternatives 2 and 3 was disturbed in 1969 by construction of a “peat road” south from Point Storkersen, which is still visible as a raised area with ditches on either side and is in various stages of erosion and revegetation. The proposed pipeline would follow this road for a short distance south of Point Storkersen and travel east toward the Point McIntyre Facilities. The peat road is not in a usable condition and would not be improved to provide access to the pipeline; however, following this road minimizes additional disturbance to undeveloped tundra areas.

Construction of the onshore pipelines would be conducted during the winter months. Ice roads would be built over the frozen tundra along pipeline routes. Holes for the VSMs to support the pipelines would be drilled through the ice road, and tailings from these holes would be removed and disposed. There would be no permanent access roads built adjacent to the pipelines, thereby minimizing impacts to the tundra and avoiding alteration of drainage patterns and water impoundments that might affect coastal vegetation and invertebrates. Because no fill will be required for the pipeline, the impact would be compression of tundra vegetation from the construction of ice roads. For Alternatives 2, 3, 4, and 5, the ice road along the onshore pipeline would affect a total of 262.7 acres (106.3 hectares), 235 acres (95.1 hectares), 180 acres (72.8 hectares), and 163 acres (66 hectares), respectively (Table 6.6-2). The amount of each tundra type affected by an ice road footprint from Alternatives 2, 3. 4. and 5 is presented in Table 6.6-3.

The pipeline routes avoid all major thaw-lakes and large tundra ponds, and the placement of VSMs in the smaller tundra ponds would depend on final pipeline alignment. Two additional VSMs would be placed in the Putuligayuk River at the crossing to support the new pipeline. These supports would be installed during the

Table 6.6-3 (Page 1 of 1)

winter months to minimize effects on riverine habitat. Therefore, impacts to aquatic vegetation and habitats are considered to be minor.

Essentially all of the pipeline route is across wet, aquatic, and moist tundra wetlands, with very minor amounts of dry tundra associated with elevated mounds (USDOI, FWS, 1991:1). Total loss of wetland habitat from placement of VSMs and fill at the valve station would be less than 2 acres (0.8 hectares). This includes the area occupied by each VSM (approximately 96 VSMs per mile [60 per km]) and 0.1 acres (0.04 hectares) of moist tundra for the valve station pad at the Point Storkersen landfall and the excavated trench from the shoreline. Changes in surface hydrology and local drainage patterns would be avoided by the installation of the pipeline on VSMs.

Gravel for the valve station pad would be hauled over an ice road during the winter months, which would limit impacts to adjacent tundra areas. No additional fill would be required for expansion of caribou crossings on the existing pipelines and roads. The size of the area covered by the VSMs and the valve station pad is small relative to the availability of similar, undisturbed tundra habitat in the vicinity and would have a very small incremental effect on the Arctic Coastal Plain. Because ice roads would be used during construction, long-term effects are not expected. Ice roads protect the tundra better than soft-tired vehicles on frozen ground; however, some vegetation would be crushed under the ice and patches of higher ground may be scraped. Studies of vegetation recovery (Emers and Jorgenson, 1997:543; Cargill and Chapin, 1987:386; Strandberg, 1997:16) indicate that recovery of tundra from soft-tired vehicle damage takes place within 7 to 9 years, and associated changes in hydrology result in small areas of subsidence and ponding. A single year of ice road construction is expected to result in much less damage than soft-tired vehicles, and vegetative recovery is anticipated within 2 to 3 years. If ice roads were repeatedly constructed during the life of the project, impacts would be greater. However, impacts would still be less than those of repeated soft-tired vehicle use over the same time period. The hydrology of this area would not be altered by the pipeline and pad, therefore, changes to wetlands are not expected. Placement of the VSMs and pad would be expected to have only a minor impact on coastal vegetation and invertebrates in the project area.

Operation Impacts: Most operational activities would occur on ice roads, at Seal Island, or involve transportation of people and materials between Seal Island and the mainland on ice roads and would have no impact on coastal vegetation and invertebrates. The presence and operation of the pipeline and valve station pad are not expected to adversely affect coastal vegetation or invertebrates; therefore, no impacts are expected.

Oil spills on the tundra or in nearshore water where oil could wash ashore and affect saline tundra constitute the greatest potential adverse effect to wetlands and terrestrial vegetation. Oil can affect tundra by killing all vegetation or portions of the vegetative community, such as the moss and lichens. Plants associated with dry tundra are generally more susceptible to damage from spilled oil in comparison to plants that inhabit wetter tundra communities (Walker et al., 1978:252). Areas of oiled tundra often show a marked increase in thaw depth of the active layer under the contaminated area (Lawson et al., 1978:28; Brown and Grave, 1979:9). Oiled tundra areas are difficult to clean up without further disturbance to the vegetative mat and the permafrost underneath.

Oil spills which reach freshwater lakes and ponds can kill the invertebrate fauna and plankton in the water, contaminate sediments, and kill or injure emergent vegetation. Effects of oil on invertebrate populations can be long-term, depending on the amount of oil contamination of the sediments, since many life stages come in contact with bottom sediments (Bergman, et al., 1977:36). Contaminated sediments would also affect emergent vegetation. Oil in sediments is expected to break down slowly due to the cold temperature (Bergman et al., 1977:36). Impacts of oil to coastal vegetation and invertebrates are discussed in Chapter 8.

Maintenance Impacts: The level of effects on coastal vegetation and invertebrates along the pipeline from maintenance and repair activities would depend on whether it was feasible to defer activities until periods of adequate snow and ice cover. If emergency repairs or unplanned maintenance activities are required during the summer months, only soft-tired vehicles would be used to access the site. Studies of Rolligon use on the tundra have shown that vegetation breakage and displacement of surface soils can occur as a result of soft-tired vehicular traffic (Felix and Raynolds, 1989:189; Walker et al., 1987:22.) Although recovery of the tundra is dependent upon the number of times a site is traversed by such vehicles, studies indicate that recovery of vegetation takes place within 7 to 9 years (Felix and Raynolds, 1989:189; Strandberg, 1997:381; Emers and Jorgenson, 1997:453) after summer use. Use of rolligons on frozen tundra would result in less impacts to the tundra than summer use, because, although impacts may include similar damage to vegetation, little frozen soil would be displaced. Impacts to the tundra under these circumstances, would be considered minor and short-term. Potential impacts are reduced by conducting routine inspections of the pipeline during the winter on snowmachine or by helicopter. Regular inspections and maintenance activities would have no effect on the tundra. The pipeline will be monitored by helicopter.

Abandonment Impacts: Abandonment impacts would depend upon the abandonment plan that is adopted and will be fully addressed in the assessment of the environmental effects of the abandonment alternatives. For an abandonment scenario involving complete removal of all facilities and infrastructure, impacts to coastal vegetation and invertebrates would be expected to be similar to the minor impacts generated during construction.

6.6.3 Summary of Environmental Consequences

Except for oil spills (Chapter 8), no significant adverse impacts were identified for coastal vegetation and invertebrates as a result of development of the proposed project. Tundra vegetation would be impacted from late melting of ice roads, fill of wetlands for the installation of the valve stations, and placement of the VSMs. Oil spills could potentially have significant adverse impacts on freshwater invertebrates, with oil spill reponse activities potentially resulting in significant impacts to coastal vegetation.

Alternative 1 will result in no impact to coastal vegetation or invertebrates. Existing vegetation communities would not be altered by ice road construction or by fill of tundra habitats. River bar habitat at the Kuparuk River delta would not be disturbed.

The development of any of the Alternatives 2, 3, 4, or 5 would result in minor loss of river bar habitat on the Kuparuk River Delta. Less than 2 acres (0.8 hectares) of tundra habitat would be lost from placement of fill for the valve station and pipeline VSMs. Ice road construction would result in some compression and late green up of up to 262.7, 235, 180, and 163 acres (106.3, 95.1, 72.8 and 66 hectares) of tundra the first year after onshore pipeline construction for Alternatives 2, 3, 4, and 5, respectively; the impacts would be considered minor. Impacts from the operation and maintenance of Seal Island and the pipelines would also be considered minor.

Development of the ice roads for construction would result in a short-term impact to vegetation which may last for several years. Long-term impacts to vegetation include destruction of tundra habitat for the construction of valve station at the landfall of the offshore pipeline. The operation and maintenance of pipelines and facilities would have no long-term impacts (beyond 15 years) on vegetation or terrestrial invertebrates.

The development of any of the alternatives would require the long-term loss or commitment of river bar habitat at the gravel mine site and the filling of small areas of tundra for the valve station will be an irreversible commitment of resources. The onshore pipeline would not require fill, and after abandonment, this area could be restored to its former habitat. The removal of the pipeline during project abandonment would allow return of the habitat.

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6.7 BIRDS

Bird species found in and around the project area, and any impacts to those species from the project, are described in this section. Threatened and endangered bird species (spectacled eider *Somateria fischeri* and Steller's eider *Polysticta stelleri*) are discussed in Section 6.9.

6.7.1 Affected Environment

Approximately 44 species of nesting seabirds, waterfowl, shorebirds, raptors, and passerines are found seasonally in the project area (Pitelka, 1974:2; Johnson and Herter, 1989:ix). Additional species are casual or accidental visitors to the project area (Table 6.7-1). Most birds in the region are migratory and present on the Arctic Coastal Plain from late May through September. They take advantage of the short summer to feed, nest, rear their young, molt, and stage for fall migration to wintering areas (Johnson and Herter, 1989:x).

The Alaskan Beaufort Sea coast, which includes the coastline of the project area, is important for a number of marine-oriented birds as a summering area for non-breeders, post-breeding staging, and as a migratory pathway, but lacks the rock cliffs and talus slopes for seabird breeding colonies (Divoky, 1984:417). Coastal areas are used for molting by several waterbird species, and for accumulating energy stores in the fall for southward migration (Johnson and Richardson, 1981:298). Many of these species are international, migrating from as far away as South America, southeast Asia, the Pacific Islands, and Antarctica (Johnson and Herter, 1989:ix). Local residents have observed that large numbers of waterfowl pass through this area, and are

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concerned that an oil spill could have a drastic effect on the population (F. Rexford in USACE, 1996:22). During summer, overall bird densities are generally low but, because they are spread over such a large area, total populations are often large (Johnson et al., 1987:131). Location of major bird concentration areas are shown on Figure 6.7-1.

Although the number, migration corridors, and staging periods of spring and fall migrating seaducks (oldsquaws [*Clangula hyemalis*] and common, king, and spectacled eiders [*Somateria mollissima, S. spectabilis,* and *S. fischeri*]), red-throated and Pacific loons (*Gavia stellata* and *G. pacifica*), and Pacific black brant (*Branta bernicula*) along the Alaskan Beaufort Sea coast have not been reliably estimated (Richardson and Johnson, 1981:117; R. Oates - Pers. Comm., 1998:1), the importance of the nearshore habitats, lagoons, barrier islands, and offshore areas to migrating, staging, and molting waterbirds is well documented (Bergman et al., 1977:7; Schamel, 1978:55; Richardson and Johnson, 1981:117; Johnson and Richardson, 1982:290; Johnson, 1985:21; Johnson and Herter, 1989:83; Suydam et al., 1997:534).

Few birds remain in the project area throughout the year. Resident species, those which spend the entire year in the region, include the common raven (*Corvus corax)*, willow and rock ptarmigan (*Lagopus lagopus, L. mutus*) and, possibly, the hoary redpoll (*Carduelis hornemanni*) and gyrfalcon (*Falco rusticolus*) (Pitelka, 1974:175-176; Johnson and Herter, 1989).

6.7.1.1 Seasonal Movements and Activities

There are three periods of bird migration along the Alaskan Beaufort Sea coast: spring migration, molt migration, and fall migration. Spring migration begins approximately mid-May with migrants arriving from two directions (Johnson and Richardson, 1982:291). Birds coming from wintering areas to the west, such as the Bering and Chukchi Seas, follow either an inland route east across the Arctic Coastal Plain, or the open lead system in the offshore ice (Section 5.6). The leads generally occur within 6 miles (9.7 km) offshore of the barrier islands, but can be found as far as 24 miles (38.6 km) offshore (Flock, 1973:267; Johnson and Richardson, 1981:131). Birds migrating from the eastern and central portions of North America approach the Alaskan Beaufort Sea coast from the east, generally following an interior route through the major river drainages in Canada, then following the coast westward to reach the project area (Richardson and Johnson, 1981:108). A large percentage of spring migrants, especially waterfowl and shorebirds, take this eastern route into the Alaskan Beaufort Sea (Richardson and Johnson, 1981:110).

During spring migration (approximately May 15 to June 20), thousands of spectacled eiders, tens of thousands of common eiders and Pacific black brant, and hundreds of thousands of king eiders and oldsquaws migrate along the Alaskan Beaufort Sea following coastal, nearshore, and/or offshore routes. Observations of Pacific black brant; common, king, and spectacled eiders; and oldsquaw during spring migration have been recorded at Point Storkersen between June 1 and June 10 (Bergman et al., 1977:6).

Much of the tundra is still frozen when migrants arrive and waterbirds concentrate in areas along the coast, flooded habitats at the mouths of rivers, snow-free areas along the roads, and meltwater ponds (Johnson et al., 1987:132). When the ice and snow thaw, they disperse to breeding areas (Richardson and Johnson, 1981:108).

As snow melt progresses, birds establish territories and nest on the newly exposed tundra. A few species utilize isolated offshore islands for nesting, which provides protection from predators. Incubation is initiated in early June and lasts for 3 to 4 weeks, with eggs hatching from late June through mid-July. Most young are generally reared from mid-July to mid-August. Some species are territorial and nest in the same locations from year-to-year, while others are more nomadic and nest where environmental conditions are favorable each year.

Birds are most vulnerable to oil spills during spring and fall migration and the post breeding, molting, and brood-rearing period (generally late June through mid-August). The post-breeding period is characterized by a general movement of shorebirds and waterfowl from nesting areas on the tundra to coastal feeding areas prior to migration (Connors et al., 1979:108; Connors, 1984:407). The movement to the coast makes many species vulnerable to potential oil spills. Waterfowl usually move their broods to rearing sites, which may be in different habitat from nesting areas. Brood-rearing areas are traditional for some species and are important for putting on fat reserves for migration (Johnson, 1991:10-15; Stickney and Ritchie, 1996:50). Other species remain on lakes and ponds within their tundra nesting areas until late fall (Johnson and Richardson, 1981:220). In late July, molting waterfowl in the lagoons are joined by thousands of juvenile phalaropes, as the young fledge (start to fly) and move from tundra breeding grounds to feed on the marine zooplankton concentrated along the beaches of the islands, especially along the outer coast (Johnson and Richardson, 1981:286; Connors 1984:407).

Molt migration is a post-breeding movement of waterfowl to areas not directly on the route to wintering grounds. For most, this occurs during mid-summer; however, it varies by species. Some non-breeding or unsuccessful nesters move from the breeding grounds to communal molting areas at either coastal lagoons or large lakes. Waterfowl cannot fly while molting, and water-bodies provide protection from predators (Johnson and Richardson, 1982:291). Some species move to the coast near their breeding grounds while others fly considerable distances, even hundreds or thousands of miles, to molt at traditional sites. Large numbers of common and king eiders (primarily males) undergo post-breeding molt migrations from northern nesting areas to presumed molting areas in the Chukchi and Bering Seas. Simpson Lagoon is one such traditional molting site (Johnson and Richardson, 1982:294). These flightless ducks, mostly oldsquaws, are vulnerable to both disturbance and to oil spills.

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Fall migration extends over a longer period of time than spring migration, with the non-incubating member of the pair of some species, such as pectoral sandpipers (*Calidris melanotos*), red phalaropes (*Phalaropus fulicaria*), and red-necked phalaropes (*P. lobatus*), leaving the breeding ground soon after the eggs are laid, followed several weeks later by the other parent and fledged young (Connors, 1984:406). In contrast, red-throated loons, Pacific loons, and tundra swans (*Cygnus columbianus*) remain on their breeding grounds until freezing weather forces them to leave (Johnson and Richardson, 1981:192). The majority of the fall migrations occur from mid-August to mid-September and typically involve feeding and staging in coastal areas to build up energy reserves for the long flight to wintering areas (Johnson and Richardson, 1981:286; Connors, 1984:412). Fall migration of seaducks, and most species of waterbirds, occurs from approximately mid-July through early November.

6.7.1.2 Habitats

The central portion of the Arctic Coastal Plain, from the Colville River to the Canning River including the project area, is regarded as having a relatively high diversity of bird habitat due to the large rivers with delta systems, barrier island/lagoon systems, extensive wetlands, and numerous ponds and lakes (Pitelka, 1974:173). A total of four different habitat types are important to birds in the project area and could potentially be impacted by the project: offshore marine waters, nearshore marine waters, barrier islands, and tundra habitats.

Offshore Marine Waters: Offshore waters are those outside the barrier islands from 10 to 165 ft (3 to 50 m) deep. Summer bird densities in offshore waters are the lowest of any marine area adjacent to Alaska. This is probably a reflection of the low primary productivity of the Alaskan Beaufort Sea (Divoky, 1984:431). There is a general absence of diving birds in the offshore waters, with the exception of small numbers of thick-billed murres (*Uria Lomuia*) and black guillemots (*Cepphus grylle*) (Divoky, 1984:424). Only a few surface-feeding bird species utilize the offshore waters, such as the red and red-necked phalaropes, pomarine and parasitic jaegers (*Stercorarius pomarinus and S. parasiticus*), Arctic tern (*Sterna paradisaea*) and, the dominant species, glaucous gulls (*Larus hyperboreus*) (Divoky, 1984:424). Density of birds during the open water season in deeper offshore waters greater than 60 ft (18 m) is relatively low at less than 25.9 birds per square mile (10/km^2); however, density increases in shallower nearshore waters to greater than 259 birds per square mile (100/km^2) (Divoky, 1979:359).

Nearshore Marine Waters: Nearshore marine waters, defined as less than 10 ft (3 m) deep, support many more birds than offshore waters. The shallow, brackish lagoon systems enclosed by barrier islands, such as Simpson Lagoon and Gwydyr Bay, are major components of the nearshore environment. These lagoons provide feeding habitat, as well as resting habitat and escape cover for large numbers of molting waterfowl. Other important habitats associated with nearshore marine waters are saline tundra (salt marsh) areas, which occur along protected coastlines adjacent to lagoon systems or at extensive river delta systems. These saline tundra areas are of major importance to Pacific black brant.

Diving birds which use the nearshore waters for feeding include red-throated loons (*Gavia stellata*) and Pacific loons, waterfowl, such as oldsquaw; and common, king, and spectacled eiders. Oldsquaws are the most numerous species with tens of thousands congregating in the lagoons from mid- to late summer, often in the lee of points, islands, and causeways during winds (Johnson and Richardson, 1981:114). Other species found abundantly in nearshore waters are glaucous gulls (Divoky, 1984:427) and red and red-necked phalaropes, typically on the seaward side of the barrier islands (Johnson and Richardson, 1981:116).

Barrier Islands: Most islands in the project area are composed of gravel and sand with patchy vegetative cover (Section 6.6.1.3) and provide a moderate amount of nesting habitat for occasional brant, low numbers of common eiders, glaucous gulls, and Arctic terns (Schamel, 1978:57; Johnson and Richardson, 1981:224). Some of the larger barrier islands support small numbers of tundra nesting shorebirds, such as ruddy turnstones *(Arenaria interpres)*, dunlins *(Calidris alpina)*, and Baird's sandpiper *(C. Bairdii)*, but overall densities are not as high as adjacent mainland tundra habitats (Johnson and Richardson, 1981:224). Common eiders nest almost exclusively on barrier islands and select nest sites among the drift debris and *Elymus* clumps. The only passerine (songbird) species that regularly occurs on these islands is the Lapland longspur (*Calcarius lapponicus*).

Tundra Habitats: Tundra habitats adjacent to the Alaskan Beaufort Sea coast are breeding habitats for most birds using nearshore marine areas. Most of the habitat available to birds consists of moist and wet tundra, aquatic tundra, large lakes and ponds with islands (Section 6.6.1). This is reflected in the high percentage (80%) of water-oriented birds dominating the avifauna (Bergman et al., 1977:8). The wet and moist tundra habitats produce a variety of different microsites for different activities, such as feeding and nesting, with the latter occurring on drier microsites (Troy, 1988:71 and 74). The dominant shorebird species such as semipalmated sandpiper (*Calidris pusilla*), dunlin, and pectoral sandpiper, prefer wet tundra habitats (Bergman et al., 1977:25; Troy, 1988:74-77).

Tundra habitats within the onshore project area and adjacent to Prudhoe Bay are intensively studied Arctic bird habitats. Numerous short-term studies dealing with the effects of oil development on various aspects of bird biology have used reference or control plots located in a large block of undeveloped tundra west of Prudhoe Bay and south of Point McIntyre, referred to as the Point McIntyre Reference Area. This area is used to represent relatively undisturbed habitat (TERA, 1993b:2). Regular census of this area from 1981 to 1992 has led to the accumulation of over a decade of breeding season data from the same area, providing a good time series of annual variation for both habitat use and long-term regional population trends on the central Arctic Coastal Plain (TERA, 1993b:3). The habitat and species composition of this reference area is generally similar to many areas on the Arctic Coastal Plain, although some habitats and species that occur throughout the Arctic Coastal Plain are poorly represented in the Point McIntyre Reference Area (Troy, 1995:16; TERA 1996:23-24).

Waterfowl species that nest in tundra habitats in relatively low densities include tundra swans, greater white-fronted goose (*Anser albifrons*), northern pintail (*Anas acuta*), king eider, and oldsquaw (Warnock and Troy, 1992:13). The only common tundra-nesting passerine is the Lapland longspur (TERA, 1990b:13).

Non-breeding birds and transients make up a considerable portion of birds present on the tundra during the breeding season, with numbers of non-breeding birds fluctuating considerably more than the number of breeders (TERA, 1990b:16). Environmental factors or recruitment from previous years' production are the likely cause for fluctuation of bird numbers on the tundra during the breeding season (TERA, 1993b:24).

The density of dominant nesting species in tundra habitats of the Point McIntyre Reference Area has been relatively stable over 11 years of documented study (1981 to 1992). Some species have shown a declining trend in breeding-season density during these years, including the Lapland longspur, pectoral sandpiper, dunlin, king eider, and oldsquaw (TERA, 1993b:22). However, causes for these declines have not been linked to oil field development. The pectoral sandpiper and Lapland longspur have exhibited noticeable among-year variation over several years of study (TERA, 1993b:26). Pectoral sandpiper fluctuation is likely due to their non-territorial nesting behavior; their breeding locations change from year to year depending on environmental conditions. Causes of Lapland longspur density fluctuations are unknown (TERA, 1992:15).

For dunlin, density of birds seen during the breeding season at the Point McIntyre Reference Area declines during 1981 and 1992 (TERA, 1993b:Table 10) and king eider and oldsquaw declines during 1981 to 1992 approached statistical importance (TERA, 1993b:17). Although dunlin has shown an apparent declining trend during this time period, the decline is not statistically important (TERA, 1993b:17). Although the downward trend in dunlin numbers is evident, the interpretation and importance of this trend is uncertain as the nesting densities did not show a parallel decrease. King eiders migrating past Point Barrow in spring indicate that the population in northern Alaska and western Canada declined by more than 50% between 1976 and 1994 (Conant et al., 1997:17). From 1986 to 1997, oldsquaw breeding populations on the Arctic Coastal Plain remained relatively stable (127,000 to 113,000, P>0.10); however, populations in northwestern Canada and southern parts of Alaska declined by 75% (Conant et al., 1997:25). Declines in populations of spectacled and Steller's eiders are discussed in Section 6.9.

6.7.1.3 Loons and Waterfowl

Two species of loons, the Pacific and red-throated, are regular breeders in the lakes and ponds of the onshore portion of the project area. The yellow-billed loon *(Gavia adamsii)* is an occasional breeder. Loons are some of the last birds to arrive in the spring (Bergman et al., 1977:6) and remain until freezing weather forces them to leave (Johnson and Richardson, 1981:192). Red-throated loons prefer to nest along water bodies in basin complexes, but fly to coastal waters to forage on small fish in the nearshore Alaskan Beaufort Sea (Bergman et al. 1977:26-35). Pacific loons generally are found nesting near the larger lakes or ponds containing *Arctophila fulva* (Bergman et al., 1977:26) but also use water impounded beside gravel roads and pads in the oil fields (Kertell, 1993:1). Pacific loons also feed in nearshore marine waters (Bergman et al., 1977:35).

The tundra swan is one of the earliest arriving migrants to the project area (Bergman et al., 1977:6) and is also one of the last species to leave, generally in late September or early October (Stickney et al., 1993:1). These swans return to traditional nesting and brood-rearing areas and, therefore, are more likely to be affected by human development than species which are less faithful to specific areas (Ritchie et al., 1991:1). Tundra swans nest in relatively low densities of 0.01 nests per square mile (0.03 nests per km^2)

and are distributed uniformly at scattered locations on large ponds and lakes throughout the onshore project area (Ritchie et al., 1991:25; Stickney et al., 1993:i).

Several lesser snow goose *(Chen caerulescens)* colonies nest consistently at Howe Island, located in the outer part of Sagavanirktok River delta east of Prudhoe Bay. This is the only snow goose population nesting in proximity to a developed oil field (Johnson, 1994:1).

The greater white-fronted goose is a regular breeder in the project area (Bergman et al., 1977:6; Moitoret et al., 1996:19). Nesting density of these geese increases with distance from the coast (TERA, 1994:13). In the onshore project area, nesting densities near the coast were 0.2 to 0.3 nests per square mile (0.6 to 0.8 nests/km^2), in comparison to 0.6 nests per square mile (1.6 nests/km^2) 12 miles (19.3 km) inland (Troy, 1988:54). The same gradient was seen in the Kuparuk area (Moitoret et al., 1996:19-20). Non-breeders and juvenile birds move to traditional molting and staging areas in larger lakes or coastal areas during the post-breeding period A few weeks later, adults with broods leave tundra brood-rearing areas to join the non-breeders in feeding in saline tundra areas (TERA, 1994:18).

Most of the Pacific black brant (brant) nesting in northern Alaska occur between the Sagavanirktok and Colville River deltas (Stickney and Ritchie, 1996:50). Brant in the project area have been studied since 1984, including systematic aerial surveys between 1988-1992 to document population levels and assess impacts from oil development (Stickney and Ritchie, 1996:48). Most of these birds nest in small dispersed colonies, with a few larger colonies consisting of over 200 nests (Figure 6.7-1). Main nesting areas are located on remnant river delta islands in the project area, including Howe and Duck Islands in the Sagavanirktok River delta and on a small island in the Kuparuk River delta (Stickney and Ritchie, 1996:47). Brant move to coastal brood-rearing areas shortly after the young have hatched (Stickney and Ritchie, 1996:48). Coastal saline tundra habitat, located in relatively small areas of the coast, is important brood-rearing habitat (Bergman et al., 1977:28; TERA, 1994:28; Stickney and Ritchie, 1996:48). Important brood-rearing areas include the Kuparuk and Sagavanirktok River deltas, Point McIntyre, the northwest side of Prudhoe Bay, and near the mouth of the Putuligayuk River at the head of Prudhoe Bay (Stickney and Ritchie, 1996:49). Data from 1988 through 1996 surveys of brant in the Kuparuk River Delta (Stickney et al., 1993:28-29 and 40-41; Anderson et al., 1996:30 and 33) indicate that colony and brood-rearing populations differ greatly from year-to-year. Numbers of nests range from approximately 25 in 1995 to 134 in 1993 (Stickney et al., 1993:34). Similar variability was noted for numbers of brood-rearing groups. Gosling numbers represent approximately 40% to 50% of the total bird count within the region that includes the Kuparuk River Delta. Brant are sensitive to disturbance from aircraft overflights; and noise impacts (Derksen et al., 1992:ii) to this species are further discussed in Chapter 9.

The Canada goose (*Branta canadensis*) is a regular breeder in the project area (Murphy et al., 1987:73 to 78; TERA, 1990b:28). Canada geese stage for fall migration in salt marsh habitats, particularly at the head of Prudhoe Bay (Murphy et al., 1987:94).

Oldsquaw is one of the most common breeding waterfowl species on the tundra in the Prudhoe Bay area (TERA, 1990b:17). Between 250,000 and 1 million oldsquaws migrate into the Alaskan Beaufort Sea region via nearshore and offshore corridors (Bright, 1998:4; Richardson and Johnson 1981:108). During spring, most oldquaws migrate east across offshore portions of the Alaskan Beaufort Sea, rather than along the coast or through the interior (Richardson and Johnson, 1981:118). Because open water is scarce in much of the Alaskan Beaufort Sea in the spring, migrating oldsquaws can be expected to land on any available water in nearshore areas (Schamel 1978:53; Bergman et al.,1977:7; Richardson and Johnson, 1981:118) and in offshore leads. Thousands of migrating oldsquaws have been observed in offshore leads in the Canadian Beaufort Sea during late May and early June (Johnson and Richardson, 1982:298). During July, there is a substantial westward movement of oldsquaws over offshore waters (Johnson and Richardson, 1982:296). Males and non-breeding females undergo molt migration in July and spend several weeks in protected lagoons along the Alaskan Beaufort Sea coast, such as Simpson Lagoon.

Common eiders breeding on the Arctic Coastal Plain are found primarily on the barrier islands (Schamel, 1978:55; Johnson and Herter, 1989:76). Numbers of common eiders nesting in northern Alaska and the western Canadian Arctic may have declined in the last 20 years (Suydam et al., 1997:26). Common eiders were identified as a species at risk by the USFWS (Bright, 1998:4). In 1995, the total numbers of common eiders nesting on Stump, Egg, and Long Islands was 80, 60, and 24, respectively (Troy, 1996:1).

Spectacled eiders are listed federally as threatened under the ESA (58 FR 27480). The Steller's eider was listed federally as threatened under the ESA in June of 1997. These eiders are discussed further in Section 6.9 (Threatened and Endangered Species).

6.7.1.4 Seabirds

The number of seabird species using the Alaskan Beaufort Sea in the summer months is relatively low, likely a reflection of the low biological productivity of the marine waters (Connors, 1984:418). Seabird densities tend to increase to the west of the project area, since biological productivity increases with intrusions of Chukchi Sea water into the Alaskan Beaufort Sea (Connors, 1984:424). Most seabirds which feed in the offshore waters (e.g., jaegers, glaucous gulls, and Arctic terns) also nest in tundra habitats or on barrier islands adjacent to the coast.

6.7.1.5 Shorebirds

Based on breeding season density, shorebirds are the most abundant of the migratory bird species in moist and wet tundra habitats. The six dominant species include: semipalmated sandpiper, pectoral sandpiper, red-necked and red phalaropes, lesser golden-plover (*Pluvialis dominica*), and dunlin (Troy 1988:55, TERA 1992:13). Nest densities and breeding densities for birds common to the Point McIntyre Reference Area are presented in Table 6.7-2. Several species of shorebirds, such as semipalmated sandpiper, dunlin, and pectoral sandpiper, utilize saline tundra and mudflats during the post-breeding period, prior to migrating to wintering areas (Troy, 1995:26). Approximately 24 species of shorebirds have been documented to breed regularly in tundra habitats in the project area (Bergman et al., 1977; TERA, 1990b:13).

Semipalmated sandpipers are one of the most abundant breeding shorebirds in the Alaskan Beaufort Sea and one of the dominant breeders in the project area (Johnson and Herter, 1989:161). These shorebirds use a wide range of tundra habitats, but show preference for wet tundra areas with ridges that provide dry sites for nesting and wet habitats for feeding (Troy, 1988:77-79). Semipalmated sandpipers are monogamous, territorial, and display a strong fidelity to nesting territories and nest sites from year-to-year (Moitoret et al., 1996:34). Nest density of these shorebirds tends to decrease with an increase in oil field development, which suggests they are affected by disturbance (TERA, 1993a:43).

Pectoral sandpipers are one of the dominant nesting species and occur throughout the project area. These shorebirds show a strong preference for wetter tundra communities (Troy, 1988:77-79). They do not maintain breeding territories or return to previously used sites. Therefore, at any one site nesters may be common one year and nearly absent the next (Pitelka et al., 1974:190).

Dunlins are one of the more common species of shorebird in the tundra habitats of the project area, but are less abundant than semipalmated sandpipers. These shorebirds prefer wet tundra habitats and their breeding strategies are similar to those of the semipalmated sandpiper, being monogamous and territorial with a high site fidelity (Troy, 1988:30). Dunlins appear to be one of the more sensitive shorebird species and show a decrease in both nesting and post-breeding density with an increase in disturbance from oil field facilities (TERA, 1990a:43). Dunlins have been identified in one study as one of the species most affected by oil field development (Meehan, 1986:75).

Red and red-necked phalaropes are common “nomadic” breeders in Alaskan Beaufort Sea coastal areas and nest in wet tundra habitats throughout the project area (Troy, 1988:14). These swimming shorebirds do not maintain nesting territories but make use of available habitats. These birds do not show avoidance of roads and facilities, which is contrary to most of the shorebird species inhabiting the Prudhoe Bay area. Phalarope densities often increase adjacent to roads and pads, possibly due to an increase in impoundments along these features which provide the ponds and aquatic tundra they use for nesting and feeding (Troy, 1988:43; TERA, 1993a:43).

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6.7.1.6 Passerines

The Lapland longspur is one of the most widespread and the most abundant tundra-nester in the Prudhoe Bay area (Troy, 1988:51-54). Lapland longspurs show a slight decrease in abundance with increased oil field facilities, such as adjacent to roads and pads (TERA, 1993a:46). The snow bunting (*Plectrophenax nivalis*) nests in cavities and selects sites that are inaccessible to foxes, such as debris piles or pipeline supports, as nesting structures (TERA, 1990a:33). Nesting abundance usually increases around human development, which provides suitable nesting sites. These birds typically are not found in tundra habitat due to the lack of nest sites (Johnson and Herter, 1989:265).

6.7.2 Environmental Consequences

The following sections describe the potential impacts of each project alternative on birds. The discussion of impacts is organized based on project alternatives as described in Chapter 4. The types of construction impacts for Alternatives 2, 3, 4, and 5 are similar, only the amount of habitat affected due to landfall location is different. Impacts from operation, maintenance, and abandonment of Alternatives 2, 3, 4, and 5 are also similar; therefore, impacts for Alternatives 2, 3, 4, and 5 are discussed together and summarized in Table 6.7-3.

6.7.2.1 Alternative 1 - No Action Alternative

No construction is required for a No Action Alternative, consequently, there would be no impacts to birds. The natural variability in population levels and habitat of birds in the project area and in the Alaskan Beaufort Sea would be undisturbed by a No Action Alternative.

6.7.2.2 Alternatives 2, 3, 4, and 5

Construction Impacts: Approximately 35 acres (14.2 hectares) of sparsely-vegetated gravel bar would be removed and converted to deep and shallow open water habitat for Alternatives 2, 3, 4, and 5. Gravel bar areas receive only light use by birds during summer months due to a lack of food sources and vegetative cover for nesting. A few birds, such as semi-palmated plover and Baird's sandpiper, prefer open, rocky sites such as river bars for nesting. Therefore, loss of 35 acres (14.2 hectares) of gravel bar habitat is considered a minor impact to birds.

Restoration of the mine site would provide 30 acres (12 hectares) of up to 40-ft (12.2 m) deep open water, and 4 acres (1.6 hectares) of 6-ft (1.8 m) deep open water which is not expected to develop emergent vegetation. The site would be connected to the Kuparuk River, and

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occasional flooding and water exchange would occur. Fish may become established in the flooded mine site. A few waterfowl may use the site for resting, and fish-eating loons may feed there. The site is not intended to become high-quality bird habitat. Restoration of the mine site would provide a negligible beneficial impact to birds. Moreover, a few or no birds would be present during the actual mining activities; hence, activities related to gravel mining (e.g., loading trucks) would have negligible impact.

Offshore ice road and winter island construction activities would affect birds only if open water remains around the island into early spring when eiders and oldsquaw return to the area. Attraction to this open water is not expected to adversely impact the birds. Since few birds would be present during winter, construction of ice roads and the island would have a negligible impact on birds. During the open water period, the lee side of the island may become an attractive loafing area for oldsquaw, eiders, guillemots, and gulls; however, relatively few birds are expected to use the area due to the distance offshore and those that do, can move away from noise and disturbances. Therefore, the impact from these construction activities is considered negligible.

Approximately 2 acres (0.8 hectares) of tundra will be lost due to placement of gravel for the valve station pad near the shoreline and placement of VSMs for pipeline supports. The largest site, the valve station pad at Point Storkersen adjacent to the coast, is in moist, frost-boil tundra. Based on studies of bird impacts from previous gravel/pad construction elsewhere in the project area, the few birds that may nest in this area are expected to be displaced to nearby habitats with no loss of productivity (TERA, 1990a:33). Impact from the small amount of habitat loss to birds would be considered a minor impact.

Indirect impacts from onshore pipeline construction include temporary disturbance to vegetation under the ice roads used for winter pipeline construction. Using the maximum ice road width of 130 ft (39.6 m), this area is estimated at approximately 16.5 acres/mile (4.15 hectares/km), which includes tundra, small ponds, and unvegetated areas. Tundra vegetation under ice roads is likely to become snow- and ice-free later in the summer following its construction than would otherwise be the case and also would become slightly flattened (Walker et al., 1987:24). Therefore, this habitat would not be available until after the start of nesting. In some areas, drifting snow may accumulate next to the pipeline each winter, resulting in an annual pattern of delayed snow melt. A 5-ft (1.5 m) high pipeline, however is unlikely to cause this effect except in small areas directly adjacent to the VSMs.

During the first year of construction for Alternatives 2, 3, 4, and 5, the delay in nest site availability due to late melting of ice roads along the pipeline would affect a total area of 262.7 acres (106.3 hectares), 235 acres (95.1 hectares), 180 acres (72.8 hectares), and 163 acres (66 hectares), respectively (Table 6.6-2). Any territorial shorebirds, Lapland longspurs, and oldsquaws which nest along this area could suffer nest site loss as a result of onshore pipeline construction. Species which do not nest in the same areas each year (non-territorial), such as the pectoral sandpiper and phalaropes, would establish nests elsewhere and would not be greatly affected. Flattening of vegetation may discourage use of traditional nest sites in the ice road corridor for several years after the initial year of slow melting (Walker et al., 1987:25). Effects would be the same as in the first year, and these would continue until the vegetation recovers to its full coverage and shape. Birds would likely use the areas covered by the ice road for foraging later in the summer after the ice melts. Considering that this loss of habitat for nesting would be relatively small and that territorial displaced birds will likely move to adjacent habitat to nest (TERA, 1990a:33), impacts to these birds are expected to be minor. For non-territorial birds, impacts of habitat loss from ice roads would be expected to be negligible since they would typically not return to the same site each year. Effects of ice road and pipeline construction along existing roads and pipelines are expected to be less than the effects on undisturbed tundra because no new types of activities would be added. Bird species sensitive to construction and road activities have likely already abandoned the existing road and pipe corridors.

Some shorebird species, such as Baird's sandpiper, prefer an exposed nest site with recently disturbed ground nearby (TERA, 1990a:25). These species may move in to use the disturbed area adjacent to the new pipeline. Snow buntings also benefit from a new pipeline as it increases nest site opportunities with each open cavity added. Numerous snow bunting nesting opportunities are expected on new pipeline supports, producing a beneficial impact for this species.

Very few birds, possibly common ravens or ptarmigan, would be present in the project area during winter. No birds would be expected in the offshore area. As a result, both the onshore and offshore pipeline construction would be expected to have negligible impact on birds.

Summer-time construction activities would be limited to installation of building foundations on Seal Island, grading island slopes, installation of geofabric and island slope protection, sealift arrival, and module installation. These activities are similar to the effects associated with maintenance activities described later in this section. Most activities will have a negligible to minor impact to birds; however, impacts to oldsquaws and common eiders from aircraft overflights in nearshore waters would be significant.

The major source of noise affecting waterfowl during open water construction activities are helicopters flying to the island. Helicopter flight path and altitude is an important factor for waterfowl during the summer post-breeding season and staging for fall migration. Information provided by BPXA and ERA Aviation, Deadhorse (Glover - Pers. Comm., 1998:1) indicates that helicopter support for Northstar primarily will be provided from the Deadhorse Airport; however, the Prudhoe Bay airstrip (operated by ARCO Alaska, Inc.) also will be used, if necessary. Helicopter flights between the Kuparuk airstrip and Seal Island are not planned (Glover - Pers. Comm., 1998:1), occasional trips may take place. Overflight restrictions currently are in place for Howe Island to avoid harassment of nesting snow geese. Pilots are requested to avoid harassment of wildlife elsewhere by either altering flight paths or maintaining sufficient altitude. Round trip flights to Seal Island (Chapter 4) are expected to total 1,100 during island construction, range from 1,140 to 1,380 during module installation (depending upon single-season and two-season construction), and total about 30 during drilling. The majority of flights during island construction would take place during April through August; flights associated with module installation would take place from late-August through November; and flights associated with drilling activities would take place throughout the year. Flights during the summer to early-fall would coincide with nesting, brood-rearing, and molting periods and could disturb birds.

Oldsquaw, common eiders, and surf scoters are also affected by low-level overflights (Gollop et al., 1974:202). Molting seaducks in lagoons tend to seek out sheltered areas during inclement weather, and if they are displaced from these areas, stress levels would increase (Gollop et al., 1974:202-232). Birds may move away from better feeding sites or protected areas because of the disturbance. Repeated low-level flights over molting aggregations of oldsquaws could displace those oldsquaws within the flight corridor. Foraging birds on the water or on land, and seabirds between the barrier islands and Seal Island, are more widespread and likely to suffer only temporary adverse impacts to individuals. Peak densities of molting oldsquaws in nearshore lagoons may reach 1,465 birds/square mile (566 birds/km2), a total of approximately 50,000 birds (Johnson and Herter, 1989:100). It can be assumed that up to 22,000 oldsquaw could be present in the eastern boundary of Simpson Lagoon and Gwydyr Bay based on the maximum density of 1,466 birds/square mile (566 birds/km2)(Johnson and Herter, 1989:100), and could potentially be affected by aircraft overflights of this area. If impacts to the species were to occur during the molting period, which extends from mid-July through mid-September, energy demands could increase and affect the growth of new flight feathers. Furthermore, populations of oldsquaw in Canada and parts of Alaska are declining (Conant et al., 1997:n.p.). Since large portions of these oldsquaw populations migrate through coastal lagoons in the project area, disruption from helicopter traffic through Simpson Lagoon could contribute to their overall declining numbers. Overall impacts to oldsquaws and common eiders from aircraft overflights would be significant during construction, and minor during operation. Impacts to most other seabirds and sea ducks would be negligible.

Operation Impacts: Operation impacts for Alternatives 2, 3, 4, and 5 are the same. Under routine operations, birds would primarily be affected by increased levels of noise, activities, and helicopters and vessel traffic to the island. Birds, primarily glaucous gulls and ravens, would also be attracted to potential food sources. Winter transportation over an ice road or by helicopter is not expected to affect birds, as few remain in the area during winter. During the open water season, activities would include small boat and barge traffic between West Dock and Seal Island, arrival of sealift barges from the west, and helicopter traffic between the Deadhorse Airport, Prudhoe Bay airstrip, or Kuparuk airstrip and Seal Island. Flight paths are assumed to be direct from the airports to Seal Island.

Small boat and barge activity between West Dock and Seal Island would disturb resting, feeding, and molting waterbirds using that area. A large number of birds that congregate in the lee of the West Dock causeway could be disturbed with each trip. Molting waterfowl, such as swans, brant, and large groups of oldsquaws in Simpson Lagoon/Gwydyr Bay and near the causeway would be vulnerable to disturbance from boat traffic. A single or occasional disturbance would constitute a negligible impact, but repeated flushing from protected resting areas could result in the expenditure of greater amounts of energy which would normally be used for feather molt and migration. Birds could be forced to move to adjacent areas with less disturbance, which would constitute a minor impact. Offshore of West Dock and the barrier islands, birds are more widely scattered and disturbance would be short-term and affect few birds. Sealift barges and more frequent, smaller, faster boat traffic from West Dock could have a minor impact on molting/staging waterfowl. Glaucous gulls, which roost on barges, may be attracted to a potential food source while barges are being unloaded. Overall impacts to birds, in offshore waters, from small boat and barge activity would be minor.

Helicopter traffic is expected to be frequent during some stages of the project, such as during freezeup and breakup when it is the only means of transportation. Low clouds and fog, which occur frequently in the area during breakup and summer, result in helicopters flying at elevations less than 200 to 500 ft (61 to 152.4 m). Pipeline inspections also would be flown at low elevations. Impacts to nesting birds would depend on the altitude, flight path, and frequency of flights, as well as the species. Reactions would range from birds sitting tight on the nest to flushing and exposing eggs or young to chilling or predation. Birds molting or caring for broods are most likely to react negatively to aircraft because of their vulnerability. Although the populations of oldsquaw on the Arctic Coastal Plain have remained relatively stable (127,000 to 113,000 from 1986 to 1997), breeding population data from parts of Alaska south of the Brooks Range and parts of northwestern Canada show a 75% decline (Conant et al., 1997:17). Since large portions of these three populations migrate through the project area (Johnson and Herter, 1989:97), it is possible that disruptions which occurred in areas such as Simpson Lagoon, and which resulted in a lower survival rate, could contribute to their overall declining numbers. Birds would be most impacted at molting areas in Simpson Lagoon and at brood-rearing areas in the flight path.

Brant are the most likely species to be affected by low-elevation aircraft traffic. Brant would be adversely affected if loss of productivity from disturbance as a result of helicopter overflights (200 - 500 feet [61.0 - 152.4 m]) affected local populations. Impacts could include disruption of nesting, reduced feeding time, and jeopardizing the intake and storage of energy needed for fall migration. The flight corridor between Deadhorse and Seal Island will fly over approximately 11 to 30 brant nests (Stickney and Ritchie, 1996:47). This flight path passes within 5 miles (8 km) of the Kuparuk River Delta colonies. The flight corridor between the Kuparuk airstrip and Seal Island will overfly approximately the same number of brant nests, and this corridor passes within 2.5 miles (4 km) of the Kuparuk River Delta colonies. Such overflights have been shown to negatively affect brant (Derksen et al., 1992:ii). Although helicopter flights between the Kuparuk airstrip and Seal Island are not planned (Glover – Pers. Comm., 1998:1), occasional trips may take place. Impacts to brant from helicopter overflights would be minor. Information about impacts to brant from aircraft noise is provided in Chapter 9.

Oldsquaw, common eiders, and surf scoters (*Metanitta perspicillata*) are also affected by low-level overflights (Gollop et al., 1974:202). Molting seaducks in lagoons tend to seek out sheltered areas during inclement weather, and if they are displaced from these areas, stress levels would increase (Gollop et al., 1974:202-232). Birds may move away from the better feeding sites or protected areas because of the disturbance. Repeated low-level flights over molting aggregations could result in an impact to local populations. Foraging birds on the water or on land, and seabirds between the barrier islands and Seal Island, are more widespread and likely to suffer only temporary adverse impacts to individuals. Overall impacts to oldsquaws, common eiders, and surf scoters from aircraft overflights would be minor. Impacts to most other seabirds and seaducks would be negligible.

Eight of the ten common tundra-nesting shorebirds have displayed some degree of avoidance of oil field facilities, such as roads and facilities (TERA, 1993a:43-44). These include the lesser golden-plover, semipalmated sandpiper, pectoral sandpiper, dunlin, stilt sandpiper, buff-breasted sandpiper, red-necked phalarope, and red phalarope (TERA, 1993:41). There would be a small displacement of nesting shorebird species overall. This would have a minor impact on birds and their productivity but would have a negligible effect on the shorebird populations in the area adjacent to the pipeline. This is due to the relatively small area affected by the placement of gravel for the valve pads and installation of VSMs.

Other potential hazards which could affect birds include the gas flare and presence of aboveground structures and lights at Seal Island. The gas flare could attract birds during migration or periods of low visibility and result in birds getting too close and being killed. Overall impact to birds from the flare and lights, at Seal Island would be expected to be minor.

Aboveground structures at Seal Island would constitute a potential collision hazard to migrating birds because the island is located within a major offshore migration corridor of sea ducks (oldsquaws and common, king, and spectacled eiders); Pacific, red-throated, and yellow-billed loons; Pacific black brant; and shorebirds (red and red-necked phalaropes). Migration corridors vary among species and season. Numbers of waterbirds during migration involves thousands of spectacled eiders, tens of thousands of common eiders and black brant, and hundreds of thousands of king eiders and oldsquaws. Flight altitudes of migrating waterbirds are often low. For example, 46% of oldsquaws fly at less than 6.6 ft (2 m) above the water or ice surface. Half of all surf scoters and 88% of eiders migrating along the coast fly at less than 32.8 ft (10 m) above the water or ice (Johnson and Richardson, 1982:Figure 3). Inclement weather, particularly fog and snow, would likely increase the potential and magnitude of strikes.

There is the potential for migrating birds to be injured or die as a result of collision with production facilities at Seal Island. Although collision is considered a minor impact to migratory birds, the USFWS will recommend appropriate measures to avoid or minimize effects.

The attraction and availability of an artificial food resource and a new breeding area could result in an increased number of gulls and ravens near Seal Island. Increased productivity of gulls and ravens could decrease the productivity of other bird species on nearby barrier islands and the mainland. Predation by gulls on common eiders has been shown to substantially decrease eider productivity in other areas (Mendenhall and Milne, 1985:155; Barry and Barry, 1990:47; Bowman et al., 1997:26). This can be minimized by containing garbage. The impact to birds would be minor and would be expected to be negligible if no additional food source or nesting area is provided.

Sea ducks and phalaropes may congregate in the lee of the island to some extent during the summer to feed in the shallows or along the shoreline. This may result in a slightly beneficial effect for a small number of birds. However, in early winter, ice may form later in the lee of the island and these birds could linger in the open water and potentially be trapped by the ice. This would potentially impact only a relatively low number birds and would be considered a minor impact to individual birds and would not be expected to impact local populations.

Oil spills present the greatest potential impact to birds from development of the project. Birds are particularly susceptible to oil because it coats their feathers, destroying the insulating properties of the feathers, and the birds may succumb to hypothermia (Hansen, 1981:1). Birds can also be affected by the toxicity of oil ingested from preening of oiled feathers or from ingestion of oil-contaminated food (Hansen, 1981:1; Nero, 1987:III). Birds that could be impacted by an oil spill are those found in the project area, although birds outside the project area could be affected if spills persist over long time periods (over 30 days). Long-term spreading of spilled oil could affect birds at a considerable distance from the spill site, such as the black guillemot colony located on Cooper Island, approximately 100 miles (164 km) to the west. Survival of oiled birds is typically poor, and considering the environmental conditions and remoteness of the Alaskan Beaufort Sea area which limits human intervention, it is likely that most birds coming into contact with oil would perish (Hansen, 1981:1). Most birds that die at sea are not washed ashore, so the effects of a spill are often uncertain or unknown.

Indirect effects of an oil spill include displacing birds from important feeding habitat, such as saline tundra, due to contamination of the areas, which could affect both vegetation and invertebrate prey species. This displacement could in turn, affect buildup of energy reserves needed for molt or fall migration and cause the mortality rate to increase.

Terrestrial birds are not as susceptible to oil, but there is some potential for contacting oil spilled on the ground from pipeline leaks during the summer months. Contact with oil can also result in contamination of eggs or young. Likelihood of injury from a spill is much less in comparison to marine and aquatic bird species. Impacts to birds from an oil spill in the project area are discussed in Chapter 8.

Maintenance Impacts: Impacts to birds from maintenance activities along the offshore pipeline and at Seal Island are the same for Alternatives 2, 3, 4, and 5. Seabirds and waterfowl that gather in the lee of the island would be affected by work on the island slopes outside the sheet pile wall. Repair work on the concrete mat on the island slopes or on the submerged gravel berm is not expected to affect birds roosting, foraging, or resting near the island. Therefore, impacts are expected to be negligible.

Normal planned maintenance activities would have no effect on birds near the onshore pipeline since they could be scheduled around critical time periods for birds (November through April). These activities would include visual inspection of the pipe and VSMs, and periodic maintenance of pipeline associated equipment. These activities would be conducted on four wheelers or snowmachines depending upon the time of the year. The pipeline will be monitored by aerial reconnaissance. Unplanned maintenance activities during the nesting season that require activity along the pipeline are likely to cause nesting birds to flush from their nests if humans come close to the nest site. Birds with broods of young are expected to return to normal activities after disturbance. If onshore pipeline inspection results in the need for summertime repair work, impacts to birds would occur over a longer period.

For each of the action alternatives, low-elevation helicopter overflights will be flown along those portions of the routes traversing roadless tundra. Alternative 2 and portions of Alternative 3 represent the longest lengths of pipeline through undeveloped areas (9.5 and 6.7 miles [15.2 and 10.8 km], respectively). Weekly helicopter inspection flights would be flown at elevations as low as 50 ft (15.2 m) above the pipeline throughout the year. The flights may flush birds from their nests, chill eggs, increase nest predation, scatter broods, and decrease nest success for some species. If a 0.25-mile (0.4 km) wide corridor along the pipeline is assumed as the impact zone for a helicopter flying at a 50 ft (15.2 m) elevation, using a mean density of 164 nests per square mile (64/km^2) (Table 6.7-2), the number of nest sites affected would be 41 per linear mile (1.6 km) of pipeline through undeveloped tundra. For Alternatives 2 and 3, the number of sites affected would be 390 and 275, respectively. Alternatives 4 and

5 would have 140 and 127 nest sites affected, respectively. The nests closest to the pipeline would be impacted most by helicopter overflights. Overall impacts of helicopter inspection overflights to birds would depend on the sensitivity of the species. Although, impacts on nesting birds would be minor, the USFWS will recommend appropriate measures to avoid or minimize this impact for all avian species, including threatened spectacled eiders.

If onshore pipeline inspection results in the need for summertime repair work during the nesting season, impacts to birds would be greater. If any nests were too close to the work site, disturbance could result in abandonment of nests. Effects would be to nests near the worksite and impacts to birds would be minor.

Abandonment Impacts: Abandonment impacts for Alternatives 2, 3, 4, and 5 would depend upon the abandonment plan that is adopted and will be fully addressed in the assessment of the environmental effects of the abandonment alternatives. For an abandonment scenario involving complete removal of all facilities and infrastructure, impacts to birds would be expected to be negligible to minor, and similar to those generated during construction.

6.7.3 Summary of Environmental Consequences

Alternative 1 - No Action Alternative will result in no additional impacts to birds in the project areas. Existing trends in population numbers and productivity will continue without any incremental effects of developing the proposed project. For Alternatives 2, 3, 4, and 5, no significant unavoidable adverse impacts were identified for birds including waterfowl, shorebirds, and seabirds as a result of developing the proposed project. Oil spills could potentially have significant effects on some bird species and are discussed in Chapter 8. In particular, oil spills could potentially affect populations of seaducks, such as oldsquaw, which undergo feather molt in Simpson Lagoon/Gwydyr Bay during the mid summer and migrating king, common, and spectacled eiders. Impact to birds from a spill on land would be considered minor and would affect a relatively small number of birds.

Impacts to birds from project construction are similar in context among Alternatives 2, 3, 4, and 5, although there are differences in project features, such as the amount of habitat affected with each pipeline route. The development of any of these alternatives will result in minor impacts to birds from habitat loss and from the development of the gravel mine at the Kuparuk River Delta. Direct habitat loss for the valve stations pads and the small surface area lost in placement of the VSMs for the pipelines is minor. Impacts to birds from gravel mining and construction of pipelines would be considered negligible due to winter construction. Late melting of ice roads is a minor impact due to habitat loss. Conversely, pipeline VSMs would provide some increase in nesting locations for snow buntings. Other bird species may exhibit some avoidance of the area adjacent to the pipeline. Attraction of seabirds or waterfowl to Seal Island would have a negligible to minor impact on these birds. There is a potential for increased productivity of gulls and ravens from an artificial food source at Seal Island, which could lead to increased predation on other birds.

Helicopter flights between Deadhorse and Seal Island would potentially impact nesting and staging birds within a 1 mile wide (1.6 km) corridor between the two locations. Helicopter inspection overflights of the onshore pipeline routes associated with Alternatives 2 and 3 would also result in disturbance to birds. Transport flight elevations of 200 to 500 ft (61 to 152.4 m), and lower during periods of low visibility and inspection overflights as low as 50 feet (15.2 m), would cause disturbance to nesting birds on the tundra, brood-rearing areas along the coast, molting seaducks in Simpson Lagoon/Gwydyr Bay, and foraging waterbirds in offshore areas. Flights over barrier islands would potentially impact nesting common eiders on each island. The number of flights during construction and operations could potentially affect productivity during one or more seasons of some species, such as oldsquaw and common eiders. Because of the number and timing of offshore helicopter overflights, impacts to common eiders and oldsquaws would be considered significant during construction. Impacts to most other seabirds and sea ducks would be negligible and then minor during operation.

Development of the gravel mine and construction of the onshore pipeline could result in a short-term impact on nesting habitat and a long-term increase in aquatic habitat with the restoration of the mine (a negligible beneficial impact to birds). Operation and maintenance of the pipeline and facilities would have no long-term impacts to birds either onshore or in offshore waters.

The development of any of the project alternatives would require commitment of river bar habitat at the gravel mine and the filling of small areas of tundra for the valve stations. These activities are considered an irreversible commitment of resources. The removal of the pipeline during project abandonment would allow return of the habitat for birds and would not be considered an irreversible commitment.

6.7.4 References

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6.8 TERRESTRIAL MAMMALS

6.8.1 Affected Environment

The overall density of terrestrial mammals species in the project area is low, similar to other arctic coastal tundra areas. The 21 species that could be found in the project area are listed in Table 6.8-1 (Seaman et al., 1981:70; Jarrell and MacDonald, 1989:1-4).

Populations of microtine rodents are known to undergo large fluctuations in numbers in arctic tundra habitats, affecting birds and mammals preying on them (Feist, 1975:135). Caribou and grizzly bear are the other common mammal species in the project area. Gray wolf, wolverine, red fox, moose, muskox, and coyote occur in small numbers on the Arctic Coastal Plain; however, they are not encountered regularly in the project area (Seaman et al., 1981:70). The species of terrestrial mammals most likely to be affected by the project are caribou, grizzly bear, and Arctic fox.

6.8.1.1 Caribou

Caribou (*Rangifer tarandus*) are one of the dominant terrestrial mammals in the project area. The project area is located within the range of the Central Arctic Herd (CAH), from the Colville River in the west to the ANWR in the east (Figure 6.8-1). The CAH range can overlap with the larger Porcupine Caribou Herd, which ranges farther to the east in ANWR (Cameron and Whitten, 1979:629; Dau and Cameron, 1986:27; Cameron, 1994:35). Local residents have observed that

Table 6.8-1 (page 1 of 1)

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caribou belonging to the Porcupine Herd come as far west as Nuiqsut when a southwesterly wind blows steadily for a week and the weather has been warm; otherwise the herd normally stops near the Sagavanirktok River (T. Napageak - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996).

The CAH has been the focus of considerable research since the early 1970s in response to concern about caribou displacement from seasonally important areas of their range due to oil field development (Cameron, 1993:227-231; 1992:7; 1994:1; Cameron and Smith, 1992:2; Cameron et al., 1995:5). Originally, the herd was believed to be a part of the Porcupine Herd (Hemming, 1971:20); however, the herd was discovered later to be a distinct herd based on fidelity to calving grounds and similar movements within the annual cycle (Cameron and Whitten, 1979:630).

The CAH moves northward in the spring from wintering areas in the foothills of the Brooks Range to calve on the Arctic Coastal Plain. Calving occurs on the open tundra from late April to early June (Whitten and Cameron, 1985:35-39). The Arctic Coastal Plain is believed to be used as a calving ground because it has lower numbers of predators and later emergence of mosquitos than the foothills, where there are higher quality food resources available (Cameron and Smith, 1992:8). Calving can occur across the summer range; however, two areas are used consistently for calving by the CAH and are located to the west and east of the project area (Cameron and Whitten, 1979:626-633; Lawhead and Curatolo, 1984:11; Whitten and Cameron, 1985:37) (Figure 6.8-1). These calving areas are: 1) the Kuparuk calving area, west of the Kuparuk River to the Ugnaravik River, 5 to 15 miles (8 to 24 km) south of Milne Point, and north of the Spine Road; and 2) the area west of the Canning River Delta and south of Bullen Point, east of the project area.

The majority of calving occurs within 24 miles (39 km) of the coast (Cameron, 1983:227-231). Little calving occurs within the project area in the Prudhoe Bay oil field between the Kuparuk and the Sagavanirktok Rivers (Pollard et al., 1992:iii; Pollard and Noel, 1996:8). Wetter tundra is believed to be the reason for low calving activity in this area (Whitten and Cameron, 1985:10). Caribou appear to prefer rough ground with some topographic relief for calving, which relates to the diversity of vegetation and biomass of forage species (Nelleman and Cameron, 1996:26). No calving concentrations have been identified along any of the alternative pipeline routes.

The Kuparuk calving area location has changed slightly, with a shift to the west-southwest in 1987 through 1990 in response to construction of the Milne Point Road, which passes through this area (Cameron et al., 1992:13). Cows with calves have been displaced from 0.6 to 1.2 miles (1 to 2 km) of either side the road (Dau and Cameron, 1986:99-100; Cameron et al., 1992:340). This shift of local caribou calving does not appear to have affected regional distribution, since calving still occurs in the Kuparuk area (Johnson and Lawhead, 1989:67-68).

Bulls, yearlings, and non-pregnant cows migrate to the Arctic Coastal Plain, including the project area, from the foothills of the Brooks Range to join cows and newborn calves after calving. The herd reaches its greatest numbers at this time and large aggregations can be found between the Kuparuk River and Oliktok Point and between the Sagavanirktok and Kavik Rivers (Carruthers et al., 1987:426). Post-calving use of the North Slope oil field areas was reported to be higher prior to development of the field

(Child, 1973:4). In recent years, cows with calves appear to avoid oil field areas to some extent (Whitten and Cameron, 1985:37; Dau and Cameron, 1986:99; Cameron, 1992:7-8; Cameron et al., 1995:6). Avoidance of oil field structures by cows with calves has been documented in Kuparuk-area oil fields (Dau and Cameron, 1986:97-100; Cameron and Smith, 1992:8; Cameron, 1992:7), although aerial survey data showed aggregations of caribou during the post-calving period throughout the area (Pollard and Ballard, 1993a:3; Pollard and Noel, 1995:iv). Avoidance of oil field areas could interfere with access to insect relief and foraging areas, affecting weight gain in these animals and, in turn, affecting their reproductive success rate (Cameron 1992:8).

Early summer marks the beginning of the insect season for the caribou, beginning in the foothills and progressing north as temperatures increase. Two groups of insects harass the CAH during summer: the mosquito group (*Aedes* sp.) and the oestrid group, such as warble flies (*Hydroderma trandi*) and the nosebot fly (*Cephenomyia trompe*) (Section 6.6). When these insects are active, they have a profound effect on the behavior and movement of caribou (White et al., 1975:158; Dau, 1986:137-140; Johnson and Lawhead, 1989:30; Lawhead et al., 1994:30).

Searching for relief from insect harassment is the most likely reason for movement of large numbers of caribou through the oil fields toward the coast (Pollard et al., 1992:39). Caribou generally return inland as soon as the temperature drops and mosquito activity lessens (Pollard and Noel, 1994:8). This movement pattern occurs throughout the mosquito season, driven by weather conditions, with caribou moving between insect-relief areas on or near the coast and inland feeding areas (White et al., 1975:158; Roby, 1978:110-116). The best area for insect relief is generally within 0.6 to 1.9 miles (1 to 3 km) of the coast (Dau, 1986:137), because lower temperatures and onshore winds reduce mosquito activity and provide some relief (Pollard and Noel, 1994:44).

Mosquitos emerge in late June, with continued presence in late July. Availability of insect-relief habitat depends on wind and temperature (Lawhead and Curatolo 1984:20). Warm, calm weather increases mosquito activity, resulting in movement of large groups of caribou from inland areas to the coast. Once at the coast, caribou tend to travel in an east to west direction parallel to the coast. In very warm, windless weather, they will even stand chest-deep in coastal waters. Caribou also travel or stand on elevated areas that afford more exposure to the wind (White et al., 1975:158; Roby, 1978:110). Elevated areas include gravel pads and roads within the oil fields (Pollard and Ballard, 1993b:14; Pollard and Noel, 1994:3).

Access to insect-relief areas such as the coast and river deltas is an important factor for caribou summering on the Arctic Coastal Plain, and barriers that obstruct access to these areas could have long-term effects (Cameron and Smith, 1988:2). However, the need for relief from harassment is the overriding factor, and caribou appear to be less affected by human activities or facilities (Shideler, 1986:61). The number of days caribou are harassed by insects (insect harassment days) averages approximately 18 per year (Pollard, 1994:3).

Oestrid flies become the major insect harassment for caribou in late July and August and, as a result, elicit different behavior compared to mosquito harassment (Roby 1978:104). Caribou react to fly harassment by splitting up into smaller groups or individually during this period. In response to flies, caribou usually stand very still with their heads down, listening for flies, then jump or lunge up or side-to-side, toss their heads, run a short distance, and stand with their heads down again. Wind has less effect on reducing fly harassment than mosquitos harassment, and few animals move to the coast and into the project area to get relief from flies (Roby, 1978:111).

Animals begin to disperse out of the project area and move inland into the foothills of the Brooks Range in mid- to late August, coinciding with the late stages of the insect season. Rut begins in October with bulls and cows mixing together in the foothills and southern portions of the Arctic Coastal Plain (Carruthers et al., 1987:425). CAH caribou disperse into relatively small bands that move into the foothills, valleys, and higher slopes on the north side of the Brooks Range in late fall.

Although most caribou spend the winter to the south near the Brooks Range, it is common for several small groups of caribou to spend the winter in the vicinity of the project area (Roby, 1978:70; Carruthers et al., 1987:427). Occasionally, large numbers can be found on the Arctic Coastal Plain in winter (Child, 1973:4).

Total numbers of caribou within the CAH ranged from 6,000 in 1978 to over 23,000 in 1992 (Cameron, 1994:3). The rate of increase has slowed in recent years (Cameron et al., 1995:3) and estimated numbers dropped to 18,100 in 1995 (Wollington - Pers. Comm., 1996). Immigration to and emigration from the adjacent Western Arctic and Porcupine Herds complicate estimates of population size (Carruthers and Jakimchuk, 1986:65; Ballard et al., 1993:21). However, when counts of the CAH in 1995 were made, the herds were separated, and little crossover between herds was suspected (Wollington - Pers. Comm., 1996).

Hunters in Kaktovik have historically testified that there used to be more caribou than today. Potential reasons stated include low-flying small planes and helicopters displacing caribou away from their calving areas and migrating patterns (N. Soloman in USDOI, MMS, 1979:16; J. Ningeok in USDOI, MMS, 1982:28) and development by oil companies in general (I. Akootchook in USDOI, MMS, 1990:10).

6.8.1.2 Arctic Fox

The Arctic fox *(Alopex lagopus)*, a year-round resident of the Arctic Coastal Plain, is a common predator throughout the project area, and has become habituated to the presence of humans and human activities in the North Slope oil fields. Humans provide both artificial food sources (garbage) and denning sites (gravel pads and roads). The Arctic fox is a major predator of eggs and young of waterfowl, shorebirds, and passerines, as well as microtine rodents and Arctic ground squirrels (Eberhardt et al., 1982:188). Any increase in numbers of fox as a result of human activities (i.e., artificial den sites and supplemental food sources) can result in increased predation on their natural prey species (Burgess et al., 1993:1). Fox dens, typically located on widely scattered, dry sites, are more abundant near the North Slope oil fields than in undeveloped areas (Burgess and Banyas, 1993:10), and productivity of Arctic fox at these sites is higher. Food during the summer months is likely the limiting factor to fox population growth, as opposed to the availability of den sites (Burgess and Banyas, 1993:13). Density of fox dens in the central portions of the Arctic Coastal Plain has been recorded at 1 per 18 to 28 square miles (46.6 to 72.5 km^2) (Burgess and Banyas, 1993:12).

6.8.1.3 Grizzly Bear

Grizzly bears (*Ursus arctos)* occur in relatively low densities throughout the Arctic Coastal Plain and in the project area. A total of 28 bears was estimated to occupy the area from the Colville River east to the Shaviovik River and inland to the White Hills in 1994 (Shideler and Hechtel, 1995:32). Home ranges of radio-collared bears in the central Arctic Coastal Plain from 1990 to 1994 were from 1,000 to 2,000 square miles (2,590 to 5,180 km^2). Grizzly bears typically feed on tundra vegetation; however, they are often attracted to oil fields and communities to feed on food waste in dumpsters and landfills. A few radio-collared bears have spent the entire summer within the oil fields, particularly near the NSB landfill (Shideler and Hechtel, 1994:32). A recently installed electric fence at the NSB Landfill has eliminated bear use of this site. Grizzly bears are known to prey on brant and snow goose nests at Howe Island in the Sagavanirktok River delta (Johnson, 1995:3) and will dig up squirrel and fox dens. Denning sites include pingos, raised lake margins, and riverbanks, generally some distance from the project area. However, six dens have been documented within the project area (Shideler and Hechtel, 1994:32).

The grizzly bear population on the Arctic Coastal Plain and in the project area has increased in recent years, (Shideler - Pers. Comm., 1996). Good survival rate of young in recent years is believed to be a factor in this increase, along with the artificial food supply at the NSB landfill. This increase in bear numbers will increase the pressure on prey species, as well as increase the potential for bear-human interactions and bear problems.

6.8.2 Environmental Consequences

The following section describes the potential impacts of each project alternative on terrestrial mammals. The discussion of impacts is organized based on project alternatives as described in Chapter 4. A discussion of impacts from Alternatives 2, 3, 4, and 5 is presented together, as impacts to terrestrial mammals differ only slightly by the landfall of the onshore pipeline. A summary of impacts is presented in Table 6.8-2.

6.8.2.1 Alternative 1 - No Action Alternative

The No Action Alternative would not impact terrestrial mammal species in the project area. Local populations of Arctic fox, grizzly bear, and caribou would be expected to continue current population trends.

6.8.2.2 Alternatives 2, 3, 4, and 5

Construction Impacts: Development of the mine at the Kuparuk River Delta would result in conversion of 35 acres (14.2 hectares) of river bar to open water habitat. The relatively barren river bar habitat is likely used for insect relief and as a migration corridor by caribou during the mid-summer mosquito season. Grizzly bears also use river bars for travel and hunting ground squirrels, which use dry river banks for burrows. Caribou would likely continue to use the area adjacent to the reclaimed mine site during the insect season when weather conditions afford relief from the insects. Impacts to caribou and other terrestrial mammals from habitat loss are expected to be minor.

Noise disturbance from blasting and heavy equipment at the gravel mine site would be similar to other industrial activities that occur periodically in the project area during winter. Grizzly bears would be denning at this time of the year when gravel would be mined. However, since the general area surrounding the Kuparuk River delta is not known to have grizzly bear denning habitat, no impact to denning grizzly bears from gravel mining is expected.

Arctic foxes are primarily scavengers during the winter and could be attracted to humans and construction activities in search of food. This has the potential to increase the survival rate of these animals during winter months. Even a small increase in the survival rate of foxes in the area can have a direct effect on their prey species, such as nesting waterfowl and shorebirds, during the summer season (Burgess et al., 1993:1). The potential impact of increased survival on their prey species would depend upon the amount of supplemental feeding. Although prevention of scavenging at oil field facilities and construction sites is a goal of industry and agencies, at least some feeding and scavenging is expected to occur.

Table 6.8-2 (page 1 of 2)

Table 6.8-2 (page 2 of 2)

Arctic foxes attracted to construction areas could be injured or killed by vehicles or other construction equipment. In addition, consumption of toxic substances in improperly stored refuse could cause injury or death to foxes. Impacts to foxes would be minor, and impacts on local population numbers are not expected.

Arctic foxes attracted to the island during the winter could become stranded when the ice breaks up in early summer. However, if no food sources were available, animals would not remain for long. Impacts would be similar to those for gravel mining, mainly from attraction to potential food sources. Foxes may become stranded on the island as the ice leaves, and such animals may need to be captured or moved by humans to another location prior to ice leaving. Foxes attracted to Seal Island would comprise a minor impact.

Construction of offshore facilities and slope protection would not be expected to impact other terrestrial mammals. Impacts would occur to individual animals and would not be expected to occur on a level that affects the species population of the project area.

Ice road and onshore pipeline construction activities are scheduled during winter and would create noise and activity and which may displace caribou wintering in the vicinity of the pipeline route. Foraging activity of caribou could be disrupted by this disturbance, but would not last beyond a single winter construction season. Numbers of caribou affected would likely be low since few winter in the project area. Displacement would constitute a minor impact by increasing energy expenditures for individual caribou, but would not be expected to affect caribou survival.

Arctic fox would be affected by disturbances during pipeline construction and would be attracted to the construction area, which would constitute a minor impact. Grizzly bears are not expected to be impacted, because the pipeline routes do not pass suitable denning sites.

Operation Impacts: Winter transportation by vehicles over ice roads and by helicopters is expected to affect Arctic foxes and small numbers of wintering caribou due to noise disturbances (Chapter 9). During summer, freezeup, and breakup, operation activities would include small boats and barges traveling between West Dock and Seal Island, and helicopter traffic between the Deadhorse, Prudhoe Bay, or the Kuparuk airstrip and Seal Island. Only flights from the Kuparuk airstrip would pass over traditional caribou calving concentrations. Grizzly bears usually would not be affected by helicopter traffic due to the elevation of flights and the low density of bears in the general area. Infrequent, low-elevation flights near grizzly bears could result in a disturbance, but this would be short-term. Arctic foxes are not expected to be impacted by helicopter flights, except in the case of low altitude flights. Overall, impacts to terrestrial mammals would be minor.

The pipeline route for Alternative 2 is located within a coastal area used as summer range for the CAH, particularly during the insect-relief season. Pipelines can potentially interfere with caribou movements. North-south movements to coastal insect relief habitat in the onshore project area are currently hampered by the number of low-elevation pipelines that are less than 5 ft (1.5 m) from the ground and numerous roads with traffic present throughout the Prudhoe Bay oil fields (Cameron et al., 1995:6). Traffic on roads is the primary disturbance to cows with calves and other caribou trying to cross pipelines next to the roads (Curatolo and Murphy, 1986:218). Caribou are likely to encounter the new pipeline while traveling eastward along the coast into the prevailing northeast wind (Smith et al., 1994:46; Pollard and Noel, 1994:3). The 150-ft (46 m) set back of the valve station and elevated pipeline from the coast would provide a corridor for unimpeded movement at the coastline. However, for the most part, caribou appear to traverse pipelines easily if they are raised at least 5 ft (1.5 m) and are not adjacent to roads (Curatolo and Murphy, 1986:218).

Alternatives 3, 4, and 5 are primarily aligned along existing pipeline corridors that contain pipelines and roads. Therefore, it is reasonable to assume that these alternatives would not introduce any additional barrier to caribou movements. Alternatives 2, 3, 4, and 5 include VSMs elevating the pipeline at least 5 ft (1.5 m) above ground, a distance that has been found to allow caribou free passage under the pipelines (Cronin et al., 1994:7; Curatolo and Murphy, 1986:23). Other pipeline design features used to minimize impacts to caribou movement include separating new pipeline alignments from adjacent roads, if possible (Cronin et al., 1994:A-57). Roads adjacent to pipelines tend to increase avoidance by caribou (Curatolo and Murphy, 1986:23); however, Alternative 2 does not include an access road adjacent to the pipeline corridors. The proposed gas line from the Central Compressor Plant to the intersection with the oil pipeline would follow existing pipeline corridors and already has two caribou crossings. Existing, congested and low-elevation pipelines presently cause interference with caribou movement; therefore, the new pipeline would not be expected to cause additional interference with movement or avoidance by caribou. Oil and gas pipelines would be placed within existing caribou crossings along the existing road system. Overall, impacts to caribou movement based on the design features and caribou behavior during insect season, would be considered minor.

Oil spills have the potential to affect terrestrial mammals through direct contact from an onshore spill or at shorelines from an offshore spill and from scavenging carcasses. Caribou may ingest oil from contaminated sea ice during the spring since they have been observed using sea ice as a salt lick. Animals that wade through oil could be exposed to inhalation and absorption of toxic hydrocarbon vapors. For Arctic fox, ingestion of oil can result in lethal and sublethal effects, such as changes in the liver and brain, bone marrow depletion, gastrointestinal tract ulcers, inflammation of lungs and nasal passages, and kidney failure. Hair loss or loss of insulating properties due to oiling of the fur could result in severe cold stress (Derocher and Stirling, 1991:56). Any decrease in the insulating quality of fur would have an effect on metabolic rate and, therefore, survival rates.

An oil spill that impacts marine birds or mammals in either nearshore or offshore waters could result in oiled carcasses washing onto area beaches and being scavenged by foxes and bears. Exposure from ingestion by grooming after contacting oil also can occur. There is little information on the effects of oil on grizzly bears; however, ingestion of crude oil by polar bears can result in adverse effects on the kidney, liver, and brain; bone marrow depletion; gastrointestinal tract ulcers; and inflammation of lungs and nasal passages (Oritsland et al., 1981:4). The time of year that an oil spill occurred would be a major factor in assessing which animals would be affected and to what degree. The open water period would be the most vulnerable time for terrestrial mammals because oil would be dispersed over a large area and it would potentially affect the largest number of animals. The impacts of oil on terrestrial mammals are discussed in Chapter 8.

Maintenance Impacts: Winter repair work would have little effect on terrestrial mammals due to the short duration of the activity and low density and scarcity of terrestrial mammals in the project area during winter. During summer months, repairs along the pipeline could cause some temporary disturbance of caribou during the insect season, which would be considered a minor impact. Arctic foxes would likely be drawn to the onshore activity, but otherwise would not be affected. Maintenance of the facilities at Seal Island would have little effect on Arctic foxes during the winter, and foxes would not be present during the open water period. Overall, impacts to Arctic fox would be considered negligible.

An increase in helicopter activities is likely to occur from routine inspections along unroaded portions of the onshore pipeline, particularly for Alternatives 2 and 3. Low-level helicopter flights would disturb grizzly bears and Arctic foxes; however, impacts would be short-term and are considered to be minor. Low-level helicopter inspection overflights would cause a minor impact to caribou from short-term disturbance during the insect season as they move to the coast; however, access to insect relief habitat would not be affected, and impacts would be considered minor.

Abandonment Impacts: Abandonment impacts would depend upon the abandonment plan that is adopted and will be fully addressed in the assessment of the environmental effects of the abandonment alternatives. For an abandonment scenario involving complete removal of all facilities and infrastructure, impacts to terrestrial mammals would be expected to be similar to those generated during construction. Overall impacts would be considered minor.

6.8.3 Summary of Environmental Consequences

No significant unavoidable adverse impacts were identified for terrestrial mammals, including caribou, grizzly bears, and Arctic fox as a result of development of the project.

Alternative 1 - No Action Alternative will result in no additional impact to caribou, grizzly bear, Arctic fox, or other terrestrial mammals in the project area. Existing population numbers and productivity will continue to fluctuate with a range of natural variation.

The development of Alternatives 2, 3, 4, and 5 would result in minor impacts to terrestrial mammals from a small amount of habitat loss in the development of the gravel mine at the Kuparuk River delta, fill for the valve station, and the small surface area lost in placement of the VSMs for the pipelines.

Development of the gravel mine and construction of the onshore pipeline could result in direct short-term displacement of any caribou wintering in the area but impacts of displacement would be minor. Attraction of Arctic fox to construction activities would result in short-term, minor impacts.

Operation and maintenance activities at Seal Island have short-term, negligible impacts on Arctic fox. Low level helicopter overflights associated with routine inspections of portions of Alternative 2 and 3 onshore pipeline routes without road access could disturb grizzly bear, Arctic fox, and caribou. These and impacts from routine onshore maintenance activities would be short-term and are not expected to modify normal movement patterns of these species. These impacts are considered to be minor.

Alternatives 2, 3, 4, and 5 require an irreversible commitment of resources (gravel mine) and, for Alternatives 2, 3, and 4, the filling of small areas of tundra for the valve stations. The removal of the pipeline during project abandonment would allow return of the habitat for terrestrial mammals and would not be considered an irreversible commitment of resources.

6.8.4 References

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6.9 THREATENED AND ENDANGERED SPECIES

6.9.1 Affected Environment

Four threatened and endangered species occurring in or near the project area are discussed based on requests by the USFWS and the National Marine Fisheries Service (NMFS) (Table 6.9-1). These species are the endangered bowhead whale, threatened spectacled eider, threatened Steller's eider, and delisted Arctic peregrine falcon. Oil tankers traveling from Valdez to refineries along the U.S. Pacific coast may encounter

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other marine mammal, bird, and sea turtle species listed as threatened or endangered. These species are not included in this analysis but are discussed in the Biological Assessment (Appendix B) to be submitted by the lead agency to the USFWS and NMFS to initiate Section 7 consultation under the ESA.

The purposes of the ESA are to conserve ecosystems on which species depend and to provide a program for the conservation of these species. The ESA defines an endangered species as, *"any species which is in danger of extinction throughout all or a significant portion of its range."* The ESA defines a threatened species as one that, *"is likely to become endangered within the foreseeable future."* Threatened and endangered species are those fish, wildlife, or plants listed under Section 4 of the ESA. The following sections summarize the biology of each species including migration, reproduction, and feeding habits.

6.9.1.1 Bowhead Whale (Endangered)

In 1964, the International Whaling Commission (IWC) began to regulate commercial whaling worldwide (Burns et al., 1993:7). The bowhead whale (*Balaena mysticetus*) was listed as a federal endangered species on June 2, 1970 (35 FR 8495). The bowhead gained further protection when the ESA and the Convention on International Trade in Endangered Species of wild flora and fauna were passed in 1973. The bowhead is hunted by natives of the Alaskan Beaufort Sea coast for subsistence. Since 1978, the IWC has imposed a quota on the number of bowheads landed and/or struck by Alaskan natives.

The Bering Sea stock of bowhead whales was reduced greatly by commercial whaling in the late 19th and early 20th centuries, from an estimated original population range of 10,400 to 23,000 (Woodby and Botkin, 1993:403) to a few thousand by about 1910. Shore-based visual surveys conducted at Point Barrow from 1978 through 1983 yielded a population estimate for that period of about 3,500 to 5,300 animals (Zeh et al., 1993:479). Revised estimates of population size, based on visual and acoustic data collected during the 1993 census off Point Barrow, indicate that the most probable size of the 1993 population was 8,200 with a 95% probability that the population was between 7,200 and 9,400 (Zeh, et al., 1996:1). This estimate was recognized by the IWC, and these numbers are in line with recent reports from local Inupiat people (USDOI, MMS, 1983:58-59).

Bowhead whales are seasonal and transient in the Alaskan Beaufort Sea, migrating through from west to east in spring/summer and back in fall (Figure 6.9-1). Most of the bowhead whale population winters along the ice front and in polynyas (irregular areas of open water) of the central and western Bering Sea (Moore and Reeves, 1993:410). Some bowhead whales also move north along the Chukotka Peninsula of Russia (Figure 6-9.1). About April or May, whales begin moving north past St. Lawrence Island and through the Bering Strait into the southern Chukchi Sea, then north through nearshore lead systems to Point Barrow (Moore and Reeves, 1993:336) (Figure 6.9-1). Behavior and timing are fairly consistent with bowheads passing Point Barrow in several "pulses:" the first between late April and early May, a second about mid-May, and a third from late May through early June (Moore and Reeves, 1993:426; A. Brower in USDOI, MMS, 1986a:49; B. Rexford in MBC, 1996:80). Whaling crews have observed that the migrating whales appear to have 'scouts' which check ice conditions in advance of the main migration (Charlie Nauwigewauk, Waldo Bodfish,

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L. Kingik in NSB, 1981:296-297). Whaling crews also have noticed that not all bowhead whales migrate into the Chukchi or Canadian Beaufort Seas, but that some bowheads remain near Barrow in summer (H. Brower, Jr. in USDOI, MMS, 1995c:85).

Most whales move eastward from Point Barrow through offshore lead systems of the central Beaufort Sea (W. Bodfish in NSB, 1981:295). They appear in leads offshore of the Alaskan Beaufort Sea by early May (W. Bodfish in NSB, 1981:295), but apparently do not stop along the spring migration route (V. Nauwigewauk in NSB, 1981:295; A. Oenga in NSB, 1980:182). They arrive in the Canadian Beaufort Sea from about mid-May through mid-June (Figure 6.9-1) (Moore and Reeves, 1993:314). During migration, bowheads may swim under the ice for several miles, and can break through relatively thin ice (approximately 7 inches [18 cm]) to breathe (George et al., 1989:26). The spring migration ends at Herschel Island in the Canadian Beaufort Sea (V. Nauwigewauk in NSB, 1981:295).

Most of the bowhead population is concentrated in the Canadian Beaufort Sea between Herschel Island and Amundsen Gulf during summer (Moore and Reeves, 1993:319). Whales begin moving back westward between late August and early October (Richardson et al., 1987:469-471; Miller et al., 1996:18; I. Akootchook in USDOI, MMS, 1995a:12). The fall migration, extending into late October some years (Moore and Clarke, 1992:29), also seems to occur in pulses, although the pattern is not as clear as the spring migration (Ljungblad et al., 1987:53-54; A. Brower, 1998a:49; Treacy, 1988:39; 1989:15-35; 1990:13-35; Moore and Reeves, 1993:342). These pulses may constitute age segregations with smaller whales migrating earlier, followed by larger adults and females with young. The first pulse has been observed to consist of hundreds of bowheads in "schools like fish" (T. Napageak - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:23). These whales are not accompanied by calves (J. Tukle in USDOI, MMS, 1986a:21). The second pulse is thought to consist of females with calves (J. Tukle in USDOI, 1986a:20; T. Napageak - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:22). Fall migration generally occurs south of the pack ice and closer inshore than the spring migration (Moore and Reeves, 1993:342).

Fall surveys conducted in the project area from 1979 through 1995 (Figure 6.9-2) recorded the occurrence of bowheads from the barrier islands to about 75 miles (120 km) offshore, with most sighted 6.2 to 37.2 miles (10 to 60 km) offshore in water depths of 33 to 328 ft (10 to 100 m) (Miller et al., 1996:14-33). Data collected from 1979 to 1995 suggest that bowheads may be present in the project area between approximately August 31 and October 22 (Miller et al., 1996:30). This period is variable depending on ice cover. In light ice years peak numbers of bowheads occurred September 21 through 25, and in heavy ice years peak numbers occurred October 1 through 5 (Miller et al., 1996:30 and 39). The authors of the study found that this difference was not important and may in part be due to the greater difficulty in seeing whales during heavy and moderate ice conditions compared to light ice conditions. Distance of the whales from shore also varied with ice conditions. Mean distance from shore was 18.6 to 25 miles (30 to 40 km) in light ice years and 37.2 to 43.5 miles (60 to 70 km) in heavy ice years (Miller et al., 1996:35). From 1979 to 1986, fall migration was observed to extend over a longer period, and sighting rates were larger and peaked later in the season in years of light ice cover compared to years of heavy ice cover (Ljungblad et al., 1987:136-137; Moore and Reeves, 1993:342).

Bowhead whales apparently take their time returning westward during the fall migration, sometimes barely moving at all, with some localities being used as staging areas due to abundant food resources (W. Bodfish in NSB, 1981:296) or for social reasons (S. Akootchook, USDOI, MMS, 1995a:18). Bowheads take about 2 days to travel from Kaktovik to Cross Island, reaching the Prudhoe Bay area by late September (T. Napageak - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:23; A. Oenga, NSB, 1980:182). From Cross Island it takes the whales another 5 days to reach Point Barrow (T. Napageak - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:22). Inupiat believe that whales follow the ocean currents carrying food organisms. If the currents go close to Cross Island, whales migrate near there (T. Napageak - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:13). In the region immediately east of the project area, bowheads reportedly travel on the inshore side of Cross Island (V. Nauwigewauk in Shapiro and Metzner, 1979:A-II-23). It also has been reported that whales are seen inside the barrier islands near Cross Island practically every year and are sometimes seen between Seal Island and West Dock (F. Long, Jr. - Pers. Comm., Nuiqsut Whaling Captains Meeting, August 13, 1996:14-15). However, aerial surveys from 1980 to 1995 have not documented that bowheads migrate inshore of Cross Island (Miller et al., 1996:3-12). Most aerial surveys are conducted during the fall migration.

Bowhead whales may swim very close to shore on some occasions (B. Rexford in MBC 1996:80; I. Akootchook in USDOI, MMS, 1979:15). Bowheads have been observed feeding not more than 1,500 ft (457 m) offshore in about 15 to 20 ft (4.6 to 6 m) of water (A. Brower in USDOI, MMS, 1979:6; H. Rexford in USDOI, MMS, 1979: 16). Smaller whales may swim in water depths of 14 to 18 feet (4.3 to 5.5 m) (T. Brower, Sr. in NSB, 1980:107). During years when a fall storm pushes ice up against the barrier islands in the Beaufort Sea, bowheads may migrate on the shoreward (lagoon) side of Cross Island, the Midway Islands, and No Name Island. Also, crews looked for whales inside the barrier islands during the years of commercial whaling (T. Brower, Sr. in NSB, 1980:107). Inupiat whaling crews have noticed that whale migration appears to be influenced by wind patterns, moving when winds start up and stopping when they are slow (P. Tukle in USDOI, MMS, 1986b:24). From Point Barrow, whales migrate back southward through the Chukchi Sea to wintering grounds in the Bering Sea (Moore and Clarke, 1992:31-32) (Figure 6.9-1).

Spring-migrating bowhead whales are difficult to survey effectively from the air because usually no well-defined lead system is present east of the Colville River (Moore and Reeves, 1993:319). Therefore, only occasional observations of bowhead whales have been made during spring, usually in small cracks or holes (Moore and Reeves, 1993:317). For example, no bowhead whales were seen within approximately 28 miles (45 km) of the Northstar Unit from April through May, 1979 through 1984 (Moore and Reeves, 1993:318). Bowhead whale observations from spring surveys during 1980 to 1982 are summarized on Figure 6.9-3 (Miller et al., 1996:18-35). These data suggest that bowhead whales do not migrate within 43.5 miles (70 km) of the project area in the spring; however, this conclusion may be unreliable due to the difficulties of seeing whales in pack ice.

In contrast, the fall migration routes in the Alaskan Beaufort Sea have been reasonably well documented. From 1980 to 1995, aerial surveys were conducted by the MMS across the Alaskan Beaufort Sea and near the Northstar Unit during fall migration and suggest that bowhead whales only seldom migrate through or near

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the project area (Figure 6.9-2). Bowhead whales were observed in the Northstar project area on October 6, 1989, when four bowhead whales were seen approximately 6.2 miles (10 km) northwest of Seal Island (Treacy, 1990:B-26). Migrating bowheads were observed within 6.2 miles (10 km) of the northern border of the project area once each in 1980, 1982, 1993, and 1994 (Treacy, 1994:40; Miller et al., 1996:25). During fall 1997, bowheads were observed feeding between Barrow and Prudhoe Bay close inshore near the barrier islands. Early estimates suggested approximately 1,200 individuals were present, but researchers believe that some of the individuals may have been recounted while in feeding areas (S. Treacy - Pers. Comm., 1997).

Fall surveys show that the median water depth at bowhead whale sightings (1982-1995) between 141°W to 146°W longitudes is 138 ft (42 m) (Treacy 1991:53; 1992:55; 1994:65; 1996:55) (Figure 6.9-2). During fall migration, whales are found close inshore east of Barter Island and from Cape Halkett to Point Barrow (Moore and Reeves, 1993:335), generally in water depths less than 164 ft (50 m) (Treacy, 1991:49-53; 1992:55; 1994:65).

Inupiat whalers question the results of aerial censuses of bowhead whales conducted by MMS in the Beaufort Sea. For example, whaling crews sighted 23 bowheads in the Kaktovik region during the fall of 1983 in contrast to five whales sighted by MMS aircraft (J. George, USDOI, MMS, 1983:58-59). Although the fall 1983 MMS aerial surveys were conducted for inshore, mid-offshore, and far-offshore survey blocks (Ljungblad et al., 1984:68), inherent limitations in a sampling survey mean that some animals will be missed. Some limitations of aerial surveys include the fact that planes do not fly in all weather and that submerged bowheads may not be observed due to the speed of the aircraft.

Little is known regarding age at sexual maturity or mating behavior for bowheads. Mating is assumed to occur in late winter and spring (Koski et al., 1993:248), perhaps continuing through the spring migration (Ljungblad, 1981:11-28; Koski et al., 1993:228). Most calves are born from April through early June during spring migration, with a few calves born as early as March or as late as August (Koski et al., 1993:250). Females produce a single calf, probably every 3 to 4 years (Koski et al., 1993:254).

Bowheads are filter-feeders, sieving prey from the water by means of baleen fibers in their mouth. They feed almost exclusively on zooplankton from the water column, with primary prey consisting of copepods (54%) and euphausiids (42%), as indicated from stomach content analyses of whales taken in the Alaskan Beaufort Sea (Lowry et al., 1994:201-238). Other prey include mysids, hyperiid and gammarid amphipods, other pelagic invertebrates, and small fish.

Bowheads feed heavily in the Herschel Islands area in the Canadian Beaufort Sea and Amundsen Gulf area during summer and in the Alaskan Beaufort Sea during fall migration (Figure 6.9-1) (ACS, 1983:27; Ljungblad et al., 1987:53; Lowry, 1993:222). Bowheads generally feed in water depths of less than 164 ft (50 m) in the Canadian Beaufort Sea (Richardson et al., 1987:468-469). In fall surveys conducted from 1979 through 1987, concentrations of feeding bowheads were observed east of Point Barrow and just north of Harrison Bay in late August and early September (Ljungblad et al., 1987:53). The barrier islands all along the coast are considered by local residents as an important resource to the bowhead whale and are used as staging and feeding areas. (M. Pederson in USACE, 1996:51). The summer distribution of bowheads within the Canadian Beaufort Sea is determined primarily by prey density and distribution, which in turn are responsive to variable current and upwelling patterns (LGL and Greeneridge, 1987:2-3).

Bowheads have extremely sensitive hearing (Chapter 9). For example, they can detect sounds of icebreaker operations up to 31 miles (50 km) away (Richardson, 1996:108). It has been suggested that such sensitive hearing also allows whales to use reverberations from their low frequency calls to navigate under the pack ice and locate open water polynyas where they can surface (Ellison et al., 1987:332). Bowheads exhibit avoidance behavior of many manmade sounds, but the range and extent to which they respond to such sounds are variable (Clark and Johnson, 1984:1437-1439).

Generally, the vocalizations of bowhead whales are low, less than 400 Hz frequency-modulated calls, however, their call repertoire also includes a rich assortment of amplitude-modulated and pulsed calls of frequencies up to at least 5 kHz (Wursig and Clark, 1993:176). Calls and songs have been suggested to be associated with different contexts and whale behavior. Observations support the theory that calls are used to maintain social cohesion of groups. For instance, loud frequency-modulated calls were heard as a mother and a calf rejoined after becoming separated during summer feeding (Wursig and Clark, 1993:189). Once the two were together again, calling stopped (Wursig and Clark, 1993:189).

During spring migration off Point Barrow, there have been several instances when individual whales repeatedly produced calls with similar acoustic characteristics (Clark et al., 1987:345). Bowhead whales have been noted to produce signature calls lasting for 3 to 5 minutes each and continuing up to 5 hours (Wursig and Clark, 1993:189). Different whales produce signature calls as they counter call with other members of their herd. It has been suggested that calling among bowhead whales may aid in migration of the herd and that the surface reverberation of the sound off the ice may allow these whales to discriminate among areas through which they can and cannot migrate (Wursig and Clark, 1993:190).

It has been suggested that bowheads are able to locate leads and open water along the marginal ice zone in winter by using acoustics (Moore and Reeves, 1993:353). Although bowheads are morphologically adapted to their ice-dominated environment and can break holes in the ice to breathe, they may use vocalization to assess ice conditions in their path. The intensity of reflected calls is as much as 20 dBs higher from ice floes with deeper keels than from relatively flat, thin ice (Ellison et al., 1987:329).

6.9.1.2 Spectacled Eider (Threatened)

The spectacled eider (*Somateria fischeri*) was listed as a federal threatened species on May 10, 1993 (58 FR 27480). In the summer, this large seaduck is found on the east and west sides of the Bering Sea and along the coasts of the Arctic Ocean. Spectacled eiders are most common in large river deltas such as the Yukon-Kuskokwim, Colville, and Canning Rivers in Alaska (Johnson and Herter, 1989:87).

The Alaskan population of spectacled eiders nests in small numbers, with a discontinuous distribution, over large areas of wet tundra along the coast of Alaska from the Bering Sea north to Barrow and east along the Arctic Coastal Plain into ANWR. The USFWS recognizes two populations of spectacled eiders in Alaska, the Yukon-Kuskokwim Delta population and the Arctic Coastal Plain population (USDOI, FWS, 1996:4). Historically, the Yukon-Kuskokwim Delta had the largest nesting population. Spectacled eiders also nest along the Siberian coast from the Chukotsk Peninsula to the Yana Delta (Johnson and Herter, 1989:87) (Figure 6.9-4). Historical breeding grounds along the Alaskan Beaufort Sea Coast are thought to be near Cape Halkett or Cape Simpson, and in the National Petroleum Reserve, Alaska (Johnson and Herter, 1989:87). Census work in 1993 on the Arctic Coastal Plain indicated that eiders were distributed widely and were most abundant within 37.2 miles (60 km) of the coast between Icy Cape and Barrow (Larned and Balogh, 1994:1). Nesting pairs have been most concentrated in the central Arctic Coastal Plain just west of the Sagavanirktok River in a band including Deadhorse and the ARCO Prudhoe Bay Operations Center (Figure 6.9-5) (Troy, 1995:19). Spectacled eider numbers decrease east of the Shaviovik River (TERA, 1996:9). Aerial surveys in June 1993 reported breeding pairs to be distributed widely throughout most of the Kuparuk and Milne Point oil fields (Figure 6.9-6a & b) (Anderson and Cooper, 1994:20).

A measurable decline in spectacled eider populations was noticed in 1990 (Stehn et al., 1993:264). This decline was especially apparent in the Yukon-Kuskokwim Delta in western Alaska, where the nesting population declined by as much as 96% between 1971 and 1990 (Stehn et al., 1993:271). In the Prudhoe Bay Unit, fewer birds were observed between 1981 and 1991, although the change was not statistically important (Warnock and Troy, 1992:13). This apparent trend was noted to be similar to that occurring in the Yukon-Kuskokwim Delta (Warnock and Troy, 1992:17). Breeding-pair surveys conducted between 1992 and 1996 showed no clear change in the spectacled eiders' breeding population (TERA, 1995:5; Troy - Pers. Comm., 1998:1). In 1993, a total of 9,284 spectacled eiders were observed to be present during surveys on the North Slope (Larned and Balogh, 1994:4).

Molting and wintering areas of spectacled eiders were unknown until recently, when individual birds were tracked by satellite telemetry. Molting spectacled eiders were found in Peard and Ledyard Bays, but could not be well quantified (Larned et al., 1995:1-11). Eiders may molt in a more geographically extensive area (e.g., Mechigmenan Bay in Russia supported approximately 37,000 molting eiders in 1994). Spectacled eiders arrive at the Alaskan Beaufort Sea coast in May from their wintering area and move onto the tundra nesting grounds as freshwater ponds thaw. Soon after breeding, male spectacled eiders leave the tundra ponds for nearshore and offshore waters where they feed for a short period prior to making their southward migration (USDOI, MMS, 1996:III B-13). Females and young remain through late August before beginning their southward migration.

Spectacled eiders usually nest in wet tundra near basin wetland complexes containing open water areas supporting pendant grass (*Arctophila fulva*) or sedges (*Carex* spp.), or near large ponds with emergent pendant grass along the shorelines. Brood-rearing habitat varies from shallow sedge ponds to basin wetland complexes and deep open water lakes (Anderson and Cooper, 1994:1; TERA, 1995:12). Food during the breeding season includes insects such as crane flies (Johnson and Herter, 1989:89).

6.9.1.3 Steller's Eider (Threatened)

The Alaskan breeding population of Steller's eider (*Polysticta stelleri*) was listed as a federal threatened species on June 11, 1997 (62 FR 31748). The historic and current population sizes of the Steller's eider are unknown (62 FR 31748). Steller's eiders may be declining in number range-wide; however, the magnitude of changes in population size are unknown due to the lack of reliable population estimates (62 FR 31749).

The current breeding range of Steller's eider in Alaska includes the Arctic Coastal Plain in northern Alaska west of the Colville River (Figure 6.9-4). In the early 1920s, naturalists described this species as relatively common at several isolated locations on the Yukon-Kuskokwim Delta. Few birds or nests have been found on the Yukon-Kuskokwim Delta in recent years. Three confirmed nests in the Kashunuk River area were found since 1994, of which one successfully hatched (Flint - Pers. Comm., 1998). In 1994 and 1996 through 1998, 1 to 2 nests were located each year on the Yukon-Kuskokwim Delta (62FR31748). Reasons for its decline may include changes in movement patterns and increased mortality, although it is not believed to have been a common nesting bird on the Yukon-Kuskokwim Delta, despite claims made by earlier observers (Kertell, 1991:177-184). There are only three recent records of broods from North Slope locations other than Barrow, Alaska. These include: one in 1997 near the upper Chipp River, approximately 50 miles (80 km) inland from the Dease Inlet/Admiralty Bay area; one in 1993 near Prudhoe Bay; and one in 1987 along the lower Colville River (62 FR 31748).

6.9.1.4 Arctic Peregrine Falcon (Delisted)

The Arctic peregrine falcon (*Falco peregrinus tundrius*) was removed from the federal list of endangered species in 1994 (59 FR 50796); however, the ESA requires the USFWS to continue to monitor the subspecies over a minimum 5-year period. Arctic peregrine falcons nest primarily in the foothills and mountains centered around the upper Colville and Sagavanirktok Rivers, with small numbers nesting in the uplands along other rivers that cross the North Slope (USDOI, FWS, 1982:6). Nests typically are located at least 20 miles (32 km) inland on cliff faces. This subspecies is an uncommon summer visitant and migrant at the Alaskan Beaufort Sea coast, but a fairly common breeder along rivers which drain the north-facing foothills of the Brooks Range (Johnson and Herter, 1989:128). Historically, approximately 150 nesting pairs of Arctic peregrine falcons occurred along the Colville and Sagavanirktok Rivers (USDOI, FWS, 1982:2). A nest was present on a communications tower on Barter Island for several years, although it has not been noted in any publication and the tower is no longer there (Sousa - Pers. Comm., 1997). The decline of this subspecies was caused primarily by contamination with organochlorine pesticides, although egg collecting, human disturbance, and habitat destruction also contributed to the decline (USDOI, FWS, 1982: 5). The likelihood of encountering an Arctic peregrine falcon in the project area is low.

6.9.2 Environmental Consequences

Potential impacts of each project alternative on threatened and endangered species are discussed below. The discussion of impact is organized based on project alternatives as described in Chapter 4. Because the impacts

Figure 6.9-4 (page 1 of 2)

Figure 6.9-4 (page 2 of 2)

Figure 6.9-5 (page 1 of 2)

Figure 6.9-5 (page 2 of 2)

Figure 6.9-6a (page 1 of 2)

Figure 6.9-6a (page 2 of 2)

Figure 6.9-6b (page 1 of 2)

Figure 6.9-6b (page 2 of 2)

for Alternatives 2, 3, 4, and 5 are similar these impacts are discussed collectively and summarized in Table 6.9-2.

6.9.2.1 Alternative 1 - No Action Alternative

No construction is required for a No Action Alternative. The natural variability in population levels and habitat of threatened and endangered species in the Alaskan Beaufort Sea would be undisturbed by a No Action Alternative. Consequently, there would be no impacts to threatened and endangered species.

6.9.2.2 Alternatives 2, 3, 4, and 5

Construction Impacts: The bowhead whale, spectacled and Steller's eiders, and Arctic peregrine falcon are not present in the Kuparuk mine site area during the winter, and thus would not be affected by mining activities (Moore and Reeves, 1993:336; Larned et al., 1995:35; Palmer, 1976:8; USDOI, FWS, 1982:7). Approximately 35 acres (14.2 hectares) of sparsely vegetated gravel bar would be removed from the Kuparuk river and converted to deep and shallow open water habitat as a result of gravel mining. This loss of river bar habitat is not expected to create loss of habitat for any of these species. The open-water lake remaining after reclamation of the site may be used by spectacled eiders, but because of its distance from wet tundra, it is unlikely to be used by breeding pairs or broods. Peregrines could hunt other ducks using the lake.

Offshore ice road and other winter construction activities will be completed by the beginning of the bowhead spring migration (late April to early May) (Moore and Reeves, 1993:336). Therefore, no impact to migrating bowheads is expected from winter construction. Summer construction would include island slope protection, pile installation, and island facilities construction. There is no evidence suggesting that construction operations would delay or hinder migratory movements of bowheads; however, local displacement during migration may occur. Any whales that do deviate around a construction area are expected to be displaced to the north, where they may experience heavier ice conditions. However, the magnitude and likelihood of such an offshore displacement is expected to be small relative to the width of the migratory pathway and would be limited to the few months when migration and construction activity coincide. Such avoidance of construction activity is expected to have a minor impact on bowhead whales. The impacts to subsistence from displacement of bowheads are discussed in Section 7.3.2.2.

Transportation requirements associated with these activities would also result in increased noise levels. Most vessel, barge and helicopter traffic during construction would occur between Seal Island and the mainland. Some disturbance, including avoidance of the area by migrating

Table 6.9-2 (page 1 of 3)

Table 6.9-2 (page 2 of 3)

whales, is expected from this traffic increase, but the degree of disturbance would depend on the distance of the main migration corridor from the activities between Seal Island and the shoreline. For example, during the years 1979 to 1994, the median distance of the main bowhead migration corridor was 28 to 31 miles (45 to 50 km) from shore, which is 16 to 19 miles (26 to 31 km) from Seal Island. In fall of 1995, the migration corridor was only 19 to 22 miles (31 to 35 km) from shore and 13 to 16 miles (21 to 26 km) from Seal Island (Miller et al., 1996:41). Impacts of noise to bowhead whales resulting from summer construction and vessel traffic are discussed in Chapter 9.

Spectacled eiders are not expected to be affected by winter construction activities at Seal Island because they are absent from the Alaskan Beaufort Sea during the winter. During spring migration and prior to fall migration, male and female spectacled eiders may be impacted both by construction activities at Seal Island and helicopters flying construction materials/personnel to and from the mainland. Post-breeding male spectacled eiders depart Arctic Coastal Plain wetlands approximately June 22 (± 11 days) and stage/migrate offshore a median distance of 4.2 miles (6.7 km) (± 6.9 miles [11 km]) (Petersen, in Bright, 1998:15). Post-breeding spectacled eider females depart Arctic Coastal Plain brood-rearing sites about August 29 (± 10.5 days) and stage/migrate 10.3 miles (16.6 km) (± 10 miles [16.4 km]) offshore. Because post-breeding females are in poor physiological condition, harassment during feeding in these areas may reduce accumulation of fat needed for migration and may have a minor adverse effect on survival. If present, both male and female spectacled eiders could be impacted both by construction activities on Seal Island and helicopter flights to and from the island, and these impacts would be considered minor.

Low-elevation helicopter flights between Deadhorse Airport and Seal Island over tundra nesting areas may flush nesting birds, which may expose eggs to predation and chilling (Gollop et al., 1974:202-232). Multiple flushing events could result in reduced nest success in areas within the helicopter flight paths. The project area supports relatively low densities of eider nests in comparison to other tundra-nesting species (TERA, 1993:9).

Densities of spectacled eider breeding pairs in the Prudhoe Bay area have ranged from 0.21 to 0.49 per square mile (0.08 to 0.19/km^2) from aerial surveys (TERA, 1996:3). Based on the mean density of spectacled eider breeding pairs for the Prudhoe Bay area, a 1-mile (1.6 km) wide flight corridor between the Deadhorse Airport and Seal Island would be expected to overfly approximately 4 to 8 breeding pairs (TERA, 1996:6). Ground surveys have not been systematically conducted along all proposed pipeline routes and helicopter flight corridors. Low-elevation helicopter flights from the Kuparuk airstrip would be expected to affect similar numbers of breeding pairs, based on surveys of that area (TERA, 1996:3). Eiders with broods may be tolerant, to some degree, of noisy human activities, as shown by studies of radio-collared eiders with broods in the Prudhoe Bay and Kuparuk oil fields that have not demonstrated avoidance of oil field facilities (TERA, 1995:14; TERA, 1996:9). Although spectacled eiders are expected to be within the area affected by aircraft, and nesting eiders could be directly affected, these impacts would be considered minor. However, the USFWS will recommend appropriate measures to avoid or minimize this impact for nesting and brood-rearing spectacled eiders.

Only one Steller's eider nesting site is known within the project area (no Arctic peregrine falcon nesting sites are known) (Federal Register - 62 FR 31748; USDOI, FWS, 1982:6) and any impact to these species from reconstruction of Seal Island would be limited to noise disturbances. Impacts of noise to threatened and endangered species are discussed in Chapter 9.

Aboveground portions of the onshore pipeline would transect eider nesting and brood-rearing areas on the proposed alignment from Point Storkersen to Pump Station No. 1. The area directly impacted by ice roads and pipeline construction is almost entirely moist tundra; few open water ponds are traversed by the construction zone. Such habitat may be traversed by eider broods but is not likely to be used for nesting or brood-rearing. The project area supports low densities of eider nests and broods. Onshore pipeline construction is scheduled to take place in winter when birds are not present; therefore, spectacled eiders will not be directly affected by pipeline construction activities. By the time the birds are selecting nest sites, construction activities on land would be complete. However, slow melting of the construction ice road would likely eliminate this area for nest sites the first year. This indirect effect of construction would be a minor impact since the ice road area constitutes only a small fraction of suitable habitat available to spectacled eiders. Impacts of noise to spectacled eiders are discussed in Chapter 9.

Construction of an elevated pipeline, without an adjacent access road, would help minimize impacts to eider breeding habitat and on movement of broods between nesting and brood-rearing areas. Overall, aboveground pipeline construction would have negligible impacts on eider nesting and brood-rearing habitat along pipeline routes.

Only one Steller's eider nesting site has been located in the project area in recent years (62 FR 31748). No Arctic peregrine falcons are known to nest in the project area (USDOI, FWS, 1982:6), and ice road construction and onshore placement of the pipeline are not expected to impact these species.

Operation Impacts: Under routine operations, threatened and endangered species would primarily be affected through increased levels of noise from drilling operations, gas-fired turbine generators, and by ship and helicopter traffic to and from the island. Transportation of personnel and supplies during routine island operations would include using trucks on the ice road during winter, helicopters during broken ice seasons (May/June and October/November), and barges during summer. Impacts to migrating bowhead whales from routine island operations would be limited to noise disturbance from industrial noise, tugs, and supply barges, and are considered to be minor. Impacts to subsistence are discussed in Section 7.3.2.2. Minor impacts to spectacled eiders resulting from noise and disturbance from helicopter overflights and inspection of the pipeline along the onshore route could occur. Impacts of noise and disturbance from offshore helicopter overflights and boat traffic would be considered minor. The potential for spectacled eiders to collide with structures on Seal Island is considered a minor impact. However, because mortality resulting from operations could adversely affect this species, the USFWS will recommend appropriate measures to avoid or minimize potential effects. Impacts to Steller's eiders and Arctic peregrine falcons from routine operations would be from the disturbance of helicopter overflights and would be considered negligible. Impacts to threatened and endangered species from noise are discussed in Chapter 9.

<u>Oil Spills</u>: Oil spills may occur as a result of operations and would present risks to threatened and

endangered species. Potential effects would include direct mortality from oil toxicity, chronic physiological or behavioral changes, destruction of food organisms, and habitat destruction. Oil spills would have the potential to adversely affect threatened and endangered species.

Bowhead Whale: It is difficult to accurately predict the effects of an oil spill on bowhead whales because of a lack of data on the metabolism of this species and because of inconclusive results of examinations of baleen whales found dead after major oil spills (Bratton et al., 1993:736; Geraci, 1990:167-169). Nevertheless, some generalizations can be made regarding impacts of oil on individual whales based on present knowledge. Oil spills that occurred while bowheads were present could result in skin contact with the oil, baleen fouling, ingestion of oil, respiratory distress from hydrocarbon vapors, contaminated food sources, and displacement from feeding areas (Geraci, 1990:181-192). Actual impacts would depend on the extent and duration of contact and the characteristics (age) of the oil (Albert, 1981: 946). Bowhead whales could be affected through residual oil even if they were not present during the oil spill.

Most likely, the effects of oil would be irritation to the respiratory membranes and absorption of hydrocarbons into the bloodstream (Geraci, 1990:184). If oil was concentrated in open water leads, it is possible that a bowhead whale could inhale enough vapors from fresh oil to affect its health. Inhalation of petroleum vapors can cause pneumonia in humans and animals due to large amounts of foreign material (vapors) entering the lungs (Lipscomb et al., 1994:269). It is unclear if vapor concentrations after an oil spill would reach levels where serious effects, such as pneumonia, would occur in bowhead whales. Although pneumonia was not found in sea otters that died after the *Exxon Valdez* oil spill, inhalation of vapors was suspected to have caused interstitial pulmonary emphysema (accumulation of bubbles of air within connective tissues of the lungs).

Available literature on potential oil impacts on whales suggested that a bowhead whale confined to a small, oil-contaminated area would suffer effects to the respiratory system limited to irritation of the mucous membranes and respiratory tract, plus absorption of volatile hydrocarbons into the bloodstream (Bratton et al., 1993:722).

Whales may also contact oil as they surface to breathe, but the effects of oil contacting skin are largely speculative. Bowhead whales have an exceedingly thick epidermis (Haldiman et al., 1985:397). Studies of oil effects on the skin of other cetacean species, such as those summarized by Geraci (1990:182) for four species of toothed whales, may not be indicative of the effects of oil on bowhead whales due to the unique characteristics of their skin. The skin of bowhead whales is characterized by hundreds of rough, skin lesion areas. "These rough areas are variable in size and shape, often 1 to 2 inches (2.5 to 5 cm) in diameter and 1 to 3 millimeters (mm) deep with numerous 'hair-like' projections extending upward 1 to 3 mm from the depths of the damaged skin surface." (Albert, 1996:7). Blood vessels are located just beneath the epidermis of these skin lesions (Albert, 1981:947; Haldiman et al., 1985:391), and large numbers of potentially pathogenic (disease-causing) bacteria have been documented in these areas (Shotts et al., 1990:358). Many of these bacteria produce enzymes that are capable of causing tissue necrosis (tissue death) (Haldiman et al., 1985:397; Shotts et al., 1990:351). The ultrastructural nature of these areas of damaged epidermis has recently been documented (Henk and Mullan, 1996:905-916).

The origin of these rough areas is unknown, but oil is likely to adhere at these sites. Haldiman et al. (1981:648) documented that Prudhoe Bay crude oil adheres to isolated preserved skin samples of bowhead whales and that, "The amount of oil adhering to the surrounding skin and epidermal depression appeared to be directly proportional to the degree of 'roughness' of the [skin]." The authors concluded that these results were, " ... indicative of the possible adherence to the live skin of an active bowhead whale". Oil contacting whale skin may inflame the epidermis, "particularly if the oil is light and aromatic, therefore more reactive" (Engelhardt, 1987:106). This inflammation ultimately may lead to ulcer formation, severe inflammation of the skin and, possibly, blood poisoning (Albert, 1981:948). These findings should be considered when assessing the potential risk to bowhead whales from skin contact with oil (Shotts et al., 1990:358).

Bowhead whale eyes may be particularly vulnerable to damage from oil on the water due to their unusual anatomical structure (Dubielzig and Aguirre, 1981; Haldiman et al., 1981; and Haldiman, 1986). A recent study documented the presence of a large conjunctival sac associated with bowheads' eyes (Dubielzig and Aguirre, 1981; Haldiman et al., 1981; and Haldiman, 1986). The conjunctival sac is a mucous membrane that lines the inner surface of the eyelid and the exposed surface of the eyeball (Zhu, 1997:61). This sac likely aids in providing mobility of the eyeball (Zhu, 1997:62). It has been suggested that if oil gets into the eyes of bowhead whales it would enter the large conjunctival sac and move "inward" 4 to 5 inches (10 to 13 cm) and get "behind" most of the eye (Albert - Pers. Comm., 1997). The consequences of this event are uncertain, but some adverse effects are expected. Detailed study of the anatomy of the bowhead eye (Zhu, 1997) supports speculation that potential impacts of oil on the eyes of bowhead whales would include irritation, reduced vision due to corneal inflammation, and corneal ulceration potentially leading to blindness (Albert, 1981:947; Zhu,1997).

Bowhead whales may ingest oil encountered on the surface of the sea during feeding, resulting in fouling of their baleen plates. It has been noted that baleen whales are vulnerable to ingesting oil when their baleen structures are coated, but the impacts on bowhead whales due to ingestion of oil are unclear (Engelhardt, 1987:108). The baleen plates of bowhead whales are fringed with hair-like projections up to 1 ft (0.6 m) long made of keratin (Lambertsen et al., 1989:29-31). These baleen filaments eventually break off and some are swallowed by the whales (Albert, 1981:950; Albert, 1996:7). Filaments also are often observed tangled into "ball-like" structures while still attached to the baleen of bowheads harvested by Inupiat Eskimos from Barrow (Albert, 1996:7). A laboratory study showed that filtration efficiency of bowhead whale baleen is reduced by 5% to 10% after contact with Prudhoe Bay crude oil (Braithwaite et al., 1983:41). It appeared that when baleen was fouled, viscous crude oil caused abnormal spacing of hairs which allowed increased numbers of plankton to slip through the baleen mechanism without being captured (Braithwaite et al., 1983:42). This loss of baleen filtration efficiency lingered for approximately 30 days. It was uncertain how such reduction would affect the overall health or feeding efficiency of individual whales. In contrast, another study (on baleen of much different structure) concluded that the most severe effects of baleen fouling are short-lived and interfere with feeding to approximately 1 day after a single exposure of baleen to petroleum (Geraci and St. Aubin, 1983:269; 1985:134).

Thick sludge (tar balls) typically appear in the late stages of an oil spill due to increase in the specific gravity of oil as evaporation progresses (Meilke, 1990:11). Anatomical evidence suggests that potential impacts of oil and tar balls on the baleen may be serious. If oil were ingested during feeding, baleen filaments could be sites of oil adherence, as demonstrated by an oil adherence study conducted on bowhead whale baleen in the laboratory (Braithwaite et al., 1983:41). When dislodged, tar balls likely would be swallowed with other food (Albert, 1981:950).

Broken off baleen filaments and tar balls are also of concern because of possible blockage between two parts of the bowhead stomach (1.5 inches [3.8 cm] in diameter) (Tarpley et al., 1987:303), and blockage could pose a major threat to the whale (Albert, 1981:950). Because tar balls may persist in the marine environment for up to 4 years (Meilke, 1990:12), bowhead whales would not have to be present during an oil spill to be affected adversely. Impacts could continue for years. Until definitive experiments are conducted to evaluate the susceptibility of the bowhead feeding apparatus and digestive system to oil pollution, effects of oil ingestion will remain speculative (Lambertsen et al., 1989:125).

It is not known whether bowhead whales can differentiate between hydrocarbon-contaminated and uncontaminated prey (Bratton et al., 1993:723). Cetaceans observed during the *Exxon Valdez* oil spill in Prince William Sound made no effort to alter their behavior in the presence of oil (Harvey and Dahlheim, 1994:263; Loughlin, 1994:366). Following the *Exxon Valdez* oil spill, daily vessel surveys of Prince William Sound were conducted from April 1 through April 9, 1989, to determine the abundance and behavior of cetaceans in response to the oil spill (Harvey and Dahlheim, 1994:263). During the nine surveys, 80 Dall's porpoise, 18 killer whales, and 2 harbor porpoise were observed. Oil was observed on only one individual. It had oil on the dorsal half of its body, and by its labored breathing pattern, appeared stressed. It is probable that bowheads would respond similarly.

Consequences of bowhead whales contacting oil have not been well documented, are largely speculative, and are highly controversial. Geraci (1990:169) reviewed a number of studies pertaining to the physiologic and toxic impacts of oil on whales and concluded, *"There is no gripping evidence that oil contamination has been responsible for the death of a cetacean."* A total of 37 cetaceans were found dead during and after the *Exxon Valdez* oil, spill but cause of death could not be linked to exposure to oil (Loughlin, 1994:368). Bratton et al. (1993:721) concluded that petroleum hydrocarbons, *"Appear to pose no present harm to bowheads,"* but also noted that this conclusion was less than definitive because of disagreement over the degree of toxicological hazard posed by hydrocarbons.

In contrast, Albert (1981:950) warned that exposure to oil could pose a major threat to bowhead whales based on their anatomy. Bowhead whales are particularly vulnerable to effects from oil spills due to their use of ice edges and leads where released oil tends to accumulate (Engelhardt, 1987:104). Ten criteria for assessing vulnerability to the effects of an oil spill have been developed to aid in impact assessment (Engelhardt, 1987:111-112). This assessment indicated the bowhead whale is vulnerable because the bowhead is an endangered species, any damage to the population could affect species survival (Engelhardt, 1987:111). Individuals are not expected to avoid oil exposure, based on the limited data discussed previously.

Contaminated food sources and displacement from feeding areas also may occur as a result of an oil spill. It is unlikely that the availability of food sources for bowheads would be affected substantially, given the plankton and fish resources available in the Alaskan Beaufort Sea (Bratton et al., 1993:723). The MMS estimated that even if a large oil spill of 160,000 barrels contacted phytoplankton and zooplankton in the Alaskan Beaufort Sea, recovery would be expected to be completed within a week (USDOI, MMS, 1996:IV-M-3). This rapid recovery was anticipated as a result of the wide distribution, large numbers, rapid rate of regeneration, and high fecundity of plankton. Impacts of oil spills on bowhead whales are discussed in Chapter 8.

Eiders: Potential effects of oil on spectacled eiders would include direct mortality from oil toxicity, chronic physiological or behavioral changes, destruction of food organisms, and habitat destruction. Oil removes the water-repellant properties of feathers, causing water to displace the air trapped in and under the plumage, and resulting in hypothermia which eventually kills the bird. Furthermore, buoyancy is lost when this air is displaced, and the bird may sink and drown (Clark, 1984:3). Physiological changes due to ingestion of oil during preening include abnormal conditions in lungs, adrenal gland, kidneys, liver, stomach, and intestines (Clark, 1984:3). Sea ducks, including spectacled eiders, are among the most vulnerable birds, because they often occur in dense flocks and spend much time swimming on the surface. During and after the *Exxon Valdez* oil spill, sea ducks were among the groups which suffered the highest mortality levels (Piatt et al., 1990:387). Impacts of oil spills on this species are discussed in Chapter 8.

Potential effects of oil on Steller's eiders have not been studied; however, it is expected that oil would likely cause adverse effects such as tissue irritation, plumage fouling, and hypothermia. Consumption of oil through contaminated prey or by preening, or inhalation of hydrocarbon vapors, may cause organ damage. Separate or cumulative physiological impacts of oil contamination may result in death. Impacts of oil spills on this species are discussed in Chapter 8.

Peregrine Falcon: The physiological effects of peregrines contacting oil have not been investigated, but effects are likely similar to the effects on spectacled and Steller's eiders. Peregrines may be exposed to oil by capturing oiled prey, which may affect individual falcons. They may also be affected indirectly by an oil spills through reduction in seabirds and shorebirds, their primary prey.

<u>Noise</u>: For bowheads, as with most animals, there is a general tendency for the level of response to manmade noises to scale with the level of variability and unpredictability in the sound source. Animals will show little or no response to a noise source with a relatively constant intensity level and frequency spectrum (e.g., a humming generator, operational drilling platform). Animals will react to a noise source that is rapidly changing in intensity or in frequency content (e.g., an exploration drilling platform, icebreaking activity).

Little is known about the reaction of bowhead whales to unusual or unpredictable noise. However, some insight on the issue can be gained from reviewing the growing traditional and scientific knowledge of bowhead responses to seismic surveys.

There have been various efforts to document the type and level of responses that bowheads have to seismic survey noise. Some have relied on visual observations from an airplane or vessel to look for avoidance response or changes in distribution, and some have included acoustic monitoring to document changes in vocal behavior as well as to measure sound levels at known distances from the seismic activity. In 1984, the MMS supported a study during which bowhead groups were observed for up to several hours prior to the operation of a seismic vessel and then during the approach of that vessel while operating its seismic array. Obvious responses were noted. Some animals responded when the vessel was less than 6 miles (9.7 km) away, and one group showed strong avoidance at a distance of 3.1 miles (5 km) from the operating seismic vessel (Ljungblad et al., 1985:45). The most obvious responses of bowheads to the approach of the vessel were changes in dive and surface behaviors, which occurred at ranges of up to 6 miles (9.7 km). When seismic operations were within 1 mile (1.6 km) of the whales, they swam rapidly away from the vessel. Interpretation of these results in terms of bowhead response range to seismic vessels when surveys were being conducted is complicated by a lack of control data since other seismic vessels were operating during all phases of the experiments. Therefore, the maximum distance out to which whales were observed consistently responding should be considered the minimum range within which responses occur. Results of the study were presented to the IWC Scientific Committee in 1984, which, after review, recommended that additional research be conducted and the results of the 1984 study be subjected to rigorous re-analysis.

There are important recent results indicating that bowheads respond to seismic operations. Acoustic call counts from bottom-mounted recorders operating during the 1996 Northstar Unit season indicate that bowhead call rates change depending upon the range from the seismic operation and whether seismic activities were occurring or not occurring. Bowhead call rates from the bottom-mounted recorder operating closest to the seismic operation were lower during hours with seismic operations than during hours without, while call rates from the recorder furthest from the seismic activity were more than twice as high when seismic activity occurred than when it did not occur (Richardson et al., 1998: 3-7). These results suggest that some bowheads diverted offshore when passing the project area when seismic activity occurred or that some bowheads decreased their calling rates. Aerial survey data from 1996 and 1997 further suggest that bowhead whales avoid areas with seismic operations (Richardson et al., 1998: 5-59 to 5-63). When the 1996 and 1997 aerial data were combined, all of the 52 sightings noted during seismic activity and within 3.5 hours after seismic activity, were greater than 12 miles (20 km) from the activity. The consistency between these results based on two different methods (acoustic and aerial survey) lend strong credibility to the conclusion that whales are displaced by seismic activity.

Analysis of the bowhead sightings (179 whales) from the aerial surveys during BPXA's 1996 and 1997 seismic programs indicate that those programs did not greatly influence the position of the migration corridor (Richardson et al., 1998:5-58). However, the power of this conclusion is limited by the small number of bowhead sightings during seismic activity (8 whales) or within 3.5 hours of seismic activity (13 whales).

Whaling crews have noted that seismic surveys conducted near Barrow, Cross Island (Nuiqsut), and Kaktovik have been responsible for altering migration patterns and for failures in harvesting success. Unsuccessful harvesting seasons have been found to closely correlate with seismic survey activities (T. Napageak in USDOI, MMS, 1995b:13; B. Adams in USDOI, MMS, 1995c:26; H. Brower, Jr. in USDOI, MMS, 1995c:84; B. Rexford in MBC, 1996:80). The extent of the migration pattern displacement has required hunting to be performed at least 10 miles (16 km) further offshore than would be the case without seismic survey activities (E. Brower, in USDOI, MMS, 1995c:29-30; T. Albert, in USDOI, MMS, 1995c:41); however, migration patterns are believed to change at distances of 35 miles (56 km) from seismic source vessels and to shift the migration path as much as 30 miles (48 km) from the normal migratory path (17 Whalers in MBC, 1997:Attachment C).

Although quantitative estimates are not available, in all likelihood, seismic survey sounds are among the loudest of any industrial noise source; and are the most ubiquitous industrial noise source. They introduce more total sound energy into the arctic water than any other industrial noise source. Furthermore, a seismic survey impulse is a sound with enough acoustic energy to cause physical harm to a marine mammal ear (Ketten, 1992; Ketten et al., 1993). Bowhead whales are possibly the most sensitive to seismic survey sounds because their hearing is expected to be the most sensitive for the band of frequencies (i.e., 100 to 400 Hertz) that can propagate to the greatest ranges. However, this does not necessarily mean that bowheads are the species most susceptible to biological impact.

Although BPXA's proposed project does not include seismic surveys, information on whale reactions to seismic noise is relevant in a general way. Recent data on seismic noise transmission and bowhead responses to seismic operations in the Northstar Unit area have come from monitoring efforts carried out as part of the 1996 and 1997 BPXA Seismic Survey Project (Richardson, 1997, 1998). These results show that no whales were seen within 11 miles (21 km) of the seismic site during active seismic periods, but numerous whales were seen 1.2 to 12.4 miles (2 to 20 km) of the site during periods without seismic activity (Richardson, 1998:5-60 to 5-62). Richardson (1998) concluded that these results suggest that bowheads avoid waters near seismic operations. Traditional Knowledge of bowhead hunters includes strong impressions about the reactions of bowheads to seismic survey activities (T. Napageak in USDOI, MMS, 1995:13; B. Adams in USDOI, MMS, 1995:26; H. Brower, Jr. in USDOI, MS, 1995:84; B. Rexford in MBC, 1996:80; E. Brower in USDOI. MMS, 1995:41; 17 Whalers in MBC, 1997: Attachment C).

No studies on the effects of noise on spectacled eiders have been conducted. It can only be inferred from studies of distribution of radio-collared eiders with broods in the Prudhoe Bay and Kuparuk oil fields that spectacled eiders have not demonstrated avoidance of oil field facilities or high noise areas (TERA,, 1995:14; TERA, 1996:9). TERA (1995:10-11) noted that at "... the present stage of understanding it is difficult to formulate defensible hypotheses as to what would be expected regarding what spectacled eiders would do in the absence of facilities, largely because of the uncertainty as to what constitutes brood rearing habitat." TERA (1995:11) also noted that "...qualitatively, the movements documented for our marked broods (6 broods) do not suggest avoidance of facilities or obstacles to movements." However, it is of importance to note that noise and activity may result in avoidance of facilities whether or not they pose obstacles to brood movement (TERA, 1995:11-12).

Spectacled eiders appear to tolerate some degree of noise from industrial sources throughout the Prudhoe Bay region. Most broods observed in the Prudhoe Bay area spent part of their time within 656 ft (200 m) of high-noise production facilities, and some broods were located near Deadhorse airport (TERA, 1996:IV). Ground surveys of spectacled eiders within 1,640 ft (500 m) of the Kuparuk and Milne Point oil field facilities showed eiders to be present at an average distance of 722 to 732 ft (220 to 233 m) from oil field facilities, with one pair as close as 32.8 ft (10 m) (Anderson and Cooper, 1994:24). Anderson and Cooper (1994:58) noted that spectacled eiders were widely distributed in the Kuparuk and Milne Point oil fields, but were not abundant at any single location. However, there were inherent weaknesses in this study, including observer bias in detecting eider nests and observing eiders at the outer boundary of 1,640 ft (500 m). During the brood-rearing period, eiders with broods were also found to move extensively through the region and did not appear to avoid high noise areas (TERA, 1995:7-9). Anderson (1992) reported potential avoidance by spectacled eiders of the GHX-1 facility at Prudhoe Bay (as cited in TERA, 1995:12). However, the area supports low densities of eider nests and broods, ranging from 0.34 to 0.57 nests/square mile (0.13 to 0.22/km^2) (TERA, 1995:5), based on aerial and ground surveys conducted from the Kuparuk Rivers to the Sagavanirktok River, an area of approximately 463.3 square miles (1,200 km^2) (TERA, 1995:1-2). Measurable effects of noise from the project are unlikely and, therefore, are considered negligible (Chapter 9).

There are no data available on the impacts of noise on Steller's eider. Given the similarities in ecology between this species and the spectacled eider, it is possible that both species show similar responses to industrial noise. Impacts of noise from the project are considered negligible (Chapter 9).

Maintenance Impacts: Both planned and unplanned pipeline maintenance activities associated with operations would take place year-round over the expected 15-year life of the project. Planned maintenance of the offshore segment would not entail excavation; therefore, impacts are considered to be negligible to threatened and endangered species. The degree of impact to threatened and endangered species from unplanned maintenance and repair would vary depending on the nature of the problem, season, and approach used to uncover/rebury the pipe and to perform repairs. These impacts are expected to be short-term and limited to the area that requires maintenance. During open water season, the magnitude of effects would vary depending on the extent of required repairs and the method used to excavate the pipeline and conduct repairs.

Low-level helicopter pipeline inspection overflights would occur weekly throughout the year, including the nesting and brood-rearing period during the summer. These activities could disrupt nesting, molting, foraging, and brood-rearing spectacled eiders. Disruptions caused by helicopter noise would depend on the flight elevations, which are anticipated to be as low as 50 ft (15.2 m). Disruption of nesting or brood-rearing activities within a 0.25-mile (0.4 km) wide corridor could affect productivity of nearby nests. The highest number of breeding pairs documented along the pipeline route for Alternatives 2 and 3 are six pairs each (TERA, 1996:3; TERA, 1996:Figure 4; TERA, 1997:Figure 4). Maximum documented spectacled eider pairs along routes for Alternatives 4 and 5 are only 2 nests (TERA, 1996:3; TERA, 1996:Figure 4; TERA, 1997:Figure 4). Because impacts from inspection overflights under all alternatives could have a minor impact on nesting and brood-rearing spectacled eiders adjacent to onshore pipeline corridors, the USFWS will recommend appropriate measures to avoid or minimize potential effects.

If onshore pipeline inspection results in the need for summertime repair work, impacts to spectacled eiders in the area would be of longer term than the inspections themselves. Birds may become used to the repair activity or they may avoid the area. If a nest were close enough to the work site, disturbance could result in abandonment of the nest. This would be a concern only for work during a 6- to 8- week period in June and July when the birds are present (Johnson and Herter, 1989:89; TERA, 1996:7). Effects to nests could affect populations of spectacled eiders nesting in the oil fields. Effect of pipeline maintenance and repairs in the summer on spectacled eiders would depend on the proximity of the activity to eider nests or broods. Because the activity could decrease the productivity or survival of spectacled eiders along the pipeline corridor, the impact would be considered minor. However, the USFWS will recommend appropriate measures to avoid or minimize potential effects.

Abandonment Impacts: Abandonment impacts would depend upon the abandonment plan that is adopted and will be fully addressed in the assessment of the environmental effects of the abandonment alternatives. For an abandonment scenario involving complete removal of all facilities and infrastructure, impacts to threatened and endangered species would be expected to be similar to those generated during construction and would be negligible to minor. Abandonment activities conducted during the winter would not impact threatened and endangered species because these species are absent from the area during winter. However, if abandonment activities at Seal Island occurred during the spring and fall migration of bowhead whales it is likely that they would be disturbed by noise from the activities. The effects of noise to bowhead whales is discussed in Chapter 9.

6.9.3 Summary of Environmental Consequences

Alternative 1 - No Action Alternative would result in no impact to the bowhead whale and to the Steller's eider and the spectacled eider. Existing population numbers and productivity would continue to fluctuate with a range of natural variation. With the exception of an oil spill, no significant unavoidable adverse direct impacts from the proposed project (Alternatives 2, 3, 4, and 5) were identified for the endangered bowhead whale.

Alternatives 2, 3, 4, or 5 (project development) would have similar impacts on these threatened and endangered species. Ice road construction and Seal Island reconstruction would not impact bowheads or eiders because these activities would occur in winter. Operational and maintenance activities, and drilling at Seal Island would create noise which might be heard by bowheads several miles away from Seal Island. Impacts of such noise on bowheads may include a change in migratory behavior as whales pass by the project area. Actual impact to the whales from the sound is considered minor and would only last during project operation. Construction and abandonment would occur in the winter. In addition, spectacled and Steller's eider would not be expected to be impacted by noise at Seal Island.

Staging and/or post-breeding spectacled eiders in the offshore waters during the open water period could be affected by extensive helicopter traffic between the mainland and Seal Island during the construction phase. Low-elevation inspection flights of the onshore pipelines during the nesting season could affect productivity of spectacled eider nests near the pipeline. Collision with vertical structures at Seal Island could result in injury or mortality of migrating spectacled eiders. Late melting of ice roads following construction can delay the availability of tundra habitat the following season. However, nest site loss due to late melting ice roads would have a minor impact, because of the abundance of suitable nesting habitat in the project area. Impacts to spectacled eiders from oil spills would be considered significant (see Section 8.7.2.7).

After abandonment of the project, there would be no further impacts to these endangered or threatened species.

The development of the four action alternatives require the commitment of a gravel resource and the filling of small areas of tundra for the valve stations resulting in an irreversible commitment of resources. Irretrievable commitments of resources for this project such as material used for constructions of the facilities would not be expected to impact the bowhead whale, spectacled eiders, or Steller's eider.

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- Fred Kanayurak
- Van Edwardsen
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- Oliver Leavitt
- Jim Allen Killbear
- Eddie Rexford
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- Ben Itta
- Joseph Kaleak
- James Lampe
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